Effective strategies for successful engineering project delivery during national crises

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Certificate of original authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Eskander Howsawi
Signature of Student:

Date:

Acknowledgment

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Abstract

Modern project management is a highly regarded approach for delivering successful projects. However, despite applying project management principles, the rate of success in projects is still below expectations. This major fact motivates the research on project success in many sub-areas of interest, such as the financial side of project success or the human resource aspect. The research in each area of interest reveals distinct results that fill a distinct knowledge gap. This thesis therefore sets out to explore project success from the perspective of the project context and in particular, in respect of national crises as a context for project management.

National crises, such as wars, natural disasters and economic crises are increasing in number, frequency and severity worldwide. These crises are unique contexts and they induce the emergence of new dynamics and abnormal challenges that affect projects. Seeking project success in such contexts is different from seeking it in peaceful situations. However, existing literature in the project success field does not clearly show the distinction between the two different contexts or how to achieve success in the context of national crises.

To tackle the topic of project success during national crises, this thesis applies the qualitative research method on multiple sets of data. The main approach of this thesis is one of multiple case studies, and several interviews, archival documents, video data and expert discussions have provided rich sources of data. Qualitative content analysis was the main analysis method used to extract the results of this research.

As a result of the ambiguity that exists in the definition of project success, this thesis provides a framework to clarify and define project success itself. The concept of managing projects during national crises is developed, and the thesis then provides its core: the success strategies employed during national crises and the model that links them to common success factors. The thesis concludes by highlighting the contributions and implication this research has made, such as the new model and framework that can guide practitioners to deliver projects successfully during national crises, the enhancement of the theory through the provision of new concepts, and suggestions for further research.

Table of Contents

1 List of figures

2 List of tables

3 Glossary

AHD	Aswan High Dam
AIPM	The Australian Institute of Project Management
APM	The Association for Project Management
BSI	The British Standards Institution
CPM	Critical Path Method
CSFs	Critical Success Factors
FDA	Food and Drugs administration
GERT	Graphical Evaluation and Review Technique
IPMA	International Project Management Association
IT	Information Technology
IWM	The imperial war museums
OGC	The Office of Government Commerce
PC	Personal computer
PERT	Program Evaluation and Review Technique
PMAJ	Project Management Association of Japan
PMBoK	Project Management Body of Knowledge
PMI	Project Management Institute
PMP	Project Management Professional
PRINCE2	PRoject IN Controlled Environment version 2
RAF	The Royal Air Force
TGA	Therapeutic Goods Administration
UAE	United Arab Emirates
UK	The United Kingdom
US	The United State of America
VD	Video data
WBS	Work Breakdown Structure
WW1	World War one
WW2	World War two

4 List of publications directly associated with this research

1. Howsawi, E., Eager, D. & Bagia, R. *Understanding project success: The four-level project success framework. In:* IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 2011, 6-9 Dec. 2011. 620-624.

2. Howsawi, E., Eager, D., Bagia, R. & Niebecker, K. 2013. *Using video data in project management research*. AIPM National Conference 2013. Perth, Australia.

3. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). The four-level project success framework: application and assessment. *Organisational Project Management, 1*(1), 1-14.

4. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). Project Management During National Crisis: Concept Development. *International Review of Management and Business Research, 3*(1). 412-422

5. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). Success Strategies For Project Management During National Crises: Insights From The British Aviation Industry During World War Two. *International Review of Management and Business Research, 3*(1), 533-556.

6. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). The use of video data in project management research *Science Journal of Business and Management, 2*(1), 10-15. doi: 10.11648/j.sjbm.20140201.12

7. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). Delivering a Mega Construction Project Successfully During a National Crisis: Lessons Learned From The Aswan High Dam Construction Project. *International Review of Management and Business Research, 3*(2), 625-647.

8. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). A success model for project management during national crises. *International Review of Management and Business Research, 3*(2) 960-981.

Appendix B at the end of this thesis contains copies of these papers in their published format.

1 Introduction

1.1 Background

It is a goal of every project manager to deliver successful projects. This goal has been continually pursued since the beginning of projects on earth. This pursuit continued after the emergence of modern project management in the 1950s. Many authors prefer to set this date as the beginning of modern project management (Carayannis *et al.* 2005).

Since the beginning of the 20th century, many tools and techniques have been developed to aid managing project successfully. This series of techniques include Gantt charts in the 1910s (Wilson 2003), the Flow-Line scheduling techniques in the 1930s and the Line of Balance technique in the 1940s (Weaver 2007). The 1950s and early 1960s saw a leap forward in project management tools and techniques. That era witnessed the introduction of the Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) and Work Breakdown Structure (WBS) (Burke 2003). Then these tools were followed by Graphical Evaluation and Review Technique (GERT) in second half of the 1960s (Pritsker 1966).

From the middle of the 1980s onwards several project management methodologies have been introduced such as Project Management Body of Knowledge (PMBoK) and The PRoject IN Controlled Environment version 2 (PRINCE2) methodologies (Sarantis *et al.* 2010). Many other minor techniques, tools and methodologies have evolved since then. These minor methodologies can be standalone methodologies or combinations of other techniques or modifications of some established techniques.

Computer applications were also used to aid the successful delivery of projects. These applications have evolved from the mainframe calculation applications in the late 1960s through to the 1970s then the project planning and scheduling software on personal computers (PCs) in the 1980s and the early 1990s followed by network and internet applications from the middle of the 1990s to date (Burke 2003).

In line with the effort to develop tools and techniques, researchers have investigated the arena of project success thoroughly and have delivered very interesting publications revealing success factors or presenting frameworks and criteria to guide the process of

success planning and evaluation (de Wit 1988; Belassi & Tukel 1996; Balachandra & Friar 1997; Atkinson 1999; Shenhar *et al.* 2001; Milosevic & Patanakul 2005; Zhiye *et al.* 2009; Howsawi *et al.* 2014b).

It is perhaps surprising to note that after several decades of development and research in the field of project management and particularly the project success arena, a great number of projects are still achieving less than expected results. The literature shows plenty of claims of unsatisfactory results (Atkinson 1999; Cooke-Davies 2002; Salleh 2009). This can be a real problem that justifies the need for research and reinvestigation of the area of project success within the field of project management.

Projects inevitably take place within certain contexts, for example, industrial, political and environmental contexts. The context of a project plays a fundamental role in determining the project management technique and the outcome of such a project (Balachandra & Friar 1997; Besner & Hobbs 2013). What might be considered a critical success factor in one context may not appear so in another context (Besner & Hobbs 2013). What may seem to be a marginal factor in one industry can be a crucial success factor in another industry. For example in the construction and petroleum industry, the physical strength of the project personnel is important for carrying out the job, while in the software industry even personnel with mobility limitations can carry out the job.

In the project success studies, some researchers addressed the issue of success in relation to some particular context such as the industrial sector. For example some studies are related to the defence industry (Dvir *et al.* 2006), construction industry (Chan *et al.* 2004) and information technology (Simmons & Korrapati 2004). Others looked at the issue with emphasis on geographical region such as China (Wang & Huang 2006), India (Iyer & Jha 2006), Vietnam (Nguyen *et al.* 2004) and Brunei (Salleh 2009). Other researchers addressed the issue as a generic issue for projects of all types (Baccarini 1999; Westerveld 2003; Andersen *et al.* 2006). This indicates that it is a practice in project success research to focus on a particular context to explore how projects succeed in that given context.

It is important to link the project to its context in order to derive realistic lessons (Engwall 2003; Maaninen-Olsson & Müllern 2009). One of the contexts that can significantly affect managing projects is the circumstance in which the project takes place either in peacetime

or in a time of national crisis. These two times have different characteristics with a direct impact on every aspect of life and projects outcomes are not exceptions.

Perhaps national crises can create new realities that may render the assumptions and mental models of peacetime project management less usable. Therefore, a different approach for success might be needed to help deliver projects successfully during national crises. The broad objective of this thesis is to continue the pursuit of project success and to contribute to the body of knowledge with new insights about delivering projects successfully during national crises.

1.2 Justification of the research topic

The topic of this research is relevant and important because when observing situations worldwide, it is found that national crises are more prevalent in the 21st century than in the past. For example, wars between countries have increased since 1870 (Harrison & Wolf 2011). The frequency of financial crises has doubled since the 1970s (Bordo *et al.* 2001) and the frequency of natural disasters is also rising (Degg 1992; Gurenko & Dumitru 2009).

There are many contemporary examples of national crises worldwide, such as the wars in Iraq and Afghanistan, the aftermath of 2011 Japan's tsunami, the aftermath of 2005 Hurricane Katrina and the 2008 global economic crisis. Recently in 2011 five incidents of civil unrest broke out in five Middle Eastern countries, three of which are neighbours. These are real national crises and the author of this thesis has had the chance to witness one of them during a visit to Egypt in 2012. These crises resulted in thousands of deaths, lack of security, economic recession and regime overthrow. Against the odds, projects during crises do not disappear but continue to be issued and implemented in these contexts (Hrůzová & Thornton 2011). Projects continue to be launched whether in response to the crisis, to sustain businesses, or to reconstruct devastated areas. Deeper understanding is needed to enhance project management and to increase the likelihood of project success during national crises.

1.3 Research overview

In this section and its sub-sections an overview about the research will be provided. This will include the research idea and the questions to be answered and the propositions of the research. In addition, the scope of the research will be presented. Furthermore, the expectations and the results from this study will be provided.

1.3.1 Research idea, questions and propositions

It is an observation that when people face abnormal or stressful situations they perform abnormally. These situations could be wars, natural disasters or even financial crises. For example before World War 2 (WW2) the norm was that women did not work in heavy industries such as munition and aircraft. However, the stresses of the war led to the change of that norm, out of which emerged the icon "Rosie the Riveter" representing the American women who worked in factories during WW2.

Perhaps this phenomenon is observed in project management too. History shows that sometimes projects were delivered successfully in a time when it was near impossible to do so. Thus, it could be thought provoking to look at some remarkable achievements during difficult times and to find out how that was achieved and what helped that achievement to take place. However, "difficult time" is a very broad term so it needs some narrowing. In this research, "difficult time" means a national crisis, and will be defined thoroughly in this thesis.

Some people might be curious to gain insights about why and how projects succeed during national crises. In response to this curiosity, it could be said that generally, these successes might be attributed to "the pressure" which forced people to achieve what they did. However, this is not a sufficient answer from a scholarly point of view nor does it provide any clue as to how, technically, that success was achieved. Therefore, scrutinizing the matter of project success during national crises may reveal factors, techniques, strategies or frameworks that increase the likelihood of successful project delivery during national crises such as wars. To pursue this research idea two research questions will be answered. These questions are interlinked and will be discussed as one question with two parts. The first question is:

Why do some projects succeed during national crises despite the adversity of the circumstances?

The nature of this part - "why"- usually leads to answers such "because of something" then the second part arises to complete the puzzle by asking what that *something* is. Therefore the second question in this study is:

What assists projects to be delivered successfully during national crises?

Answering these two questions is expected to contribute to building the body of knowledge about project success during national crises.

These questions will be answered through evaluating three propositions. First, these questions are talking about project success which indeed means different things to different people (Howsawi *et al.* 2011), so the first proposition to be evaluated in this study is:

P1*: The definition and assessment of project success are subject to multiple viewpoints, and are context-dependent and sensitive to many factors beyond the direct control of a project team.*

Evaluating this proposition is expected to aid in judging whether the projects during national crisis are successful or not.

Second, the research questions address the issue of project success in the particular context, which is national crises context, with the presumption that this context is different from others, thus the second proposition to be evaluated is:

P2*: National crises are unique contexts that require a project management approach that is different from a peacetime approach.*

Evaluating this proposition can help in determining if there is something unique to this context and that is worth addressing the matter of project success in such a context.

After evaluating the concept of success and the characteristics of national crises then it is possible to move to answering the core of the research questions which is "why" and "what". The answer is based on evaluating the third proposition which is:

P3: *There are several strategies or techniques which, if adopted, will increase the likelihood of project success during national crises.*

1.3.2 Research scope

This research is addressing project success during national crises. However, this is a broad title that needs to be focused. Here, some scoping dimensions will be presented to provide such focus.

First, national crises are not all of the same type so that to make the research manageable and focused, war was chosen as the prime example of national crises. The personal interest of the author in the achievements during wartime and the help and support of the supervisors of this thesis were behind this choice. Moreover, probably the best of human dexterity materializes during wartime; therefore studying the achievements during wartime may reveal the best of what humans can do. References to other examples of national crises will be made for the purpose of comparison and generalization.

In order to investigate the wartime achievement from a project management point of view, two temporal periods were chosen. The first period is WW2 which continued from 1939 to 1945. From this period the main results of this study will be extracted. The second period will be the Middle Eastern conflicts, which span from late 1950s to early 1970s. There is more than 10 years between these two periods and this could serve as a good test of the validity of the findings of the first period through time. Furthermore, references to other periods will also be made for the purpose of comparison and generalization and to demonstrate the validity of the findings through time.

For spatial scope of this research also two locations were chosen. The first location is The United Kingdom (UK) to be in line with the first temporal period. UK could be the best example among the allied countries in WW2 to represent the difficulties of the war since it was the only country in Western Europe to stand against Nazi invasion. The second spatial

location in line with the second temporal period is Egypt. This country was chosen because it suffered from a series of national crises (mainly wars) during the mentioned period yet the Egyptians managed to complete some remarkable projects, one of which is the Aswan High Dam (AHD). Here also references will be made to other locations such as The United States of America (US) for the purpose of comparison and generalization.

There are two main industry types to be covered in this research. They are aviation and construction industry. Other industries will be mentioned for several reasons, such as to support an argument or to highlight similarities. Moreover, this research is about project management; however, due to the multidisciplinary nature of project management other disciplines will be consulted as needed.

This research addresses different periods of time in different countries with many differences between them such as political, economic and cultural differences. These differences in the scoping dimensions of this research can help in establishing the required generalizability of this thesis.

1.3.3 Research expectations

Many scholars have conducted the research on projects success for long time. However, one of the major gaps in the literature is that the scholars present their results with no distinction between peacetime and national crisis time, perhaps presuming the results will work in both situations. Upon completion, this research is expected to make the following main contributions:

- Developing a new and more adaptive project success framework that captures wider aspects of project success and helps significantly in defining and evaluating project success.
- Developing and introducing the concept of "project management during national crises" as a new concept which differs from traditional project management.
- Compiling an original set of success strategies for project management during national crises. This set will be different from any other list in terms of the context at which it is targeted.

- Developing a success model for project management during national crises. This model incorporates the success strategies and the success factors and provides recommendation to deliver projects successfully during national crises.

The outcome of this research can benefit several interests such as:

- Project management research community: by developing the new project success framework for defining and evaluating project success and by expanding the historic knowledge about project management; and
- Project management practitioners: by presenting a practical success model for project management during national crises.

1.4 Research Design overview

Probably it is a good introduction to present upfront a few main and basic points about the design of this research. In this study project cases from history will be investigate. History is a fundamental source for lessons about project success. By addressing cases of past projects lessons can be extracted. One reason that supports going to history is that the data of recent projects might not be available, particularly when these projects are sensitive or secret such as defence and R&D projects. This approach, investigating historical cases, is a common practice in project management research. For example, the construction project of Florence Cathedral Duomo between 1420 and1436 is a case that was investigated in 2013 (Kozak-Holland & Procter 2013). History constitutes a powerful way to test the relevance of an existing theory or to generate insights on contemporary questions (Lenfle 2011).

This study will investigate actual practical cases and not experimental or simulation based cases. The basic premise here is that there are too many factors that intervene in project management and investigating the success in isolation from some factors may lead to less practical results. Since the discipline is practice-based, the knowledge creation might also be conceived as practice-derived too. In this regard the management expert Peter Drucker said “What constitutes knowledge in practice is largely defined by the ends, that is, by the practice” (Drucker 1985). This philosophy is a fundamental theoretical base of knowledge creation in this research.

This study mainly uses qualitative method and it will address diverse cases with multiple data sets and multiple data collection methods to enhance the rigor through triangulation. This way increases the validity of the findings (Turner & Turner 2009).

It is quite often that designing a research is not an easy task and easily it could go wrong or miss an important component. For this reason, this study will adopt a well-established research framework known as "the research onion" (Saunders *et al.* 2009) to minimize the possibility of mistaken research design.

This study comprises five major milestones. First, the framework of defining and evaluating project success will be developed. Because there is no consensus about the meaning of project success in the literature of project success, this framework might be a good start to build a common ground of what is meant by project success. Second the concepts of project management during national crises will be crystallized. It would be beneficial to have a clear concept about the phenomenon before moving to the case studies. The third major milestone is the investigation of the first set of case studies. The investigation will include a portfolio of case studies which consists of 24 aircraft projects from the British aviation industry during the national crisis of World War 2. The resulting success strategies and their dynamics form a specific success model for this stage and based on it the initial success model for project management during national crises will be described. In the fourth milestone the second major case study of this research will be investigated. This second case study is the construction of the Aswan High Dam in Egypt during the national crises of the 1960s. Here also a specific success model for this case will be described; however, this second case study works as a validation case for the initial model created after the first portfolio of case studies from the British aviation industry. The final milestone will be the presentation and evaluation of the success model for project management during national crises. In the course of the research there will be few minor milestones and contributions which will be discussed throughout this thesis.

1.5 The role of peer-reviewed publication in this research

This research consists of five major milestones. To check the outcome of each milestone and to enhance its use in subsequent milestones the idea of peer-reviewed publication was

adopted. The rule was that each milestone must be published in a good quality peer-reviewed journal. Many submissions have been made and numerous rounds of review have been gone through. The results of these processes are eight publications; six journal papers and two conference papers.

1.6 Thesis structure and overview of chapters

This thesis is structured according to the conventional five sections thesis namely; introduction, literature review, research design, results and conclusion. Each section consists of one chapter except the results section which contains three chapters.

Chapter one is the introduction. It provides a background to the research. Following that, the chapter presents the justification of the research topic, the idea behind this research, the questions and the propositions of the research. Also the chapter discusses the scope of the research and what the expected outcome of this endeavour is. Then the chapter discusses the design that will guide the process of answering the research questions and evaluating the research propositions. The chapter concludes by providing a brief description of the thesis structure.

Chapter two presents the literature review. It includes the required analysis of existing literature and links the findings of this analysis to the research topic.

Chapter three is the research design and methodology chapter. It explains in detail the components of the research design according to "the research onion" framework.

Chapter four is the chapter that presents the first result of this research. The analysis and the creation of the four-level project success framework are discussed in this chapter and the first research proposition is evaluated in this chapter.

Chapter five is the second results chapter. It provides the literature synthesis that led to the development of the concept of project management during national crises. The concept is discussed and the second research proposition is evaluated in this chapter.

Chapter six is the last results chapter. It contains the main case studies results including the success model for project management during national crises. The success strategies are presented here and the model is discussed. The third research proposition is evaluated in this chapter.

Chapter seven is the conclusion chapter. It discusses the answers to the research questions. It also highlights the contribution of this research as well as its implications and limitations. The chapter concludes by suggesting further research.

1.7 Summary

This chapter has presented the foundation of this thesis. It has provided key information about the research background, justification, scope, idea, question and proposition. It also has provided a brief description of the research design and the structure of the thesis. On this basis, the thesis can proceed to the detailed description of the research.

2 Literature review

2.1 Introduction and objective

It is a tradition in the research world to review the previous literature in order to build upon existing findings and not to reinvent the wheel. This is the main objective of this chapter, to review the literature in the field of project management that is relevant to the topic of this thesis. Also because of the multidisciplinary nature of project management, several references to other fields are included.

This review was divided into several sections that are relevant to the topic of this thesis. At the end of each section the required conclusion was derived. Figure 1 below represents the divisions of this review.

The logic of this literature review division was derived from the title of this research. This research is titled "effective strategies for successful engineering project delivery during national crises". In order to research such a topic first the concept of a project from its root was reviewed. Then because managing projects is a distinct field of study called project management, this field was reviewed through its history to modern days. Then, project management research contains many areas of interest such as project planning and project control. Among these many areas project success is the area of interest in this thesis so that the literature related to project success such as project success, success factors and success criteria was reviewed. Further division is based on the premise that achieving success requires strategies so that the concept of strategy in the field of project management was reviewed to pave the way for discovering the effective strategies from this study.

Also a project is tightly linked to its context or environment so in order to investigate the strategies that lead to success the literature about the project context was reviewed. Furthermore, since the contexts are of many types, the specific type of contexts in this study which is the national crisis was reviewed. Finally, because the topic is about crises the notion of crisis management in the field of project management was also reviewed.

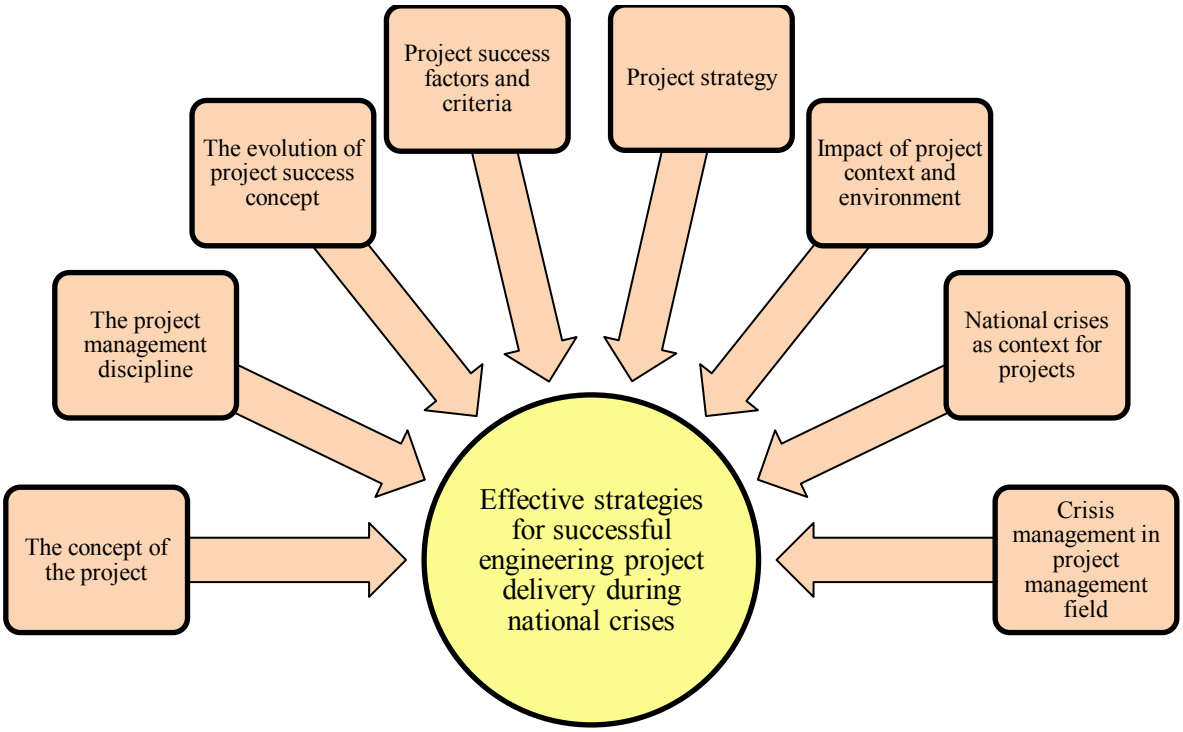

Figure 1: The division of the literature review

This literature review adopted the chronological order in each section as much as possible. In each section the review starts with the oldest references and move through to the most recent. This chapter concludes with a brief summary to recap the review and to highlight the links between the conclusions of the review and the research topic.

2.2 The concept of the term project

2.2.1 The definition

The word project is a widely used word in many fields in contemporary societies. It is very elastic and used with many objects to give specific meanings. For example a research project, R&D project, construction project, information technology project, relief project and even entertainment project.

The linguistic meaning of the word "project" as a noun is "an individual or collaborative enterprise that is carefully planned to achieve a particular aim" (Oxford Dictionaries 2014) or "a piece of planned work or an activity which is finished over a period of time and

intended to achieve a particular aim" (Cambridge Dictionaries 2014). These definitions include some distinct themes of projects such as the time boundary meaning it is not a continuous operation and having a particular aim meaning it is unique.

In the research and professional terminology there are several attempts to define the word "project". Since the emergence of project management as a distinct field of science and practices in the second half of the 20th century researchers tried to define the concept of project. One of the early definitions of the concept of a project is "a project is an organization unit dedicated to the attainment of a goal, generally the successful completion of a development product on time, within budget, and in conformance with predetermined performance specifications (Gaddis 1959). Turner and Cochrane proposed a comprehensive definition of a project. They defined it as "an endeavour in which human material and financial resources are organized in a novel way, to undertake a unique scope of work of given specification, within constraints of cost and time, so as to achieve unitary, beneficial change, through the delivery of quantitative and qualitative objectives" (Turner & Cochrane 1993). Also a project is defined as "a series of activities and tasks which consume resources, has to be completed within a set specifications and has definite start and end dates" (Munns & Bjeirmi 1996). Another definition is "a focused work activity that is temporary and has a starting and end point" (Perce 1998). Another widely accepted definition is "a temporary endeavour undertaken to create unique product, service or result" (PMI 2008). Kerzner defined the project as "any series of activities and tasks that have a specific objective to be completed within certain specifications, has defined start and end dates, has funding limits (if applicable), consume human and nonhuman resources (i.e. money, people, equipment), and they are multifunctional (i.e., cut across several functional lines) " (Kerzner 2013). It can be observed from the previous definitions through the years the definition did not change that much. Probably all modern definitions of project starting from the second half of the 20th century are writing the same themes in different words. The main themes of project definitions that apply to all types of projects are time, cost and resources boundaries and the uniqueness of objective and specifications.

Table 1 shows a comparison between different authors' definitions of a project throughout about 50 years.

Table 1: Comparison between several definitions of project

The author	time boundary	cost and resources boundary	uniqueness of objective and specifications
(Gaddis 1959)	on time	within budget,	attainment of a goal + conformance with predetermined performance specifications
(Turner & Cochrane 1993)	within constraints of cost and time	within constraints of cost and time, + human, material and financial resources	unique scope of work of given specification
(Munns & Bjeirmi 1996)	has definite start and end dates	consume resources	within a set specifications
(Perce 1998)	temporary + has a starting and end point		focused work
(PMI 2008)	temporary		unique product, service or result
(Kerzner 2013)	has defined start and end dates	has funding limits+ consume human and nonhuman resources	specific objective to be completed within certain specifications

This consistency of definitions tells that the meaning of project is well established and there is a kind of consensus upon the main characteristics of a project regardless of the

specific field of application. The two main characteristics of a project upon which consensus exists are uniqueness and temporariness.

All definitions of projects agreed upon the fact that projects must be of temporary nature. The continuous work is not a project even though the project might be very long but still it should be conceived as temporary. For example establishing a company is a project but operating the company is not. Also all definitions of project imply that each project is unique in one way or another. The similarities and differences may vary between projects but there are no two identical projects.

Historically, starting from the industrial revolution, the concept of project was exclusive to industrial and construction works (Fondahl 1987; Kwak 2005). However, things have changed dramatically since then. Now in the 21st century the concept of project is applicable in many fields, for example, research project, classroom project, relief project and rescue project.

It can be concluded that the concept of project is well established and is applicable to many fields once the major characteristics of that concept appear; uniqueness and temporariness. Any piece of work that is temporary and unique is a project. This thesis is a project even though there are thousands of theses in libraries around the world.

2.2.2 Classifications of projects

Projects are carried out in different fields with many dimensions suitable for classification purposes. Size, scope, cost, location, industry, level of novelty, complexity, culture and environment are among the dimension on which projects can be classified. This variation could make it difficult to have a universal classification system that fits all projects (Shenhar 2001). However, there are some well-accepted approaches to classify projects proposed by leading scholars in the field of project management. One of those approaches is called the Goals-and Methods matrix (Turner & Cochrane 1993). Their classification of projects is based on two dimensions. The first dimension is how well-defined are the goals of a project. The second dimension is how well-defined are the method to achieve such goals. The result is a matrix of four categories as shown in Figure 2

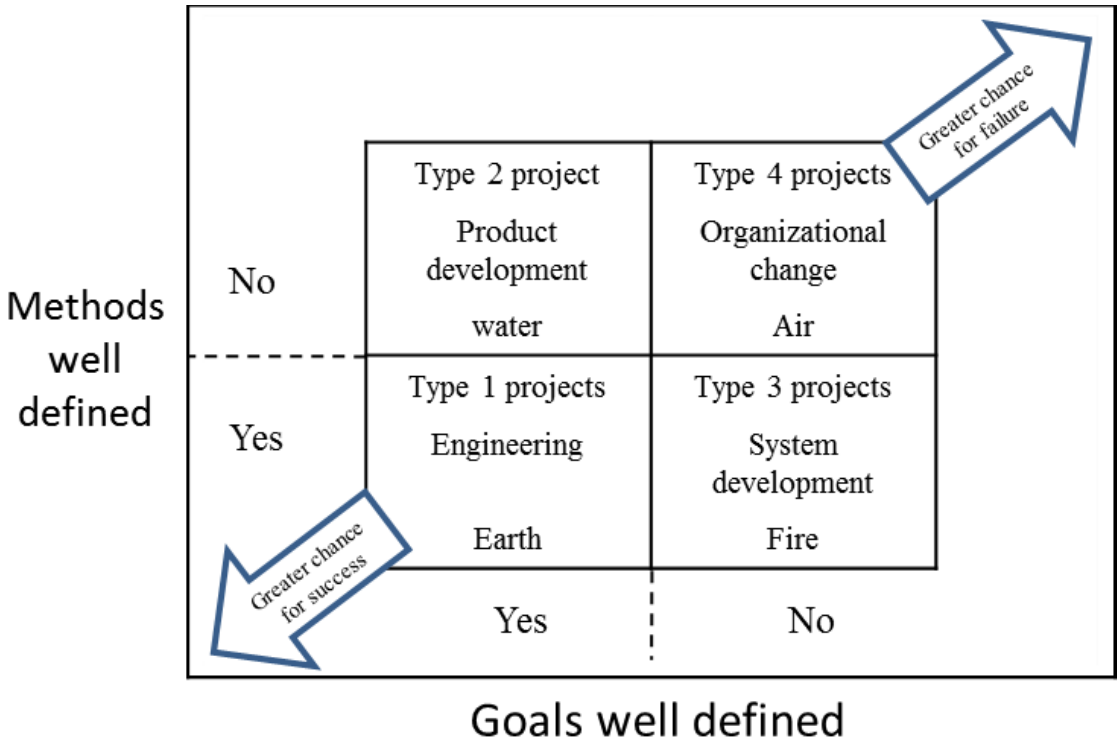

Figure 2: Goals and Methods matrix (Turner & Cochrane 1993)

In this approach of classification the four resulting categories are as follows:

- Type 1 projects: are those projects with clear and known goals and the methods to achieve such goals are known. Typical examples of such projects are engineering projects such as construction- say; to build a 2 story building. All the details are known in advance including details as tiny as the colour of the door handles. The methods to construct such a building are well-known and have been mastered by many practitioners in the field of construction.
- Type 2 projects: are projects with well-known goals but the methods to achieve such goals are vague. Typical examples of such projects are product development projects. For example in developing the Lockheed SR-71spy plane, the new specifications required in that plane were so new to the aviation industry that the project team had to invent new methods of welding the parts together.
- Type 3 projects: are those projects which have known methods of execution but the goals of such projects are vague. Software projects are good examples of such

projects. The methods of producing a software product are known, basically through programming. However defining the user requirements is difficult and can change at the last moment.

- Type 4 projects: are those projects with ill-defined goals and less known methods to achieve these goals. Organizational development projects represent this category. Developing an organization to a better position in the market includes the difficulty of defining what the better position is and the difficulty of defining how to reach this position.

One comment on this approach to classify projects is that in reality the transition between Yes and No in this matrix is gradual not sudden as suggested in the matrix.

Shenhar, as shown in Figure 3, proposed a classification system based on two dimensions namely; uncertainty and complexity (Shenhar 2001). Uncertainty in Shenhar's classification means the level of new technology used or required in the project while the complexity (also referred to as system scope) means the amount of different hierarchies within a product or a system with many managerial and design implications. Table 2 Table 3 below summarizes the possible types of projects based on the two mentioned dimensions.

Table 2: The four project types based on uncertainty (Shenhar 2001)

Classification dimension : Uncertainty				
	Project type			
	Low-tech (A)	**Medium-tech (b)**	**Hi-tech (c)**	**Super Hi-tech (d)**
Definition	Using existing technology	Adaptation of familiar technologies: some new technology or new feature.	Integrating many new but existing technologies	Integrating key technologies that do not exist at the time of project initiation
Examples	Road building	Improvement of existing product	New military system	Apollo moon landing project

Table 3: The three types of projects based on complexity (Shenhar 2001)

Classification dimension : complexity or system scope			
	Project type		
	Assembly	**System**	**Array**
Definition	Building or developing a collection of components and modules combined into a single unit either as a subsystem of a larger system or a stand-alone product performing a single function	Building or developing a collection of subsystems and interactive elements that perform a wide range of functions and activities	Building, developing or adding to a large widespread collection of systems functioning together to achieve a common purpose
Examples	Power supply Washing machine	Computer Radar	Building a city National air defence system

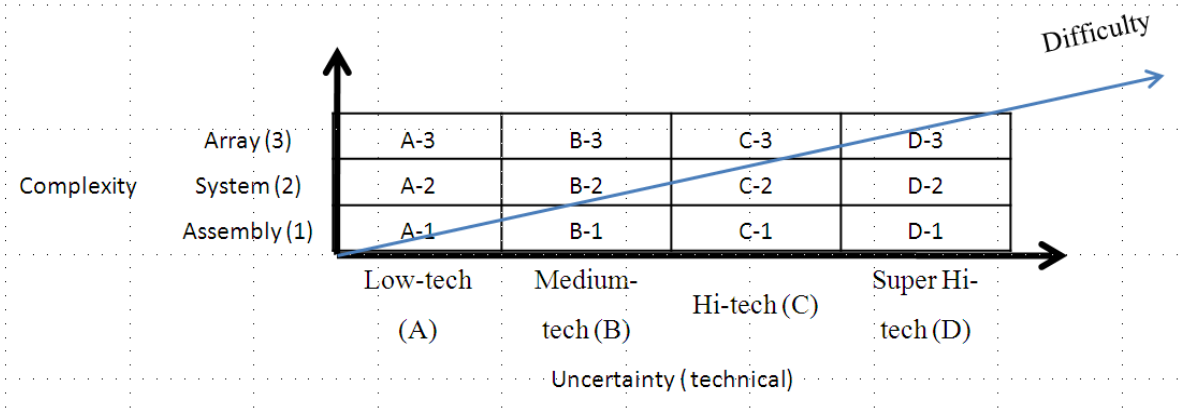

Figure 3: Project types based on uncertainty and complexity dimensions (Shenhar 2001)

Also (Shenhar, Dvir, *et al.* 2002) proposed the classification of projects based on:

- Strategic goal: meaning the characteristics of business objective behind the project
- Market uncertainty: meaning what kind of product the market will better accept
- The pace: meaning how critical meeting the time requirement is

Table 4: Project classification summarized from Shenhar, Dvir, *et al.* (2002)

Classification dimension	**Project type**				
Strategic goal	Extension	Strategic	Problem solving	Utility	Research
Market uncertainty	Derivative	Platform	Breakthrough		
The pace	Regular	Fast	Blitz		

Also Shenhar *et al*. pointed out that different stakeholders will use different dimensions to classify the same project. This reinforces the perception that the same project means different things to different stakeholders.

Wysocki proposed the classification of projects based on the management approach namely traditional, agile and extreme project management (Wysocki 2011). Also he proposed dimensions such as cost, duration and business value for classification purpose.

A routine and non-routine projects is a classification proposed by (Le Masurier *et al.* 2006). They mean by routine projects those executed during normal circumstances while non-routine means post-disaster reconstruction projects.

It could be concluded from various attempts to classify projects that the classification of projects is a multi-dimensional process and its complexity is proportional to the number of dimensions used as inputs to the classification process. Also, based on the diversity shown about the dimensions of classification, the classification of projects based on the context in which they take place namely; peacetime and crisis time could be an acceptable

classification. Peacetime means the normal context of everyday life while crisis time means the context of intense circumstances such as war.

2.2.3 The importance of projects

Human beings have continued doing things to sustain and improve their life and environment. One of the means to achieve their objectives is by executing projects. In the light of previous definitions of a project, projects draw their importance from many domains.

Successful projects are key elements for sustaining businesses and ensuring a nation's prosperity (PIPC 2005). Successful projects mean a positive impact and continuity of businesses. For example, the Sydney opera house was a monumental project that greatly and positively impacted the tourism business in Sydney, Australia. On the other hand, failed projects may ruin the business yet they provide valuable lessons to the body of knowledge.

Also improvements in public sector program delivery and operations are usually accomplished using a specific project, for example, projects to implement a new government policy or to introduce a more efficient financial system in an entity (ANAO 2010).

The importance of projects can be seen in the global trend of project-oriented business where a company performs a network of internal and external projects simultaneously. This trend paves the way for a new management approach called management by projects or project-based organization (Gareis 1989). This approach allows companies to be more flexible in facing market competition and more innovative and to be responsive to changes in customer's requirement or product properties (Hobday 2000). These are very important features in today's turbulent marketplace. Also projects are reported as strong means to implement strategic change in organizations (McElroy 1996).

Moreover, one important impact of projects is the development of new technologies that benefit all mankind. The Apollo moon mission is a clear example of such impact of projects. The technologies which resulted from that project were not only applied to the

space programs but in many civilian aspects such as environment, medicine and entertainment (NASA 2004).

During the times of crises or in the aftermath of disasters relief projects are very important means to deliver aid to affected communities. Many government and non-government agencies apply the project concept to their relief effort.

From economic point of view, the Project Management Institute (PMI) reported that one fifth of the world's GDP is spent on projects of various types and this is a significant portion(PMI 2014).

It can be concluded that the importance of projects makes the research in the field of project management and particularly project success extremely important and worth investigation at many levels of study such as master and PhD.

2.3 The project management discipline

2.3.1 The evolution and definition of project management

Projects- as defined earlier- exist since the early existence of humans. There are several examples of monumental projects which took place in the past. For example, the cairn of Barnenez is one of the oldest buildings in the world. Its construction is dated to the Neolithic period more than 6ooo years ago. The ancient Egyptians built the pyramids more than 4000 years ago. Nabateans constructed the city of Petra more than 2000 years ago. The Taj Mahal was constructed in India about 500 years ago.

Despite the significances of these monuments and the great engineering works they include, there seems to be little recorded about the art of managing the work in these projects. Mostly the discussion goes about the engineering significance in these projects. Perhaps the science of management was not conceived then as an important part in the engineering works.

The basic techniques of management can be traced back about 5000 years ago in Iraq. However, the industrial revolution in the 18th and 19th century marked the dawn of modern management science (Pindur *et al.* 1995). Several management schools and techniques emerged in the second half of the 19th century and the first half of the 20th

century. For example, the scientific management theory was introduced by Frederick Taylor in the 1880s. In the 1900s and1910s Henry Gantt introduced and developed his remarkable planning and control technique known as Gantt charts (Wilson 2003). He uses a simple, easy to read graphic bar chart to display relationships between work (planned and completed) on one axis and elapsed time on the other axis. Gantt chart is still one of the most widely used techniques in project scheduling and controlling today. Figure 4 shows a typical Gantt chart.

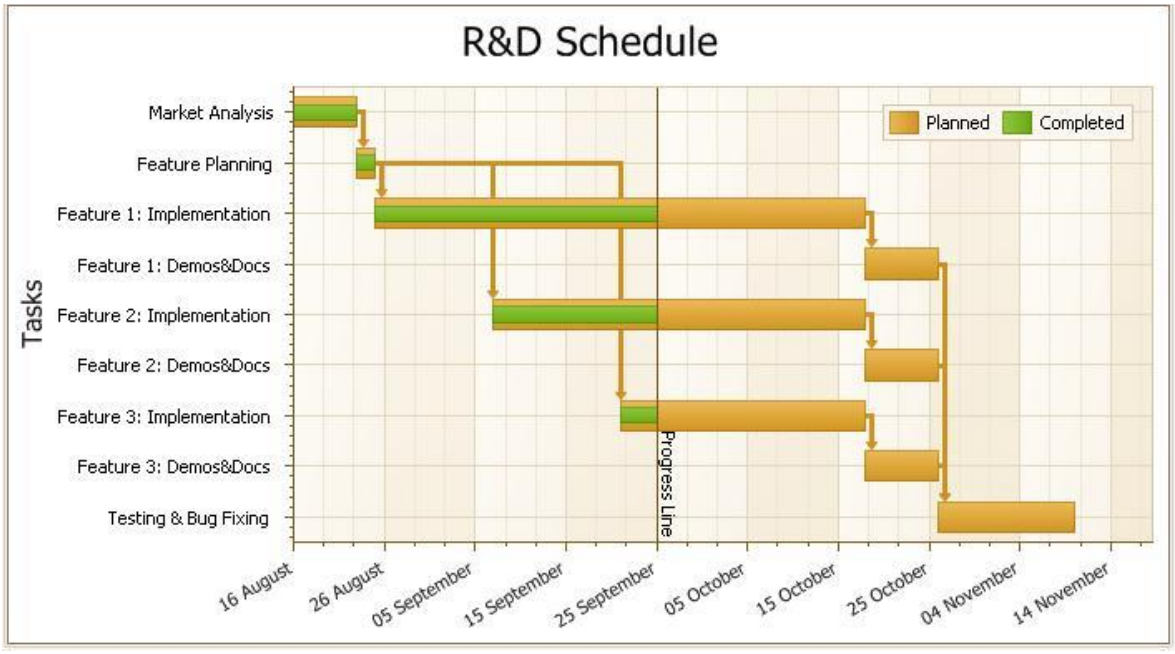

Figure 4: Typical Gantt chart

Contemporary to Fredrick Taylor, Henri Fayol introduced his theory of management which was later known as Fayolism. In that theory he introduced the five roles of the management, namely: planning, organizing, commanding, coordinating and controlling. Management science kept evolving throughout the first half of the 20th century but the project management era was to emerge in the second half of the 20th century.

There is a debate in specifying the exact beginning of modern project management. Some authors argue that the origin of modern project management comes from the chemical industry just prior to World War II while others prefer to set the beginning of modern project management with the introduction of the Critical Path Method (CPM) and Program

Evaluation and Review Technique (PERT) in late 1950s (Kwak 2005). Since then there has been a progressive evolution in the definition and understanding of project management concept and standards.

Olsen reviewed the definition of project management since 1954 through to the 1970 PMI symposium where he collected various thoughts from participant in that symposium. He came up with one of the first universal definitions of project management. He defined project management as "the application of a collection of tools and techniques (such as the CPM and matrix organization) to direct the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task" (Olsen 1971). Another definition is proposed by Boznak which is "The direction, coordination, and control of a one-time project to achieve specific cost and schedule objectives" (Boznak 1988). Munns and Bjeirmi proposed that project management can be defined as "the process of controlling the achievement of the project objectives " (Munns & Bjeirmi 1996). The concept has seen little profound change since the introductions of Olsen's definition in 1971. For example, PMI defined project management as "the application of knowledge, skills, tools and techniques to project activities to meet project requirements" (PMI 2008). Many researcher chose to adopt this PMI's definition and this definition is globally accepted (Brewer & Strahorn 2012).

It can be concluded that the concept of project management is well established and the authors over the years proposed similar definitions to the concept of project management. However, the application of such concept may vary depending on many factors such as the practical standards used in the implementation of the project. These standards will be discussed in the following section.

The variety of methodologies on how to implement and manage projects may mislead some people to think that the concept itself is vague. Ali (2010) captured the argument of whether the concept is definable or not and divided the researchers into two teams. One team argues that the concept is evolving and non-definable while the other claims that the concept is definable (Ali 2010). The previous conclusion supports the argument that the

concept is well-established in the literature as many authors over the years without prior agreement proposed similar description of the same concept. Also this complies with the basics of any profession that it should be defined. However, different strategies and approaches that people adopt to manage projects, the experience they gain from those projects and the various forms of uniqueness of projects lead to different standards for application and practice. Organizations should adopt a more project-specific approach for managing their own projects (Shenhar 2001; Van Niekerk & Steyn 2011).

All in all, while the definition of project management is well-established, the practice of managing projects might be very elastic to comply with the uniqueness, the environment, the context and the circumstances of each project.

2.3.2 The international project management organizations, standards and certification

Starting from the beginning of the second half of the 20th century project management has gained momentum in various organizations. However, until the middle of the 1950s and early 1960s this field of practice had no universal standards of practice. There was a need for promoting and enhancing the practices of project management. This led to the formation of organizations and associations with a prime goal, namely to enhance the practice of project management.

The two leading organizations of project management are the International Project Management Association (IPMA) and the PMI. IPMA was established in Europe in 1964-1965. It is an international umbrella organization, or federation of more than 50 national project management associations from all over the World. The important feature of having national organizations is that national organizations understand the unique needs and cultures of their respective nations (IPMA 2013). This probably complies best with the uniqueness of the project definition because culture is one of the dimensions that affect the application of project management tools (Wang & Liu 2007). On the other side of the Atlantic PMI was established in the USA in 1969. It sees itself as “one of the world’s largest not-for-profit membership associations for the project management profession” (PMI 2013). PMI provides professional resources and research to empower more than

700,000 members, credential holders and volunteers in nearly every country in the world to enhance their careers, improve their organizations' success and further mature the profession. In addition to these two organizations there are several other government and non-government organizations aiming to enhance project management practices and output. Some of which are listed in Table 5 below.

Table 5: Examples of project management organizations

Organization's title	Type
The Association for Project Management (APM) founded in UK in 1972-	Non-government
The Australian Institute of Project Management (AIPM) Formed in 1976 -	Non-government
The Office of Government Commerce (OGC). now is a part of the Efficiency and Reform Group of the Cabinet Office, a department of the Government of the United Kingdom	Government
Project Management Association of Japan (PMAJ) formed in 2005	Non-government
The British Standards Institution (BSI)	Non-government

These organizations introduced methodologies and standards for the best practices in project management. Each organization publishes one or multiple standards or methodologies and updates them in a series of editions. Table 6 below provides a summary of standards or methodologies provided by project management organizations.

Table 6: Summary of standards provided by project management organizations

Organization	Standards or methodologies
IPMA	IPMA Competence Baseline (ICB®)
PMI	Foundational Standards • A Guide to the Project Management Body of Knowledge (PMBOK Guide) • The Standard for Program Management • The Standard for Portfolio Management • Organizational Project Management Maturity Model (OPM3) Practice Standards and Frameworks • Practice Standard for Project Risk Management • Practice Standard for Earned Value Management • Practice Standard for Project Configuration Management • Practice Standard for Work Breakdown Structures • Practice Standard for Scheduling • Practice Standard for Project Estimating • Project Manager Competency Development Framework PMI Standards Extensions • Construction Extension to the PMBOK Guide • Government Extension to the
PMAJ	Project and Program Management for Enterprise Innovation (P2M)
OGC	PRojects IN Controlled Environments (PRINCE2®)
AIPM	The Professional Competency Standards for Project Management
APM	The APM Body of Knowledge
BSI	BS 6079-1 Principles and guidelines for the management of projects

Despite promoting the same concept of project management, these standards have several differences between them and no single document can be claimed as the complete solution

for project management. Any document of body of knowledge is a guide to one view or aspect of the project management at a point in time (Crawford 2007).

The differences between various standards stem from several causes. For example, the standards can be different due the focus on which the standards are based. The standards' focus can be on project, people and organization. Figure 5 below shows the foci of these standards.

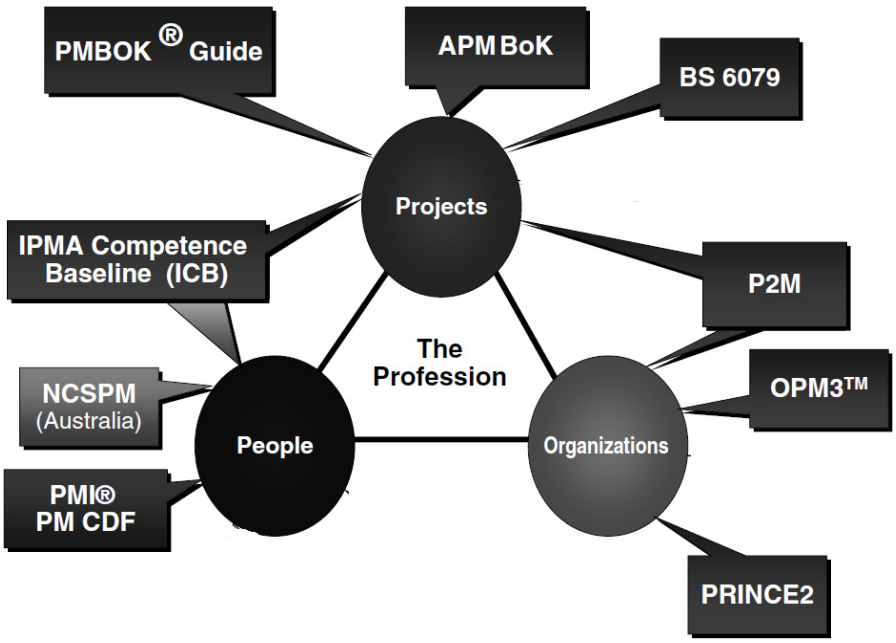

Figure 5: The foci of project management standards. Modified from Crawford (2007)

The differences between standards are justifiable because projects are unique by definition. A high level of agreement in these standards is possible and has already been achieved. At the lower levels of details the possibility of such agreement could be very limited. Actually due to the uniqueness of projects there could be no need to unify these standards. This view is strongly supported with Shenhar's statement "one size does not fit all" (Shenhar 2001).

The other function of the international project management organization is to provide certification to enhance the capability and the competency of practitioners. Table 7 below provides a summary of certification provided by project management organizations

Table 7: Summary of certification provided by project management organizations

Organization	Certification title
IPMA	For individuals IPMA Level A: Certified Projects Director IPMA Level B: Certified Senior Project Manager IPMA Level C: Certified Project Manager IPMA Level D: Certified Project Management Associate For consultants IPMA PMC: IPMA Certified Project Management Consultant IPMA PPMC: IPMA Certified Program and Portfolio Management Consultant For Organizations IPMA Delta®
PMI	Certified Associate in Project Management (CAPM)® Project Management Professional (PMP)® Program Management Professional (PgMP)® PMI Agile Certified Practitioner (PMI-ACP)® PMI Risk Management Professional (PMI-RMP)® PMI Scheduling Professional (PMI-SP)® OPM3® Professional Certification
AIPM	Certified Practicing Project Practitioner - CPPP Certified Practicing Project Manager - CPPM Certified Practicing Project Director - CPPD Certified Practicing portfolio Executive - CPPE
PMAJ	PMS PM Specialist Project Management Specialist PMR- Project Manager - Project Management Registered PMA - PM Architect - Program Management Architect
APM Group (licensed agent to provide the exam)	PRINCE2® foundation PRINCE2® practitioner

These certifications are aiming to enhance the capability of project practitioners. However, their approaches are different because they are mainly based upon different standards.

The review of these standards and their respective certification revealed two important features. The first is that these standards are evolving over time. For example, the PMBOK Guide issued by PMI was gathering the skills of project management into nine areas of knowledge. A tenth area of knowledge was introduced in the fifth edition launched in 2012. This was a result of continuous research in the field of project management. The second is that the standards are different from each other in many areas depending on several reasons. For example, the Japanese P2M standards admit that Japan is lagging behind Europe and US in risk management and attributed this lag to the historical and cultural background of Japan.

All in all, the various bodies of knowledge in the project management field and the respective standards derived from them are far from being ideal and areas such as managing projects during national crises were not mentioned. This leaves a gap that needs to be addressed and this research will address the issues of project management during national crises.

2.3.3 The benefits of project management

Since after WW2 industries have been more project intensive and the complexity of product development and service provision has been increasing. With this comes the importance of having an efficient approach to manage these projects and to deal with such complexity. This can be described as the territory of project management where it can show its benefits best.

Project management as defined earlier is a practical approach that has proven its worthiness in many areas of application. In general it presents efficient techniques and tools to deal with many problems that projects encounter such as objective definition problems, responsibility assignment problems and delays (Morgan 1987).

In many industries project management tools and techniques have proven to be the choices for better results. In an automotive industry based study Curley and Ryder reported

that utilization of project management will enable manufacturers to create superior products through high-quality product development techniques (Curley & Ryder 1993). In the global market that is characterized by competition, complexity, pace, change and unexpected events project management plays a role in helping businesses to succeed (Frame 2002). In a research industry (clinical research) several benefits of the application of project management methodologies were reported with enthusiasm. It was reported that the application of project management methodology (PRINCE2) provided many benefits such as improvement in understanding of the trial process at the funding body, ongoing time saving for team members through standardization of site reporting and improvement in risk management (Gist & Langley 2007). In the library industry it was found that project management is an effective tool for the planning of projects in libraries and can increase the likelihood of success (Massis 2010).

The wide application of project management tools and techniques in various fields is a convincing factor that doing research in this profession is an important direction to follow.

It was found that most of the research explored peacetime project management and presented its advantages to help projects to succeed. However, very little was found to explicitly address project management during national crises. As a result, this gap will be addressed in this research.

2.4 The evolution of the concept of project success

Projects as defined earlier in this thesis are as old as human history and the goal of success has accompanied projects ever since. However, project management as a discipline of knowledge is relatively new so that the formal definition and understanding of project success is new too and it began with the beginning of this field.

In the early years of the project management profession up to the 1970s, project success was conceived as completing the project according to limited criteria namely, time, cost and quality; this is known as The Iron Triangle, the golden triangle and other few titles (Ika 2009). This triangle was accepted widely and is still accepted today. Even though it is "Iron", it has been criticized for being insufficient to fully define the project success (Dvir *et al.* 1998; Milis *et al.* 2003; Ika 2009). Completing a project on time, on budget and

according to desired quality does not necessarily mean success (Turner & Zolin 2012). An example of that is the F-20 Tiger Shark aircraft project. It was completed according to the iron triangle yet it was a failure and no single aircraft was sold (Martin & Schmidt 1987). The iron triangle seems to be very operational and could not assess the strategic dimensions of projects and it lacks the ability to assess the soft dimensions of projects such as customer communication (Davis 2013). The project success concept appeared to have more dimensions than the iron triangle criteria.

In the 1980s the ground breaking work of de Wit (1988) (often mistakenly attributed to Baccarini 1999) enhanced the concept of project success by splitting the project success into two parts namely the project success (meaning the product) and project management success (meaning the managerial processes) (de Wit 1988). In this new concept de Wit argued that the success of the product of a project should be assessed separately from the success of the project management activities. Successful project management activities are not a guaranty of a successful product and a successful product is not necessarily a result of good project management activities. For example the Sydney Opera house in Australia suffered huge cost and time overruns yet it is still an amazing product (Ika 2009).

The concept of project success did not stop there as questions of success continue to arise such as what about projects with successful product and efficient project management activities yet no desired result. For example, applying de Wit's concept to the example of the F-20 suggests the success of that project because there were good project management processes and an outstanding product compared to the state of the art of the time. However, the actual assessment of the project was that it was a failure. Herein from the 1990s the literature started to show further development to the concept of project success. Researchers started to argue that project success should be understood at different levels or dimensions with each level or dimension having its own criteria. Shenhar *et al.*(1997) introduced the business as a distinct dimension of project success criteria in addtion to the previous work of de Wit. They suggest four distinct dimensions at which the project success can be assessed. These dimensionas are: project efficiency which is equivalent to project management activities, impact on the customer which is equivalent to the product, business and direct success, and preparing for the future (Shenhar *et al.* 1997). Even though

Shenhar *et al* (1997) consider these dimensions as four distinct dimensions, the direct success and preparing for the future are both business dimensions with timeframe differences. The direct success dimension is related to short term while preparing for the future is related to long term. Later, Shenhar *et al.* incorporated these four dimensions into a multi-dimensional strategic framework for project success assessment containing 13 measures distributed between these four dimensions (Shenhar *et al.* 2001). The proposal of Shenhar *et al.* solved more issues in the question of project success. Assessing the F-20 project according to Shenhar's framework shows that the project failed at the business dimension when it could not attract sales.

Baccarini introduced the logical framework method to define project success. He argued that four levels of project objectives should be used the define success (Baccarini 1999). These levels are summarized in Table 8.

Table 8: Logical framework levels (Baccarini 1999)

	The level			
	Goal	**Purpose**	**Output**	**Input**
Meaning	The overall strategic orientation to which the project will contribute	Short term effect on the user of the project's deliverables	The project deliverables	Resources and activities to produce the output
Example from a power station project	Economic development of the country	Producing electricity	Power plant	Resources and work

Baccarini's four levels are similar to Shenhar's four dimensions. Table 9 below shows this similarity

Table 9: Baccarini's four levels vs. Shenhar's four dimensions

Baccarini	**Shenhar *et al.***	**The similarity**
Goal	Preparing for the future	Assessing the long term results
Purpose	Business and direct success	Assessing the short term results
Output	Impact on the customer	Assessing the project's deliverables
Input	Project efficiency	Assessing the project management processes

Judev and Müller provided a detailed review of the concept of project success and the issues related to it covering a period of the past 40 years. Their findings support the emergence of a line of thought for having distinct levels or dimensions to assess and understand project success (Jugdev & Müller 2005). This line of thought complies better with the multidimensional nature of projects as projects usually have multiple stake holders with different points of view so they perceive project success differently (Andersen *et al.* 2006; Davis 2013). This line of thought continues to date but the early definition of success is still widely used.

In addition to the mentioned frameworks, several authors also highlighted the importance of the factors with possible influence in the definition of success. For example the cultural differences may affect the perception of "project success" between project teams when projects are cross-national effort (Pereira *et al.* 2008). Also the success definition is sensitive to the time at which the assessment takes place meaning that different success criteria are required at different stages of the project lifecycle (Shenhar *et al.* 2001; McLeod 2012). For example the criteria for strategic assessment of the project will take effect after the implementation of the project while the criteria for assessing project management processes take effect during the activities of the project.

Despite all attempts in the literature of project management since the 1970s to date, there is no consensus upon the concept of project success (Ika 2009; Han *et al.* 2012). Many

factors influence the process of defining the project success and every evaluator perceives the success from his or her point of view (Baccarini 1999; Turner & Zolin 2012; Kerzner 2013). For example, the project owner may define the project success as producing the new asset by the project works as expected while a project team member may think about the success as having a satisfactory experience working on the project.

The lack of a universal definition of the project success concept supports the need for continuous search for project success definition frameworks that can satisfy a wider range of multiple evaluators and bring them closer to consensus. Also it has a very profound impact on the practices of project management as it becomes necessary for stakeholders to agree upon the desired meaning of success upfront in order to have better collaboration towards success (Thomas & Fernández 2008; Davis 2013).

It can be concluded that the concept of project success is still vague and is evaluator-specific. Based on this conclusion this study may need to develop a framework for project success assessment to clarify the specific meaning of success used throughout this research.

2.5 Project success factors and criteria

The term success factors and the term success criteria appear regularly in the literature of project management. These two terms form the heart of project success studies.

2.5.1 Project success factors

Most of the studies about project success use the term "success factor" to describe the element that contributes to the success of a given project. The word factor means "a circumstance, fact, or influence that contributes to a result" (Oxford Dictionaries 2014). It is defined by project management scholars as "those inputs to the management system that lead directly or indirectly to the success of the project" (Cooke-Davies 2002). Another definition of project success factors is " the elements of a project which, when influenced, increase the likelihood of success; these are the independent variables that make success more likely" (Müller & Jugdev 2012). The second definition has an important addition, which is "independent variables". However this addition can change depending on the

point of view of the analysis. This point will be discussed in the coming section titled strategy- factors relationship.

Since the beginning of project management as a distinct discipline the search for success accompanied that beginning. Many authors provided some success factors based on case studies and anecdotal evidence. These factors are often called critical success factors (CSFs). Some authors went further and introduced failure factors but the orientation towards success factors is much more common in the literature. However, the period of the 1980s saw a real advancement and introduction of empirical works in the field of project success factors by scholars such as Pinto, Slevin, and Prescott. That work affected almost all subsequent works (Müller & Jugdev 2012).

The literature of project management contains many of articles before and after Pinto *et al.* reporting varieties of project success factors. However, due to the high influence of Pinto *et al.* works in the 1980s (Davis 2013) their work was chosen to be the starting point of this review. Ten CSFs were presented by (Pinto & Slevin 1987) based on a comprehensive review of previous literature on CSFs and empirical analysis of the responses of project personnel. These factors are:

1. Clearly defined goals
2. Top management support
3. Detailed plan
4. Client consultation
5. Availability of skilful project personnel
6. Availability of required technology and expertise
7. Good control and supervision mechanisms
8. Adequate communication
9. Ability to deal with unexpected problems
10. Client satisfaction

Almost all the works that were published after this article by Pinto and Slevin and that the author could reach and review included one or more of those ten CSFs in one way or another. For examples de Wit reported several generic success factors from previous studies such as planning effort, project team motivation and project manager technical

capabilities (de Wit 1988). Gemuenden and Lechler found that top management support, project team communication and information sharing are among the critical success factors for projects while conflict and change in the goal are failure factors (Gemuenden & Lechler 1997). Chan *et al.* studied the success factors for design and build type projects and extracted six factors as critical ones to success. Those factors are project team commitment, contractor's competencies, risk and liability assessment, client's competencies, end-users' needs, and constraints imposed by end-users (Chan *et al.* 2001). A study from the construction industry in Vietnam revealed 20 success factors some of which are; clear objective, top management support and commitment to the project (Nguyen *et al.* 2004). For international development projects Do Ba and Lin identified several success factors some of which are Competencies of project designers and Clear understanding of project environment by funding and implementing agencies (Do Ba & Tun Lin 2008). For a successful implementation of government projects in developing countries Jo and Barry presented a list of factors that includes for example, designing the projects in accordance with government objectives and stakeholder involvement (Jo & Barry 2008). An even more recent study from the construction industry in Malaysia reported CSFs such as adequacy of design details and specifications, team leader competency and cooperation in solving problems (Yong & Mustaffa 2012). These examples show the significance of the work of Pinto and Sliven, and bring forward the first feature of CSFs, which is the possibility of achieving a commonality in CSFs at the high level. However, the commonality at the details or lower levels is a different story.

The second feature of CSFs is that the significance of a CSF can differ with different objectives of the project such as cost and time. Chua and Kog identified a list of critical success factors for construction projects and related them to project objectives of time, budget and quality performance. For example project manager competency as a success factor ranked 5th in the list for budget performance objective, 4th for schedule performance and 6th for quality performance. The top two factors which are adequacy of plans and specifications and constructability retained their ranks in all objectives (Chua & Kog 1999). More than ten years after the study of Chua and Kog another study was conducted to distinguish the different CSFs for different components of construction projects as

perceived by different professions such as mechanical and electrical engineering, architecture and survey. A list of 67 CSFs was compiled. Some of those CSFs are project manager competency, adequacy of plans and specifications, constructability and clear objectives. A group of experts in the construction industry were asked to rate the importance of these CSFs for different components of a construction project. The findings confirmed that the importance of a CSF differs with the objective and more surprising is that the adequacy of plans and specifications and constructability relatively retained their ranks in all objectives (Kog & Loh 2012)

These lists kept evolving and with no complete consensus upon them and they are far from being universal to all projects (Shenhar, Tishler*, et al.* 2002). This reinforces the essential characteristic of the project definition as a unique endeavour in a sense that a unique endeavour should have some success factors that differentiate it from others. However, different lists agree upon several individual CSF despite the different contexts of the studies such as different geographical location or different ownership type; public or private. For example, a study on large construction projects in Vietnam (Nguyen *et al.* 2004), a study from the Indian construction industry (Iyer & Jha 2006), and a third study about the success factors in government owned projects (Jo & Barry 2008) and a fourth study on multiple public and private firms in multiple industries (Mishra *et al.* 2011) all agree that the first or second most important factor for success is the competency of the project manager. This supports the argument that a success factor with wide commonality (not consensus) is possible.

It can be concluded that because CSFs can differ based on several dimensions such as the context, studying project success in a national crises context may reveal some commonalities with previous studies as well as some differences that are unique to the national crises context.

2.5.2 Project success criteria

The project success is a highly regarded concept to all project personnel, yet its meaning is illusive. The description of a project whether it is a success or a failure can be very different depending on many factors such as the assessor's point of view and the time

frame of assessment (Pinto & Prescott 1988; McLeod 2012; Davis 2013). A stakeholder may consider a project as a success while another stakeholder may see it as a failure. For example, the F-20 Tiger Shark fighter jet was a triumph for the technical personnel in the project but it was a real failure for the marketing team as they failed to sell a single aircraft (Martin & Schmidt 1987). Also a product can be considered successful at a time and obsolete at another. The P-51 Mustang fighter aircraft was a highly regarded plane in 1945 and an obsolete product in 1950 (Howsawi *et al.* 2011). In order to minimize this subjectivity, clear success criteria should be defined and agreed upon at the outset of the project (Wateridge 1998).

In the language "criterion" means "a principle or standard by which something may be judged or decided" (Oxford Dictionaries 2014). In the project management literature it is defined as "the set of principles or standards by which project success is or can be judged" (Lim & Mohamed 1999). Another definition is "the measures used to judge on the success or failure of a project; these are the dependent variables that measure success" (Müller & Jugdev 2012).

One of the early accepted set of criteria for measuring project success is the iron triangle. The iron triangle is a nick name of the cost, time and quality criteria (Atkinson 1999). These three criteria can be found in the definitions of project management proposed by Richard P. Olsen (1971). These criteria are widely used as the main criteria for measuring the success of projects (Agarwal & Rathod 2006). However, as the concept of project success evolved over time so the criteria of success did too. The evolution of project success criteria took off from the simple intuitive iron triangle to a diverse set of criteria and frameworks to assess the project success. Perhaps the necessity for this evolution came from the insufficiency of the simple criteria of cost time, and quality to fully judge a project. The evolution of success criteria can be grouped into three periods as shown in Table 10.

Table 10: The evolution of success criteria (Ika 2009)

	The period		
	1960s–1980s	**1980s–2000s**	**21st Century**
Success criteria	"Iron triangle" (time, cost, quality)	Iron triangle Client satisfaction Benefits to organization (org) End-user's satisfaction Benefits to stakeholders Benefits to project personnel	Iron triangle Strategic objective of client organizations and business success End-user's satisfaction Benefits to stakeholders Benefits to project personnel and symbolic and rhetoric evaluations of success and failure

Early attempts to expand the criteria of project success proposed plain lists of new criteria other than cost, time and quality. One of such attempts was made by de Wit. He proposed six criteria to measure a construction project success. These criteria are Budget performance, Schedule performance, Client satisfaction, Functionality, Contractor satisfaction and Project manager/team satisfaction (de Wit 1988).This trend of plain lists of success criteria continued to date. Table 11 below summarizes the findings of some key authors.

Table 11: Success criteria from some key authors

The author(S)	The proposed success criteria
(Turner 1993)	Achieving stated business purpose Achieving satisfactory benefit to the owner Satisfying the needs of the owner, user and stakeholders Meeting pre-stated objectives to produce the facility Producing the facility to specification, within budget and on time Satisfying the needs of the project team and supporters
(Shenhar *et al.* 1997)	Project efficiency; Impact on customers; Business and direct success Preparing for the future
(Wateridge 1998)	Meeting user requirements; Achieving purpose; Meeting timescale Meeting budget; Making the user happy; Meeting quality
(Collins & Baccarini 2004)	Time, Cost, Quality/Meeting Specification , Client Satisfaction , Cooperation, Organizational Goals, Stakeholder Satisfaction, Project Management Process, Profit, High Standard of work, Achieving Scope, Team Members Satisfied, Cost Efficiency of Product, Risks Managed, Change & Change Management, Repeat Work, Meeting Standards, Safety, Project Recognition, Satisfies Users Needs, Community , Acceptance, Personal Development, Continuing Relationships, Environmental
(Van Niekerk & Steyn 2011)	Efficiency of project execution Impact of the product on the customer Impact on the project team Business success Preparing for the future Impact on the country and the community Regulatory standing

It is notable that these criteria can be divided into two high-level groups as shown in Figure 6. The first is the common project success criteria which exist in almost all projects

such as cost and time. The second group is the project-specific success criteria group which contains those criteria that are specific to one project or a set of closely related projects. For example the level of novelty as a project success criterion is limited to some projects such as new product development but it is not important in a traditional construction project. Also achieving the approval of a certain authority (say Food and Drugs administration- FDA- in the USA or Therapeutic Goods Administration – TGA- in Australia) is a must for the success of any project that seeks to produce medicine while for a software project this particular criterion is irrelevant.

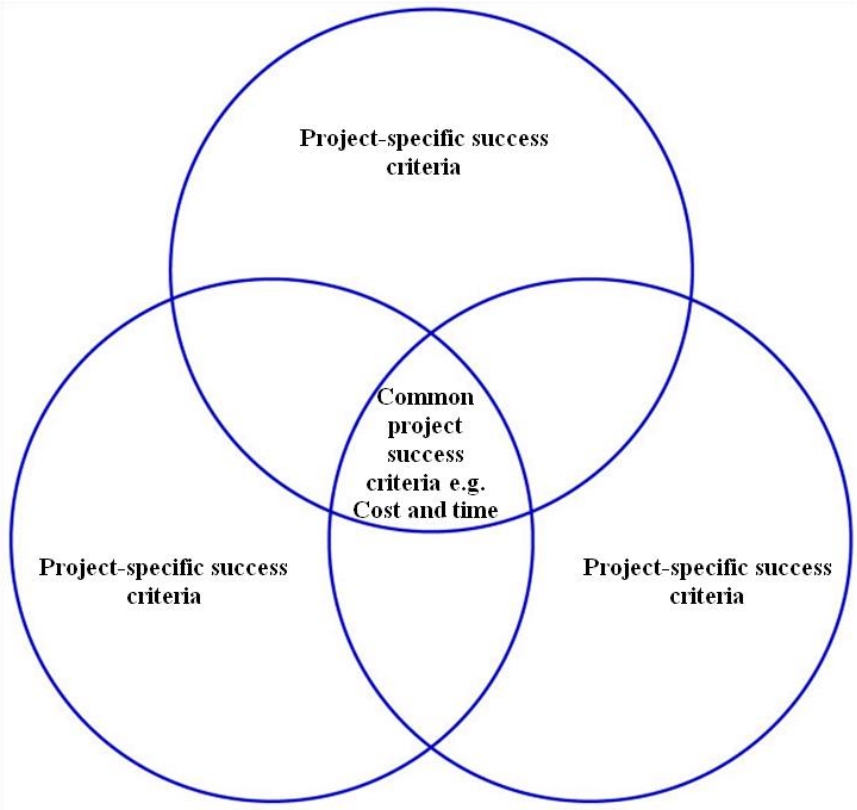

Figure 6: Venn diagram to represent the two groups of project success criteria

Other authors grouped success criteria into different success dimensions instead of proposing plain lists of success criteria. For example (Griffin & Page 1996) proposed groups such customer-based success criteria, technical performance success criteria and financial success criteria. They made a derivative of the main criterion into these groups.

For example, the cost is a main criterion for the assessment. They stated "market share" as a customer-based success criterion, "profit goal" as a financial-based criterion and "development cost" as a technical performance based criterion. These sub-criteria are related in one way or another to the cost performance of a project. Shenhar *et al*. (2001) grouped several criteria to four success dimensions summarized in Table 12 below.

Table 12: Grouping project success criteria into four success dimensions (Shenhar *et al.* 2001)

Success dimension	**Measures (Criteria)**
1. Project efficiency	Meeting schedule goal Meeting budget goal
2. Impact on the customer	Meeting functional performance Meeting technical specifications Fulfilling customer needs Solving a customer's problem The customer is using the product Customer satisfaction
3. Business success	Commercial success Creating a large market share
4. Preparing for the future	Creating a new market Creating a new product line Developing a new technology

Another example of grouping the criteria into different dimensions is presented by (Wai *et al.* 2012) . They grouped 20 criteria under five dimensions as shown in Table 13 below.

Table 13: Grouping project success criteria into five success dimensions (Wai *et al.* 2012)

Success dimension	Measures (Criteria)
company success	Company growth Personnel training Experience and knowledge gain Improvement of management Developer-contractor relationship Capital gain
Profitability success	Sales of product Product market share Project profitability
Primary product success	Quality Durability Complete within time period Complete within allocated budget
Secondary product success	Sustainability Environmental effect Project safety Lifecycle cost
Branding success	Customer confidence on product Developer reputation Customer satisfaction

In the grouping examples mentioned here it is noted that there are different mindsets in this grouping approach; however, there is some degree of similarity between them. For example business success dimension proposed by Shenhar *et al*. and profitability success proposed by Wai *et al*. are similar.

The movement from plain lists of criteria to the grouping approach led to the development of frameworks and models that link the project success criteria to the project success factor

in order to have a better way of linking the perception of success (success criteria) with the practice of project management (success factors). This will be discussed in the next section titled factor- criteria relationship.

2.5.3 Factor-Criteria relationship

Knowing success factors tells the practitioners what they need to have in order to increase the likelihood of their projects to succeed while knowing success criteria tells the practitioners what is meant by the success itself.

The literature of project management contains plenty of articles that address the relationship between success criteria and success factors. However, the majority of those articles rank the importance success factors to given success criteria rather than identifying the path for satisfying given criteria through specified factors. For example, (Chua & Kog 1999) took a group of critical success factors and ranked them for three project criteria namely; quality, schedule and cost. The factors hold different ranks for each criterion.

Table 14: Ranking success factors' importance for given success criteria taken from (Chua & Kog 1999)

Budget Performance	Schedule Performance
1. PM competency	1. PM competency
2. Budget updates	2. PM commitment and involvement
3. PM commitment and involvement	3. Schedule updates
4. Design complete at construction start	4. Construction control meetings
5. Formal communication during design	5. Capability of contractor key personnel
6. PM authority	6. Site inspections
7. Constructability program	7. Formal communication during construction
8. Formal communication during construction	8. Constructability program
9. Construction control meetings	9. PM authority
10. Design control meetings	10. Competency of contractor proposed team

However, given the wide variety of success factors and criteria the approach of merely ranking the factors' importance may not be sufficient to help in achieving success. There are few articles in the literature actually addressing the issue of matching the right factors to the given criteria to tell the practitioners how to achieve the perceived success through the application of factors.

In an attempt to relate success factors to criteria or success dimensions (Belassi & Tukel 1996) distributed, as in Figure 7, a group of success factors to several dimensions and denoted the relationship between them to represent the final outcome of the project as a success or failure.

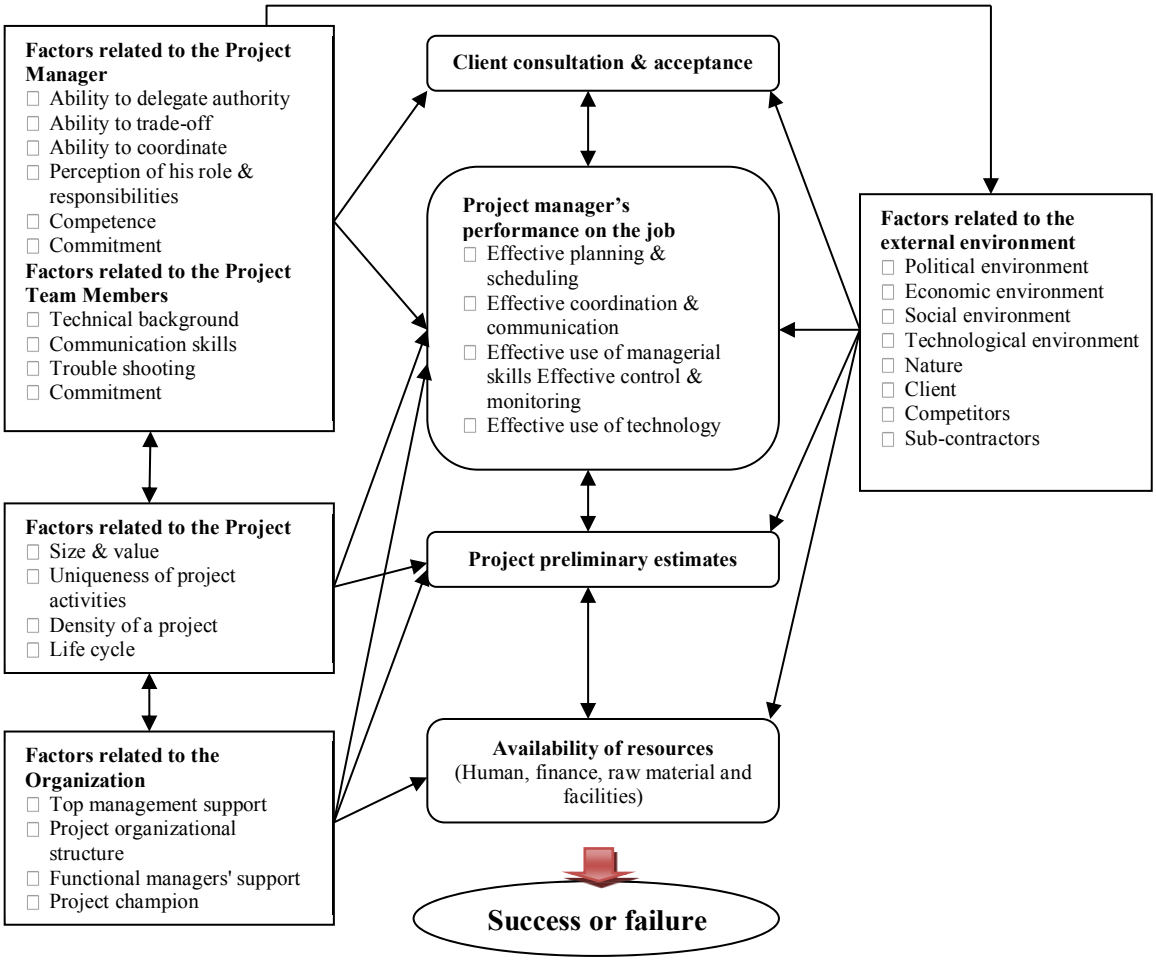

Figure 7: Linking success factors to success dimensions by (Belassi & Tukel 1996)

This attempt by Belassi and Tukel tells in a shallow depth what factor works for which dimension. However more depth is still required.

This depth came in the form of the project excellence model (Westerveld 2003). Westerveld, as shown in Figure 8, named the success criteria as result area and the success factors as organization area and came up with a flexible model that explains to good extent the relationship between project success criteria and project success factors.

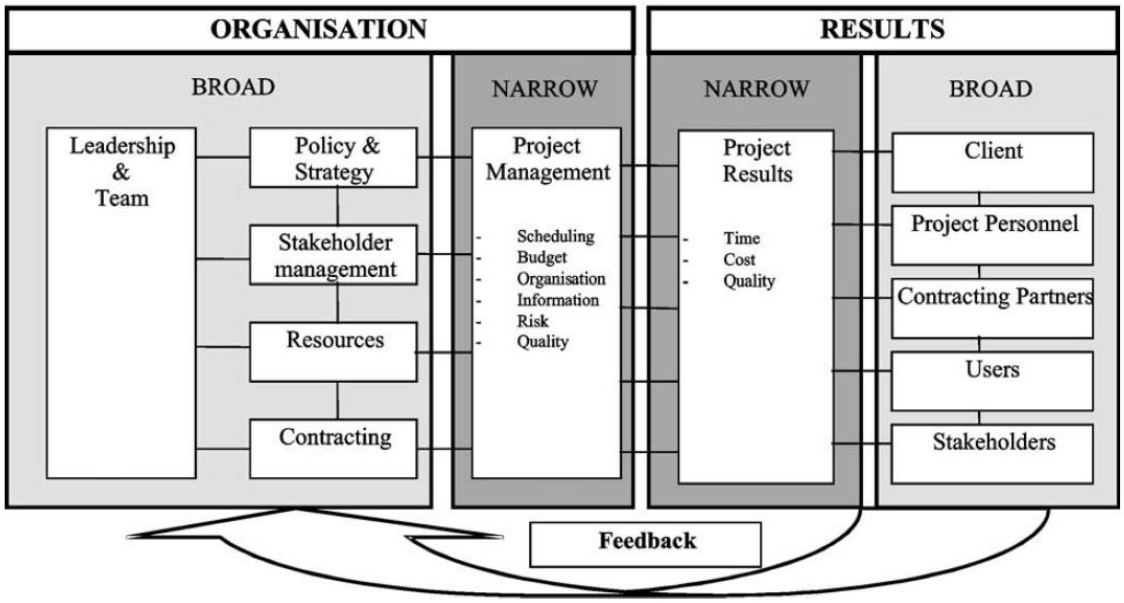

Figure 8: The project Excellence Model (Westerveld 2003)

Project life cycle is a step further in the relationship between criteria and factors introduced by (Do Ba & Tun Lin 2008). Based on the study of international development projects they narrowed the criteria to project life cycle phases and accordingly they associated the factors to such criteria. Their findings are summarized in Table 15.

Table 15: Success criteria and factors for international development projects life cycle (Do Ba & Tun Lin 2008)

Life Cycle phase	Success Criteria	Critical Success Factors
Conceptualizing	• Addressing relevant needs of the right target group of beneficiaries • Identifying the right implementing agency capable and willing to deliver • Matching policy priorities and raising the interests of key stakeholders	• Clear understanding of project environment by funding and implementing agencies and consultants • Competencies of project designers • Effective consultations with primary stakeholders
Planning	• Approval of, and commitment to, the project by the key parties • Sufficient resources committed and ready to be disbursed • Core organizational capacity established for PM	• Compatibility of development priorities of the key stakeholders • Adequate resources and competencies available to support the project plan • project planners Competencies • Effective consultation with key stakeholders
Implementing	• Resources mobilized and used as planned • Activities carried out as scheduled • Outputs produced meet the planned specifications and quality • Good accountability of resources utilization • Key stakeholders informed of and satisfied with project progress	• Compatible rules and procedures for PM • Continuing supports of stakeholders • Commitment to project goals and objectives • Competencies of project management team • Effective consultation with all stakeholders

Table 15: (part 2) Success criteria and factors for international development projects life cycle (Do Ba & Tun Lin 2008)

Life Cycle Phases	Success Criteria	Critical Success Factors
Closing/ Completing	• Project assets transferred, financial settlements completed and team dissolved to the satisfaction of key stakeholders. • Project end outputs are accepted and used by target beneficiaries. • Project completion report accepted by the key stakeholders	• Adequate provisions for project closing in the project plan • Competencies of project manager • Effective consultation with key stakeholders
Overall Project Success	• Project has a visible impact on the beneficiaries. • Project has built institutional capacity within the country. • Project has good reputation. • Project has good chance of being extended as result of success. • Project's outcomes are likely to be sustained.	• Donors and recipient government have clear policies to sustain project's activities and results. • Adequate local capacities are available. • There is strong local ownership of the project

This attempt added life cycle to the factor-criteria relationship and it contained both types of success factors and criteria namely; common and project-specific. It presented some criteria that are suitable for international development projects. For example the criterion "Project has built institutional capacity within the country" is relevant to an international development project but it has nothing to do with a commercial software project. On the other hand the criterion "Activities carried out as scheduled" is common to almost all projects. This endorses the basic characteristics of project success research; that is nothing is totally universal.

All in all, there can be room for developing models and frameworks that can deal with the common criteria and factors as well as the project-specific ones.

2.6 Project strategy

2.6.1 Brief history of the strategy concept

The linguistic meaning of strategy is "a plan of action designed to achieve an overall aim" (Oxford Dictionaries 2014). However, in professional fields such as project management the concept of strategy may not be as clear as the linguistic definition.

There is no exact point in the history to be described as the explicit starting point of the concept of the strategy (Bracker 1980). Apparently this concept is as old as the early writing about war. Military philosophers were the first to explicitly introduce this concept in some of the famous books such as "the art of war" by Sun Tzu first written in 400 BC, "The military institutions of the Romans" by Vegetius first written around 380 AD, and "on war" written by Clausewitz in the early18 th century. For the military philosopher the strategy concept was clear; that is how to win the war (Patanakul & Shenhar 2012).

Then it took years for the concept of strategy to expand to new fields such as business and management. Early explicit references to this concept in the business and management literature dated back to the end of the 1940s (Bracker 1980). One of the early definitions of this concept in the business and management field of study is "a plan which specifies what choices he will make in every possible situation for every possible actual information which he may possess at that moment in conformity with the pattern of information which the rules of the game provide for him for that case" (Von Neumann & Morgenstern 1953). Since then the concept has been refined and elaborated. Contemporary authors made several attempts to capture the definition of strategy. Hofer and Schendel reviewed a great deal of previous work and they defined strategy as "the fundamental pattern of present and planned resource deployment and environment interactions that indicate how the organization will achieve its objectives" (Hofer & Schendel 1978). Mintzberg, who is one of the leading authors in strategy literature, views the strategy as a concept of 5 Ps namely: Plan, Ploy, Pattern, Position and Perspective (Mintzberg 1987). Based on more than 25

years of experiences in the consultation and management Daniell views the best definition of strategy as "the art and science of informed action to achieve a specific vision, an overarching objective or a higher purpose for business enterprise" (Daniell 2004)

However, based on the previous samples of strategy definitions it can be said that the concept of strategy is still ambiguous (Bakir & Todorovic 2010; Noy & Luski 2012). For the sake of clarity, one definition of strategy will be chosen for this research to avoid the ambiguity problem.

2.6.2 The definition of Project strategy concept

Through the history of this concept, strategy has been classified according to several dimensions. One of such dimensions is the field of practice. Authors customize the concept of strategy to the field of practice such as manufacturing strategy (Cheng & Musaphir 1996), marketing strategy (El-Ansary 2006) and project management strategy (Poli & Shenhar 2003; Artto, Martinsuo*, et al.* 2008; Patanakul & Shenhar 2012).

In the project management arena the term "project strategy" is relatively new (Patanakul *et al.* 2012). There are several definitions for the project strategy in the project management literature. It is defined as "a direction in a project that contributes to success of the project in its environment" (Artto, Kujala*, et al.* 2008). Also it is defined as "the project perspective, position, and guidelines for what to do and how to do it, to achieve the highest competitive advantage and the best value from the project" (Patanakul & Shenhar 2012; Poli & Shenhar 2003). This definition is based to some extent on the Mintzberg's 5Ps strategy concept (Mintzberg 1987). There are several attempts to define the project strategy such as in Poli (2006) Zhiye *et al.* (2009) and Yang (2012). Those definitions are similar to some extent with more elaboration in the definitions provided by Poli & Shenhar 2003 and Patanakul & Shenhar 2012 which captures wider aspects of the project strategy concepts so that it will be the base definition of strategy in this research.

2.6.3 The component of the project strategy

The definition of project strategy as "The project perspective, position, and guidelines for what to do and how to do it, to achieve the highest competitive advantage and the best value from the project" includes several components summarized in Table 16 below.

Table 16 : Project strategy component (Patanakul *et al.* 2012)

Project strategy component	Description
Perspective	
Business background	The business motivation for implementing this project or producing project products
Business objective	The ultimate business goals of the project
Strategic concept	The general strategic idea behind the project's expected business and how this idea is aligned with the company's business strategy
Position	
Product definition	The description of project products, including their specifications
Competitive advantage	The reasons why the project products are better than other products and the value the products create
Success and failure criteria	The perspective and expectations that the organization has for the product/project
Plan	
Project definition	The project boundaries, scope of work, project deliverables, and project type
Strategic focus	The mindset and guidelines for behaviour to achieve the product's competitive advantage and value

As per definition, project strategy contains a perspective for the project team or a proper vision that lead to understanding the true value and impact of the project. This includes reasoning and justification. This perspective answers questions such as why this project is commenced, what is the significance of the product or the service resulting from this project. Proper perspective may lead to better focus of the team effort.

Also the project strategy contains a position of the project in the bigger picture. This is more focused and detailed than the perspective. The position can include product definition, competitive advantage/value, and success/failure criteria. Having the position as a part of the project strategy may encourages the team to define the project or realizing the competitive advantage or setting the success criteria in response to the business perspective. This may increase the alignment of the team effort with the business objectives.

Also project strategy contains guidelines for the effort and behaviour of the team to achieve the required results. Such guidelines can include what to do and what not to do.

These components can be used in the formation of a complete project strategy. Also the strategy implies a high level concept and allows for a series of complementary and coherent sub-strategies (Anderson & Merna 2003). Some individual components of the strategy concept can be used to formulate a strategy for individual aspects of the project such as project procurement strategy, project staffing strategy and project communication strategy.

The literature of project management contains very little about the project strategy component that can be explicitly used to evaluate and judge any given strategy. This limitation about project strategy causes this research to adopt the components which were presented in Table 16.

2.6.4 Examples of project strategy

Strategy is a concept that received a lot of attention in many fields and it is gaining the momentum in project management literature. The examples in Table 17 part 1, 2 and 3 show some project strategies and their explanation based on the definition of project strategy.

Table 17: Project strategy examples (Patanakul *et al.* 2012)

Project strategy component	Project strategy		
	product superiority	**product time-to-market**	**customer intimacy**
Perspective			
Business perspective	An opportunity to become a market leader in a certain market niche with superior products	An opportunity to gain revenue in an allotted time	A potential to gain customer satisfaction, leading to future business opportunity
Business objective	To generate revenue from premium-quality products	To gain revenue by introducing a new product to the market, within the window of opportunity or being first on the market	To establish strong relationships with existing customers or customers with significant buying power
Strategic concept	Formulate ideas around the product quality that contributes to business success	Formulate ideas with the emphasis on development schedule that leads to business success	Formulate ideas with the emphasis on customer satisfaction that can contribute to business success

Table 17 (part 2) : Project strategy examples (Patanakul *et al.* 2012)

Project strategy component	Project strategy		
	product superiority	**product time-to-market**	**customer intimacy**
Position			
Product definition	Contingent to each project but generally, defined characteristics of a superior quality product that addresses or goes beyond customers' needs	Contingent to each project but generally defined characteristics of a product that meets the desired specifications with the time constraint	Contingent to each project but generally defined characteristics of products that satisfy customers
Competitive advantage/ value	High-quality product for which customers are willing to pay premium or competitive price	Product delivery time is consistent with the time of need, and product characteristics meet customers' expectations	Products that meet customer requirements established relationship for future opportunity customer satisfaction
Success and failure criteria	Product: premium product quality time and cost are monitored revenue gained after product launched	Delay is unacceptable; cost overrun is tolerable product characteristics are met revenue gained after product launched	Future opportunity: accessibility to future business

Table 17 (part 3) : Project strategy examples (Patanakul *et al.* 2012)

Project strategy component	Project strategy		
	product superiority	**product time-to-market**	**customer intimacy**
Plan (guidelines)			
Project definition	Contingent to each project but product quality is emphasized focus on R&D to ensure the desired characteristics of products	Contingent to each project but project schedule is emphasized strictly monitor project schedule	Contingent to each project but emphasize the customer's needs involve customers in product development
Strategic focus	Monitor project schedule, project cost can be compromised	Find balance of tradeoffs between schedule and product features or schedule and cost	Concentrate on product quality to satisfy customers establish strong relationship with customers for future business

2.6.5 The strategy-factor relationship for project success

The previous Section 2.5.1 mentioned the definition of project success factors as " the elements of a project which, when influenced, increase the likelihood of success; these are the independent variables that make success more likely" (Müller & Jugdev 2012). However, describing the success factors as independent variables can be true in the case of the unit of study being an isolated project but in reality the project is not an island (Engwall 2003). A project is necessarily linked to several elements such as its environment or its stakeholders or its parent organization (Besner & Hobbs 2008). On this basis there might

be “something” that influences success factors. For example availability of resources is an essential success factor mentioned in many studies. This factor is influenced by other elements at a higher level. For example the control of raw materials in United Kingdom during WW2 significantly affected the availability of resources to many projects (Backman & Fishman 1941a). This example shows how a contextual or environmental element affects an essential project success factor.

The project strategy definition in this research is “the project perspective, position, and guidelines for what to do and how to do it, to achieve the highest competitive advantage and the best value from the project” (Poli & Shenhar 2003; Patanakul & Shenhar 2012). Based on this definition it can be suggested that the mission of a project strategy is to guide the project in its environment. The strategy should be well-formulated at the beginning of the project as it holds significant importance in the success of or failure of a project (Anderson & Merna 2003). The strategy can be the high level element that affects the project success factor. The formulation of the strategy should take into account the possibility of change during the project implementation.

Many success factors are generic, thus great importance lies in the search for strategies that will enhance success factors in any given situation or context. However, there is very little in literature to link the strategy to project success factors explicitly. Alternatively reviewing the literature helps to draw such links. For example it is stated by (Pinto & Slevin 1987) that “Ability to deal with unexpected problems” is a success factor and in other research the researcher concluded that the adoption of parallel work strategy helped the Manhattan project to deal with unknown problems (Lenfle 2011). In this way the positive impact of the strategy is clear upon the success factor. However, this way of relating success factors and strategy does not appear much in the literature.

On the basis of the definitions of both terms the project strategy and the project success factors it can be proposed that the strategy is the driver to enhance or diminish a particular factor or factors. This proposition will be discussed later in this thesis, particularly in Chapter six.

2.7 Impact of project context or environment

Any project is executed within certain settings with definable characteristics. These settings can collectively be called environment or context. In the project management literature authors use both terms to describe these settings. To comply with the literature this research will use both terms context and environment interchangeably to describe the project settings.

The term "context" means "the circumstances that form the setting for an event" while the term "environment" means "the setting or conditions in which a particular activity is carried on" (Oxford Dictionaries 2014). It is appears from the language perspective that both terms are synonyms.

The context of a project and the circumstances surrounding it are key factors that influence the outcome of the project and projects should be understood within their context (Balachandra & Friar 1997; Engwall 2003; Maaninen-Olsson & Müllern 2009; Besner & Hobbs 2013). Studying projects out of their contexts may lead to incorrect or incomplete conclusion. Also, despite the generic commonalities between some high level concepts of project management, the practice of project management is governed by the details of the context in which the project is executed (Besner & Hobbs 2008).

Many dimensions constitute the project context and their number depends on the chosen boundary of the study. The culture of a nation, the type of the industry, the geographical location and the political situation are examples of contextual dimensions that can affect a project.

In a comparative study between western project management culture and its Chinese counterpart (Wang & Liu 2007) empirically found that there are some cultural barriers which prevent the western style of project management from being adopted in Chinese enterprises. The result of that study is summarized in Table 18: Traditional Chinese values and beliefs that prevent the adoption of western project management below. This table demonstrates how the culture as a contextual dimension can affect the practice of project management.

Table 18: Traditional Chinese values and beliefs that prevent the adoption of western project management (Wang & Liu 2007)

Western project management values and beliefs	Traditional Chinese values and beliefs that prevent the adoption of western project management values and beliefs
Horizontal management: • Small power distance • Cross-functional communication and cooperation • Influencing and coordinating ability important	**Strong hierarchy:** • Large power distance • Superior-subordinator vertical work relationships • Line authority and control important
Team Consciousness: • Short-term orientation of relationships • Work contributions oriented evaluation of people • Project team of high diversity • Everyone plays important roles	**Family Consciousness:** • Long-term orientation of relationships • Guanxi-oriented evaluation of people • Family members are homogeneous • Only elite play important roles
Task orientation • Completing the task • Viewing people by their work performance	**Boss orientation** • Making the boss happy • Viewing people by their hierarchical position

Regarding the industry type as a contextual dimension, the literature contains many articles which address the project management with prime focus on industry type. The construction industry is the main focus of many articles for example (Chan *et al.* 2004; Taylor & Ford 2008; Yong & Mustaffa 2012). Also the literature addresses several other industries such as defence (Dvir *et al.* 2006), information technology (Agarwal & Rathod 2006; Patanakul *et al.* 2012), aid and relief (Steinfort 2010) and even the library industry

(Massis 2010). The difference in industry type can change the priorities in the practice of project management. For example in information technology projects people with disability can perform well because the nature of the tasks in such projects does not require high physical ability. In contrast, the tasks in the construction industry projects usually require a lot of movement and good physical ability. Also the difference in the industry type can lead to critical success factor lists that are significantly different from each other (Müller & Jugdev 2012). Table 18 below shows success factors resulted from studying projects from different industries.

Table 19: Comparison between success factors from different industries

Authors	**(Dvir *et al.* 2006)**	**(Yu & Kwon 2011)**	**(Jo & Barry 2008)**
Industry	**Defence industry**	**Construction**	**Multi-disciplinary public sector**
Critical success factors	• Essential and urgent operational need • Cohesion of the development team • Quality of the escorting team • Involvement of the developing organization in the project definition • Existence of learning mechanisms in the development team • Budget and technical control • Definition of operational and technical requirements • Managerial qualifications of the project manger	• Minimization of conflict between stakeholders • Optimization of legal and administrative services • Standardization of decision making process • Good communication and information sharing • Reasonability of project master and implementation plans • Suitability of project management system • Establishment of appropriate organizational structure • Cooperativeness of stakeholders on project • Performance management at each phase • Balanced adjustment between the public and the private interests	• Projects are designed in accordance with government objectives • A trained and experienced project manager • Stakeholder involvement • Full-time project managers • The availability of technical expertise • Political support • Enough funding to complete projects • Timely payment to the client • A regular progress meeting on projects • Detailed planning of projects • Holding of close-out meetings at the end of projects

These factors in the table are not different solely due to the industry type difference; rather it is a demonstration of the wide possibility of differences that can result from different contextual dimensions. However, as the contextual dimensions between different projects get closer to each other (say; same industry) the similarity between success factors increases. Table 20 below demonstrates some similarities between selected factors from some studies.

Table 20: Similarity between project success factors in similar industry highlighted in colour

The author	**(Iyer & Jha 2006)**	**(Yong & Mustaffa 2012)**	**(Nguyen *et al.* 2004)**
The country	**India**	**Malaysia**	**Vietnam**
Critical success factors	Project manager's competence; Commitment of all project participants Good coordination among project participants Availability of trained resources Monitoring and feedback Interaction between project participants	Team leader competency Commitment to the project Cooperation in solving problems Skilful workers monitor the project progress Communication among project stakeholders	Competent project manager Commitment to project Timely, valuable information from different parties Multidisciplinary competent project team Frequent progress meeting Continuing the involvement of stakeholders in the project

As in Table 20 one study on the construction industry identified ten success factors five of which are common to another two studies whereas in Table 19 there is no explicit common factor between the three different studies.

It can be concluded that the context of a project as defined earlier has an important impact and the context should be considered when studying project success.

2.8 National crises as context for project

"Crisis" is a generic term meaning "a time of intense difficulty or danger"(Oxford Dictionaries 2014). Another definition is "a situation that has reached an extremely difficult or dangerous point; a time of great disagreement, uncertainty or suffering" (Cambridge Dictionaries 2014). This term can have specific meaning depending on the context with which it is associated. Thus, national crisis can initially be defined as a situation or time at which a country or a nation faces intense difficulty, uncertainty, danger or serious threat to people and the economy. This definition will be formalized in Chapter five. There are many examples of national crises, such as wars, the aftermath of huge natural disasters and economic crises.

Projects can have different contexts depending on the required definition of the context. For example, the industry type can be described as a project context. The geographical location also can be described as a project context. Among the different possible project contexts, the context of a national crisis has very high impact. During such a crisis, a large portion of the nation (if not all) is engulfed in difficult circumstances. The occurrence of a national crisis, such as war, or the aftermath of a huge natural disaster, is associated with sudden changes and the emergence of new realities. Figure 9 demonstrates the impact of the national crisis upon project success based on links from various sources in the literature of related topics. For example, war introduces institutional changes and restructures society into a new order (Modell & Haggerty 1991). World War 1 (WW1) and WW2 are crises that enabled women to undertake jobs such as aircraft manufacturing which were not easily open to women prior to these crises (Bloomfield & Bloomfield 1997; Littlea & Griecob 2011). The reflection of such change is that the issue of gender in project management practices arises particularly in conservative societies given that the field of project

management is male-dominated (Cartwright & Gale 1995; Henderson & Stackman 2010). Also this has an impact on the availability of skilful workers which is a critical success factor in projects (Yong & Mustaffa 2012).The government control of raw material is also an example of an institutional change that affects projects (Backman & Fishman 1941b) as this will affect the availability of resources -either negatively or positively- which is a critical success factor in projects (Nguyen *et al.* 2004) . Another example of the impact of war as a contextual dimension of projects is that an employee's commitment to their organization is negatively affected by the event of war (Messarra & Karkoulian 2008) and the literature of project success tells that commitment is a critical success factor in projects (Iyer & Jha 2006). Many studies emphasized the importance of cooperation between project stakeholders or team members for project success (Guiney 2009; Yu & Kwon 2011). Cooperation is a very good example of prosocial behaviour which is affected by the event of a national crisis. It is reported that a national crisis and the stress accompanying it induce the prosocial behaviour and draws people closer to each other (Rodríguez *et al.* 2006; von Dawans *et al.* 2012).

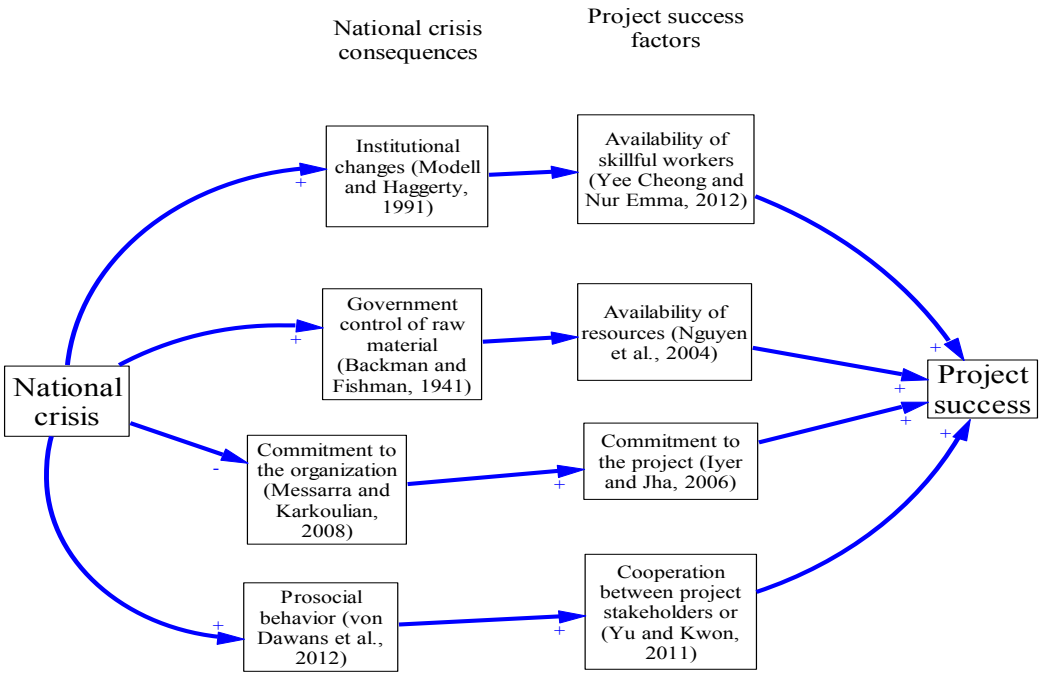

Figure 9: Demonstration of the impact of national crisis on the project success

Higher risk and safety issues, a greater need for change, and a shorter time for decision-making are among the obvious characteristics of a national crisis context such as war (Shaluf *et al.* 2001; Riley 2006; Karlin 2007). All projects will face the reality of the national crisis irrespective of whether the project is a response to a crisis or happened to be in the process of being executed during the crisis period.

However, there is very little distinction between peacetime and a time of crisis as a context for project management in the literature of project management particularly project success research. This reflects the assumption that the results of those studies will be applicable to both contexts. However, the two contexts are not similar and this dissimilarity may impact that underlying assumption.

Reviewing the situations worldwide shows that national crises are more prevalent in the 21st century than in earlier centuries as mentioned in Section 1.1. In such a context, project stakeholders may need to adopt and practice certain strategies to increase the likelihood of successful project delivery. However, the abnormality of the crisis context raises doubt as to whether or not peacetime project management practices and strategies are suitable for delivering successful projects in such circumstances. Based on this point of view it can be suggested that studying project success during national crises is an important research activity.

2.9 Crisis management in the project management field

The notion of crisis management in the project management field is not frequently encountered. For example an electronic search (as of October 2013) in the database of the International Journal of Project Management returned 36 articles containing the term "crisis management". Perhaps this is due to the newness of the introduction of the term "crisis management" in the project management field. In the late1990s the research in crisis management within the project management field was described as being in its infancy (Loosemore 1998b). A decade later it remains a poorly addressed topic within project management research (Chartier *et al.* 2010; Geraldi *et al.* 2010) with few references addressing it (Crawford *et al.* 2013). However, some insights can be found there.

The literature on crisis management in project management can be classified into two directions; one is searching for the sources and nature of crises while the other looks to find the right strategies and techniques to deal with such crises to increase the likelihood of success. Some articles contain findings of one direction and others contain both types of findings.

Following first direction, Loosemore (1998) identified three ironies in crisis management in construction projects. These ironies are: at a time when effective communication is important it is less likely; at a time when mutual sensitivity between project members is important it is less likely; at a time when collective responsibility and teamwork are important they are less likely (Loosemore 1998b). He stressed that crises create opportunities for increased cohesion, harmony and efficiency within project teams. Another study surveyed 120 construction companies and came up with 28 factors contributing to a project crisis some of which are inadequate government policies of human resources, and sabotages (Öcal *et al.* 2006). Based on a comparison between routine and post-disaster projects, Le Masurier *et al*. (2006) pointed out that the legislation for routine projects is not sufficient to cope with the needs of projects during crises such as post disaster recovery projects. They call for revised legislation for such types of project (Le Masurier *et al.* 2006). The recent global crises in the 2000s such as the global financial crisis 2008-09, led to a new view of crisis management in project management, which is project management during times of crises (Hrůzová 2011). This view is concerned with the impact of the external circumstances that affect the broader portion of a nation rather than the limited sector of industry. A typology to classify unexpected events in projects was offered by (Piperca & Serghei 2012). Because crises by definition are results of unexpected events, this typology works as a classification of the origins of crises in projects. This typology is a result of the intersection of two dimensions; event predictability and locus of generation with three types under each dimension. Table 21 represents this typology.

Table 21: Crisis origin classification typology (Piperca & Serghei 2012)

event predictability	locus of generation		
	Internal environment	**Immediate external environment**	**General external environment**
More intense than predicted	Overrun	Setback	Swing
Predictable but unpredicted	Oversight	Knock on door	Revelation
Unpredictable	Showstopper	Mystery visitor	Shocker

The other direction in the literature reports tactics, recommendations and strategies to increase the likelihood of success. Mallak *et al*. (1997) suggested some useful tools in preparing for crises. These tools are risk analysis, contingency plans, logic charts and table top exercises. Also they offered some recommendations to successfully manage the crisis. They encourage; establishing a crisis team before the crisis occurs, choosing a project manager indigenous to the place where the project is conducted and to be mindful of the social and political consequences of the crisis (Mallak *et al.* 1997). Loosemore (1998) suggested some practices to resolve the three ironies he discovered; for example, paying particular attention to the financial aspects of a crisis and balancing control with flexibility in managerial strategies (Loosemore 1998b). Engwall and Svensson (2004) proposed the concept of cheetah teams for responding to the crisis (Engwall & Svensson 2004). These teams are distinguished from other types of teams by being at the same time explicitly sanctioned, mission-specific, intended to dissolve when the mission is accomplished, staffed with full-time members and not planned in advance. Hällgren and Wilson (2008) offered 15 remedies to projects in crises based on project-as-practiced observation (Hällgren & Wilson 2008). Their remedies include site teams to undertake overtime works and re-planning. Geraldi *et al*. (2010) proposed that successful crisis management is based

on three pillars. These pillars are; responsive and functioning structure at the organizational level, good interpersonal relationships at the group level and competent people at the individual level (Geraldi *et al.* 2010). Practical application of these pillars can increase the likelihood of success. Post disaster recovery projects are typical examples of projects in crisis times. The analysis of successful PM in crises times from three countries, China , Indonesia and Australia, showed that the two common factors for successful project resourcing in times of crises are competence of the project team and government response and intervention (Chang *et al.* 2012). Baroudi and Rapp (2013) suggest that to successfully manage recovery projects, organizations should be able to staff their projects with capable competent teams and to consider the many stakeholders involved. Also they suggested particularly for the project manager that he or she should be able to build strong stakeholder relationships as well as having good social awareness (Baroudi & Rapp 2013).

All in all, the literature is characterized by having relatively few references that are scattered in several journals some of which are not specialized in project management. Some authors offered insights into the concepts while others provided practical steps.

Since the concept of crisis management is new in the project management field, it may not contain answers to the issue of project management during national crises. The crisis management literature lacks specific frameworks to deal with crises such as national crises and this can be a good area for recent research to contribute. Deriving lessons from practice may lead to building a body of knowledge from which to choose in dealing with projects during national crises.

2.10 Summary

This chapter has set out to cover the themes that are relevant to the topic of this research as stated in the introduction section of this chapter. As this study is about projects and project management it was concluded that the concepts of project and project management are well established and the research can proceed on that basis. Also the topic is about success so that this chapter reviewed the literature on project success and summarized the issues that this research will tackle. For example, the required strategy concept is established so the result of this research will be based on such structure. Another issue is creating a success

framework to be used in this study and for broad application. Also the topic of this research is addressing the success within the context of national crises so that this chapter reviewed the literature regarding the project context and the crises worldwide and highlighted the importance of this research. Finally the chapter reviewed the crisis management literature in the project management field for possible hints regarding the topic of the research.

This literature review reinforces the justification of the research mentioned in Section 1.2 since it shows the importance of projects and the need for success in delivering these projects. Also the review of the context and particularly the context of national crises reveals the importance of addressing success in such context. By the provision of several historical and contemporary examples, this chapter clarifies the importance of the research topic.

All in all, the required basis for this research has been established and the way ahead for detailed and focused work is ready.

3 Research design and methodology

3.1 Introduction and objective

This chapter will discuss the structure and the design of this study. It starts by explaining the framework that guides this research. The justification of the choice of this framework will be presented. The entire components of the framework will be explained highlighting the links and application to this study. In addition to the components of the framework, this chapter will discuss the research sequence and the trustworthiness approach of this research. The chapter finishes with a brief summary.

3.2 The research framework

The framework that guides this research is based on "the research onion" (Saunders *et al.* 2009). This framework consists of several layers namely; the research philosophy, approach, strategy, choice, time horizon and techniques and procedures. Each layer deals with particular aspect of the research. Figure 10 shows "the research onion" framework.

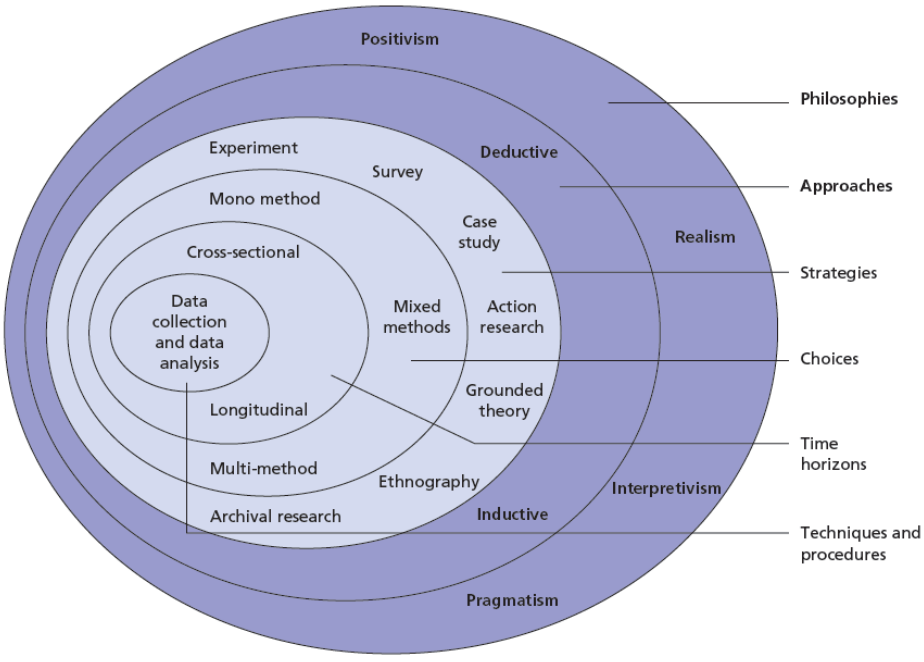

Figure 10: "The research onion" framework (Saunders *et al.* 2009) p108

This framework was chosen because of its powerful multi-disciplinary application. This makes it suitable for this research as a multi-disciplinary research in project management. In fact this framework was used successfully in several previous studies at masters and PhD levels and in several disciplines. For example, (Arlt 2010) used it in a PhD research in project management, (Noor 2011) used it in a PhD research in project management at the school of property construction and project management, (Vuckic 2012) used it in a master level research about project management at the department of civil and environmental engineering and (Chaves 2012) used it at master level in project management research at the department of industrial engineering and management. It proved effective in guiding the research effort and providing the baseline for answering philosophical questions. In the following sections each layer of this framework will be discussed in relation to this research.

3.3 Research philosophy

Research philosophy can be defined as an overarching term relating to the development of knowledge and the nature of that knowledge in relation to research. It contains important assumptions about the way in which a researcher views the world. It underpins the research strategy, the method, the data collection, the analysis and the presentation of results (Saunders *et al.* 2009) p107.

There are many research philosophies possible to adopt, for example positivism and realism. However, not all of them are equally applicable to all fields of study. For project management as a multidisciplinary field of study-particularly a multidisciplinary field between engineering and management in the case of this research- probably four research philosophies are more relevant than the others. These four philosophies are positivism, interpretivism, realism and pragmatism. Positivism is the dominant philosophy in the project management research (Smyth & Morris 2007; Bredillet 2010). Perhaps the reason for this is that the project management discipline is derived from the operation research which is largely purely numerical. A comparison between the four philosophies is presented in Table 22.

Table 22: A comparison between relevant research philosophies in project management research (Saunders *et al.* 2009) p-119

	Positivism	**Realism**	**Interpretivism**	**Pragmatism**
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Small samples, in-depth investigations, qualitative	Mixed or multiple method designs, quantitative and qualitative
Epistemology: the researcher's view regarding what constitutes acceptable Knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law like generalizations, reducing phenomena to simplest elements	Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent on the research question. Focus on practical applied research, integrating different perspectives to help data interpretation

Table 22 (part 2): A comparison between relevant research philosophies in project management research (Saunders *et al.* 2009) p-119

	Positivism	**Realism**	**Interpretivism**	**Pragmatism**
Axiology: the researcher's view of the role of values in research	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view
Ontology: the researcher's view of the nature of reality or being	External; Objective and independent of social actors	Is objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning (critical realist)	Socially constructed Subjective; May change; Multiple	External; Multiple; View chosen to best enable answering of research question

3.3.1 Pragmatism as an appropriate philosophy for this research

To simplify the meaning of pragmatism it can said that pragmatism is centred around the idea of "it is true if it works" (Bawden 1904). A century later, authors still support this meaning of pragmatism as " doing what works" (Nissen & Snider 2002). In more academic way pragmatism - as a research philosophy - can be defined as a research philosophy which argues that the true and correct ideas are those which practically proved successful. This definition is a compilation from the characteristics of the pragmatism philosophy described in several works such as Bawden (1904), Nissen & Snider (2002), Ormerod (2006), Ulrich (2007) and Saunders *et al.* (2009). As outlined in Table 22, this philosophy advocates for building conceptual foundations based on real life practices. Also it advocates that there could be more than one correct answer. It allows mixing research methods, approaches, strategies…etc. to better answer the research questions for better applicability. It might be criticized as a sloppy way of thinking, a failure to adhere to theory or lacking principles (Ormerod 2006). However, in answering such critiques it can be said that this philosophy was dominant during the period of economic, political and knowledge growth – since the second half of the 19th century – after which the USA emerged as a world super power (Ormerod 2006). If this philosophy was ineffective it would not have allowed that growth and rise to take place. Also real life does not consist of a single reality; rather, there are multiple realities, so there is a need for a philosophy that can accommodate multiple views, and that is pragmatism.

In this research, pragmatism is seen as an appropriate philosophy for several reasons. First, the practical nature of the project management discipline may require a conceptual foundation that has greater linkage to real life practice. In this regards the management expert Peter Drucker said "What constitutes knowledge in practice is largely defined by the ends, that is, by the practice" (Drucker 1985). This idea is the fundamental theoretical base of knowledge creation in this research. Also, the theory of project management is contained within its practice (Nissen & Snider 2002). This lies at the core of pragmatism as simplified earlier "it is true if it works". This research is based on extracting lessons and formulating theoretical foundation based on real life cases.

Second, the data of this research exists in various forms and is dispersed in several sources. As a result, a mixture of data collection tools and means is required and this is what pragmatism advocates. Moreover, in reality, project management consists of qualitative and quantitative aspects. In order to achieve a realistic conclusion out of a research the researcher probably needs to address both qualitative and quantitative data and pragmatism allows for this mix.

Third, one of the basic principles of pragmatism is that a fact can have more than one correct interpretation. For example, the statement "the project manager smiles to his team members every day" is a plain fact that can have more than one correct interpretation. It can be interpreted as "he smiles to motivate his team members" or "he smiles because he believes that smile is a good personal character" or "he smiles to them because they are producing great results". One interpretation can be the right one or more than one can be also right at the same time. Given that the fact can have more than one correct interpretation, either or both objective observation alongside subjective meaning can constitute acceptable knowledge and this is one of the features of pragmatism. In this research, both objective observation and subjective reasoning are needed to construct the conclusions out of the data.

All in all, pragmatism is seen as a suitable philosophy to constitute the philosophical foundation of this research.

3.4 Research approach

The research approach in the framework of this study can be defined as the direction of movement between research and theory. As proposed by Saunders *et al*. (2009), there are two research approaches namely; deductive and inductive. In the deductive research approach the researcher develops a theory or a hypothesis or a proposition then designs a research to test the hypothesis or evaluate the proposition. So in this approach the movement is from theory to research. On the other hand, the inductive research approach means that the researcher conducts the research – including data collection and analysis - then develops a theory or a hypothesis or a proposition as a result of the research. In this

approach the movement is from research to theory. The major differences between the two approaches are summarized in Table 23.

Table 23: Major differences between deductive and inductive approaches to research (Saunders *et al.* 2009) p127

Deductive research approach	Inductive research approach
• scientific principles • moving from theory to research • the need to explain causal relationships between variables • the collection of quantitative data • the application of controls to ensure validity of data • the operationalization of concepts to ensure clarity of definition • a highly structured approach • researcher independence of what is being researched • the necessity to select samples of sufficient size in order to generalize conclusions	• gaining an understanding of the meanings humans attach to events • a close understanding of the research context • the collection of qualitative data • a more flexible structure to permit changes of research emphasis as the research progresses • a realisation that the researcher is part of the research process • less concern with the need to generalize

Saying that there are two approaches does not mean they cannot be mixed in a certain research; indeed it is often advantageous to do so (Saunders *et al.* 2009) p127. In this study the two approached are combined. One of the important features of combining the two approaches is that it allows for gaining understanding of the overall situation of the projects under scrutiny as well as finding causal relationship between the project success and the elements that caused that success. Also it allows the researcher to benefit from both qualitative and quantitative data. Moreover, combining the two approaches allows the flexibility needed for the exploratory part of the research and the more structured approach for the explanatory part. This study has an exploratory beginning about the possible

outcome of the research so that it needs a flexible approach at the beginning. Then when the outcome become clearer a more structured approach will be suitable. Based on that, an inductive–deductive combined approach was applied in this study. This combination has been used successfully in the project management research such as in Biedenbach & Müller (2012).

The inductive approach at the beginning of this research is based on an observation that there are several projects which achieved great successes when the context surrounding them is so difficult; literally that context is a national crisis. For instance, WW2 is a perfect example of a national crisis. It is one of the most difficult times in the history of mankind yet many achievements happened then such as the successful projects completed by the British aviation industries during WW2. Many of the advancements of today have their roots in that era such as radar, the jet engine, sonar and the computer. There are still lessons to be learned from that era.

This observation induced the research effort to search why these projects succeeded. This part of the research effort is guided by the first research question (Why some projects succeed during national crises despite the adversity of the circumstances?) and it will lead to some propositions claimed to be the answer.

Then to evaluate and validate these propositions, the research effort took a deductive approach to evaluate these propositions. This part of the research is guided by the second research question (What assists projects to be delivered successfully during national crises?) and it will reveal some elements that assist the success during national crises. Figure 11 illustrates the research inductive-deductive approach and the research questions in this research.

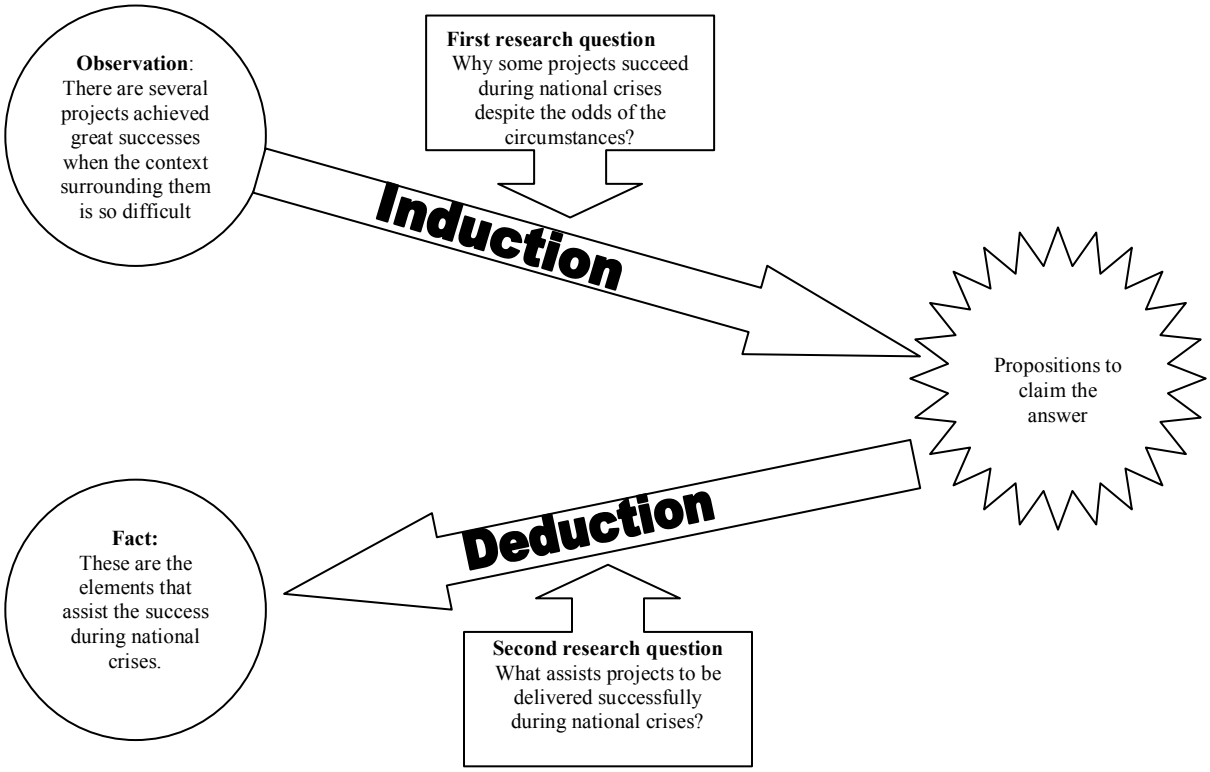

Figure 11: The research inductive-deductive approach

3.5 Research strategy

The research strategy (alternatively it is called the methodology) in the research framework proposed by Saunders can be defined as the methodology used in the research effort to aid investigating the research problem and answering the research question in a systematic way.

There are many research strategies such as case study and experiment strategy that can be used in different types of research. However, it is important to note that no one strategy is inherently superior to any other; the superiority comes from the ability of a certain research strategy to answer particular research questions (Saunders *et al.* 2009) p141. Saying that they are distinct strategies, it is possible to use a certain strategy within another. For example the experiment strategy can be used within the case study strategy.

The choice between different strategies might be guided or affected by the research philosophy, the research approach, the type of research questions, available data, time and

resources available for the research, ethical issues and the researcher's expertise. In the following sections the research strategies suitable for this study will be discussed in detail.

3.5.1 Case study as a research strategy

This section elaborates on the case study as the main research strategy here. The concept, the strength and weaknesses of the cases study will be discussed. Also the justification of choosing this strategy will be presented as well as description of the cases used in this research.

3.5.1.1 Concepts and applications

Cases study is a research strategy that is widely used in research projects in many disciplines such as engineering, management and social science. It can be defined as a research method that focuses on understanding the dynamics present within single settings (Eisenhardt 1989). It is also described as an empirical strategy that aims to develop the understanding of "real world" events (McCutcheon & Meredith 1993). One of the comprehensive and highly cited definitions of case study as a research strategy was presented by Yin who has been cited more than 22000 times according to Google scholar as of 31st of July 2013. Yin defines case study in four points as follows:

- An empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.
- Copes with the technically distinctive situation in which there will be many more variables of interest than data points
- Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion
- Benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin 2003) p13-14.

These definitions show the practical orientation of this research strategy. Also they highlight the importance of the context of the phenomenon under study when the boundary between the phenomenon and its context is not clear. This is opposite to other research

strategies such as the experimental strategy where the context of the study is highly controllable. Also they imply that the data can be collected from several sources using several methods such as surveys, interviews and archive documents.

On the other hand, it may not be necessary that the case should be "contemporary". Historians for example apply the case study strategy to investigate events which happened several centuries ago. In the project management discipline there are many studies that addressed cases from history, for example, the case study about the project management of the construction of the Florence Duomo by Filippo Brunelleschi in the fifteenth century (Kozak-Holland & Procter 2013).

Case study strategy can take the form of qualitative research, quantitative research or a mixture of the two types (Eisenhardt 1989). However, it is more popular among qualitative studies than quantitative ones.

Case study research can be classified according to several typologies. For example there are single case research vs. multiple cases research or a holistic case vs. embedded case (Saunders *et al.* 2009) p146. Another typology offers different types of case studies such as explanatory, exploratory and descriptive case studies (Baxter & Jack 2008). There is a wide range of factors that control the classification of the case study research such the number of cases or the size of the case in terms of cost or workforce.

Case study strategy is applied in many disciplines including project management; see for example (Cao & Hoffman 2011; Zhai *et al.* 2009).

3.5.1.2 Strengths and weaknesses

Any research strategy has its own strengths and weaknesses and case study strategy is not an exception. There are several strengths of case study research strategy. They can be summarized in the following two points:

- **The case study is inherently able to help gaining rich understanding of the research context.**

This point is particularly important when the research aims to answer real-world problems. Studying the problem in isolation from its real life context may lead to illusive findings so that case study strategy is of particular benefit here.

- **The case study facilitates doing real life research with little or no control over the variables of the research.**

In some research strategies such as experimental strategy the researcher needs to isolate some variables to examine their particular behaviour. However, in real world it is not always possible to isolate variables; rather, the researcher needs to holistically address the interaction between the variables in their natural settings to draw conclusion. In this research situation the case study strategy stands out (McCutcheon & Meredith 1993).

On the other hand, probably the strongest criticism of the case study research strategy is about the generalization of the results to a wider population. The use of multiple cases with enough diversity can counter such criticism and can provide what is called analytical generalizability (McCutcheon & Meredith 1993).

3.5.1.3 Cases for this research

Project management (either in theory or in practices) in general is a learning discipline. Lessons are learnt from previous practices to enhance the present and future outcome of projects. The approach of studying previous cases to extract lessons for current and future projects is a widely used approach in the project management discipline. For example the case study of project management merits in the construction of the Florence Duomo by Filippo Brunelleschi in the fifteenth century revealed good lessons to contemporary project management practice in both product and process innovation and helped in understanding key drivers of project management success (Kozak-Holland & Procter 2013). The success of the construction of the Hoover Dam in the 1930s in the USA is also a case study that revealed several success factors beneficial to today's project management (Kwak *et al.* 2014). Following this direction, this research is set to investigate historical cases to draw lessons for the present and the future.

This study is about successful project management during national crises so the context of any case should be a national crisis not peace time. There are many examples of national crises to choose from. However, the example of war is probably the best representation of a national crisis because it covers almost all the characteristics and the difficulties often associated with a crisis. Based on that, this research addresses cases from WW2 in the

United Kingdom and the 1960 wars in Egypt. More elaboration about these crises will be provided in Chapter 5.

The case studies of this research were divided into two main portfolios of case studies. The first is a portfolio of case studies which consists of 24 cases from the British aviation industry during WW2. These cases are aviation projects intended to produce aircraft for the war effort. The war years from 1939 to 1945 saw several major events which shaped the context of every project that was undertaken in that time. For example, in the Battle of Britain, Nazi Germany bombed British strategic targets such as industrial facilities. The maritime convoys which carried essential goods to the UK (including materials needed for projects) were threatened and attacked by German naval vessels such as U-boats during the Battle of the Atlantic. These projects were conducted during the war period and some of these projects were remarkably successful despite the obstacles of the time. Because of that these projects could be good cases for understanding successful project management during national crises. Table 24 contains the names of all aircraft projects included in this portfolio of case studies.

Table 24: The case studies from the British aviation industry during WW2

Aircraft name	Year	Aircraft name	Year	Aircraft name	Year
de Havilland Mosquito	1941	Fairey Firefly	1943	Bristol Brigand	1944
Avro Lancaster	1942	Hawker Tempest	1944	Bristol Buckingham	1943
Handley Page Halifax	1940	Hawker Sea Fury	1945	Westland Welkin	1944
Bristol Beaufighter	1940	Avro Lincoln	1945	Supermarine Spiteful	1944
Hawker Typhoon	1941	Fairey Fulmar	1940	Hawker Tornado	1939
Fairey Barracuda	1943	de Havilland Hornet	1944	Vickers Windsor	1943
Short Stirling	1941	Avro Manchester	1940	Miles M.20	1940
Armstrong Whitworth Whitley	1937	Blackburn Firebrand	1943	Supermarine Type 322	1943

The second portfolio contains a single but very large case; the Aswan High Dam project in the 1960s in Egypt. The AHD is one of the largest dams in the world and it is the largest in Africa. It is 3820 meters long, 980 meters wide at the base, 40 meters wide at the top and 111 meters high. The dam can discharge water at a rate of 11,000 cubic meters per second. Its reservoir, Lake Nasser, is 550 kilometres long and 35 kilometres wide at its widest point, and contains 162 billion cubic meters of water (Ibrahim *et al.* 2011). The dam is located in the Aswan province south of Egypt, where it traps and controls the flow of the River Nile into Egypt.

The dam was constructed throughout the 1960s and since that time it has contributed to the national growth of Egypt and has provided many economic advantages. It has protected the country from several severe floods, and its massive reservoir provides water to the whole country during years of drought. Moreover, it provides electricity to the country, and at one time, the dam generated more than half of the country's electricity (Abu-Zeid & El-Shibini 1997). Figure 12 shows the electrical output of the dam as a percentage of national output.

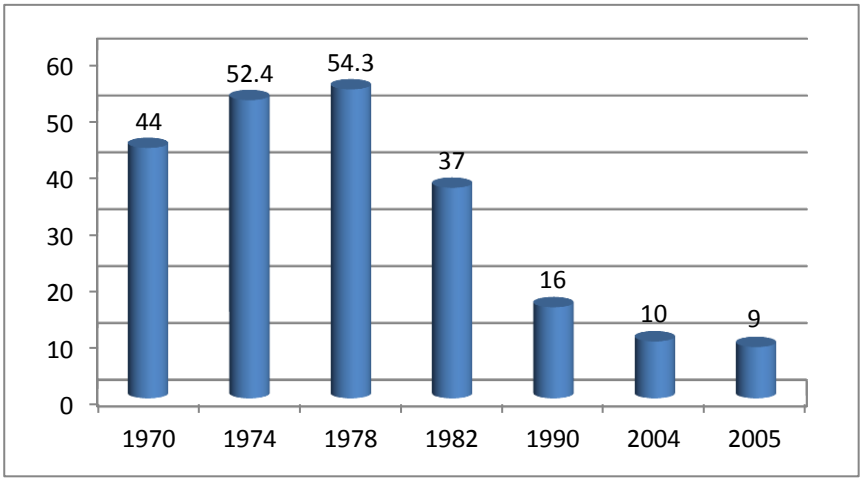

Figure 12: Percentage of Aswan High Dam contribution to national electricity generation (MoEE 2005)

Nevertheless, the construction of this massive structure brought several disadvantages. Many people from the tribes around the dam area were removed from their homeland, and

several archaeological sites were flooded during the creation of Lake Nasser. Other negative impacts of this project include water loss by evaporation and the degradation of downstream river courses (Abu-Zeid & El-Shibini 1997). Overall, however, this project was a great construction achievement and the advantages outweighed the disadvantages (Zeid 1989).

There are other cases from the literature used to support the findings of the main cases. These cases include for example the construction of the Hoover Dam in the USA in the 1930s and the rescue project in the Chilean mining crisis in 2010.

The multiple cases have been chosen in this research because this choice may enhance the generalizability of the results (Baxter & Jack 2008). Also, choosing cases with different contextual dimensions such as the industry, the cultures, and the political systems could increase the validity of the results.

3.5.2 Justification for strategy choice in this research

It is a rule of thumb that behind any choice there is a reason so that there are a few reasons behind the choice of the case study strategy in this research.

First, the case study strategy has been used successfully in many project management research articles and theses. Thus this study is building upon this tradition in the literature.

Second, the project by definition is a unique endeavour so that in order to extract lessons the researcher needs to study one or a group of "unique endeavours" or in another word "cases". In the chemistry discipline the molecule is smallest unit in a compound that holds a complete set of characteristics of that compound while the atom is the basic unit of a chemical element. The analogy with the project management discipline is that the case project is like the molecule: the basic unit of extracting a complete set of knowledge in the project management discipline. The project practices (such the scheduling and staffing) represent the atoms; the basic unit for extracting knowledge in a single project. Studying the case will cover the interaction between the internal project practices and the mutual relationships between the project and the external environment. Studying project practice (atom) in isolation from the whole project (molecule) may lead to less accurate findings.

For example, the chlorine atom (Cl) is poisonous and the sodium atom (Na) is explosive but the compound of the two atoms (NaCl) is safe table salt.

Third, some research strategies require control over the phenomenon under scrutiny in order to generate acceptable results. For example, experiment strategy requires an experimental group and a control group to conduct a good research. However, this study is investigating a phenomenon (project success) within its real life context (national crises) and there is no control over its elements. In this situation the case study is a preferred strategy (Saunders *et al.* 2009) p146. It allows for holistic investigation of the phenomenon and generates results that fit closely to the real life settings.

Fourth, the research questions are why-what type and the case study strategy is known for its considerable ability to generate answers for such question types. (Saunders *et al.* 2009) P146.

Fifth, the case study strategy is suitable when there is a need for deep understanding or when the topic of the research is relatively new (Cao & Hoffman 2011; Vissak 2010). This applies to this research because the topic (project success during national crises) is relatively new and there is little literature in this direction (Hrůzová & Thornton 2011). Also there is a need for in-depth understanding of the complexity associated with the phenomenon of project success under the abnormal situation of national crises.

Sixth, some research strategies do not allow for multiple sources of data. For example, the experiment strategy restricts the data to the results of such experiment. On the other hand, the case study research strategy allows for the combination of data sources to enhance the accuracy of the research findings (Baxter & Jack 2008; Vissak 2010). This study by its very nature requires multiple sources of data so that case study strategy is suitable here.

Seventh, the case study strategy helps the researcher to overcome some ethical issues. For example, it is unethical to impose the death threat upon a project team to study their performance under such a threat. However, when a national crisis happens such as the war this type of threat exists with no control from the researcher. Herein the researcher can conduct the research in compliance with ethics. This is the case in this study because the author has no control over the dangers and threats imposed by national crises on the

projects. However, studying these projects during these circumstances may lead to extracting lessons for success in similar situations.

Eighth, when the research aims at explanation and causal inference rather than statistical correlation the case study is the method of choice (Vissak 2010). This study aims to discover and describe the underlying reasons for project success during national crises. This concludes the eight points to justify the choice of case study as the main research strategy.

3.6 Research choice

The nature of the research can be described based on the two opposite types of research namely; qualitative and quantitative. The major distinction between the two types is the techniques and procedures focus whether it is on numeric (numbers) or non-numeric (words) data. The quantitative research is dominated by numeric (numbers) focus and uses quantifiable data collection techniques (such as questionnaire) or numerical data analysis procedures (such as graphs or statistics). On the other hand the qualitative research is dominated by a non-numeric (word) focus and uses non quantifiable data collection techniques (such as the interviews and videos) or data analysis procedures (such as content analysis) which generate non-numerical results.

According to "the research onion" framework the selection between quantitative, qualitative or a mix of them in the research techniques and procedures is known as 'research choice' (Saunders *et al.* 2009). In this framework the research choice can take one of the possibilities shown in Figure 13. Table 25 explains each choice.

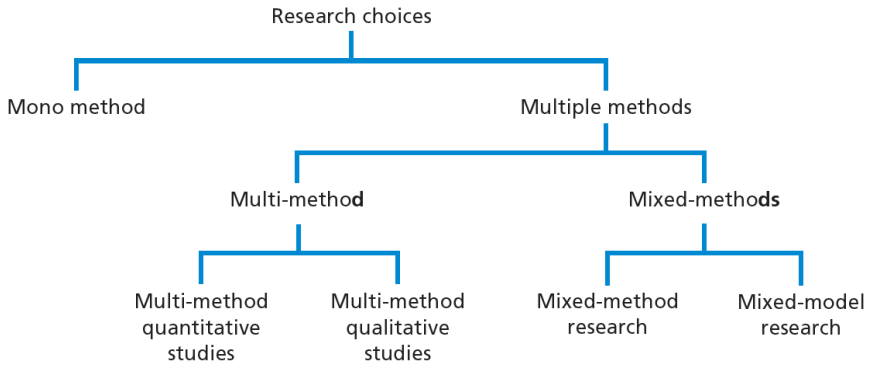

Figure 13: Research choices possibilities (Saunders *et al.* 2009) p152

Table 25: Research choices explanation (Saunders *et al.* 2009) p151-153

Research choice		Description
Mono method		using a single data collection technique and corresponding analysis procedures
Multi-method		The combinations where more than one data collection technique is used with associated analysis techniques, but this is restricted within either a quantitative or qualitative world view
	Multi-method quantitative study	The combinations of more than one data collection technique with associated analysis techniques restricted within quantitative world view
	Multi-method qualitative study	The combinations of more than one data collection technique with associated analysis techniques restricted within qualitative world view
Mixed methods		The general term for when both quantitative and qualitative data collection techniques and analysis procedures are used in a research
	Mixed-model research	combining quantitative and qualitative data collection techniques and analysis procedures
	Mixed method research	The use of quantitative and qualitative data collection techniques and analysis procedures either at the same time (parallel) or one after the other (sequential) but not combining them.

In the disciplines where the science and the social aspects interact with each other (such as in project management) pure quantitative or qualitative techniques and procedures may overlook some important aspects of the real life situations (Abowitz & Toole 2010). There is increasing acceptance towards mixing qualitative and quantitative techniques and procedures in many disciplines including project management. Many articles in the project

management field such as Biedenbach & Müller (2012) and Koh & Crawford (2012) have used mixed methods successfully.

This study is largely a qualitative research. The main reason behind that is the nature of available data, which consists of a very large amount of narratives and verbal details. However, there will be some use of quantitative data that exists within the data set. More over this study uses more than one technique for data collection and more than one method of analysis and results presentation. Based on this combination of techniques and procedures, this study falls in the "mixed model" research choice as defined in "the research onion" framework.

This choice is increasingly advocated within business and management research where a single research study may use quantitative and qualitative techniques and procedures in combination and use primary and secondary data (Saunders *et al.* 2009) p151. Also this choice might be an optimum twin to pragmatism as a research philosophy of this study (Johnson & Onwuegbuzie 2004). Also this choice may increase the validity and reliability of the result and may enhance the causal inference (Abowitz & Toole 2010).

To sum up, the mixed model research can be a good choice to help this research to achieve its objectives.

3.7 Research time horizon

According to (Saunders *et al.* 2009) research can have two time horizons. To distinguish between both times they asked the following question "Do I want my research to be a "snapshot" taken at a particular time or do I want it to be a series of snapshots and be a representation of events over a given period?. So the time horizon means the span of the time the research covers and the rounds of data collection and analysis performed. The single round or a single snapshot at a specific point in time is called a cross-sectional time horizon and the multiple snapshots over a period of time is called a longitudinal time horizon.

The main strength of the cross-sectional time horizon is its ability to capture the instantaneous relationship between cause and effect while the main strength of the

longitudinal time horizon is the ability to capture the change and to test the stability of the conclusions over time.

To benefit from the strength of both time horizons in this research, multiple case studies have been investigated. Each case study is typically a cross- sectional research as it catches the causes and effects of that particular case. For example one of the case studies of this research is the case of the de Havilland Mosquito aircraft project which is a cross-sectional research for that particular aircraft project. To reach a more generalizable conclusion, a collection of "snapshots" from many case studies was used to forms the longitudinal research that tests the stability of conclusions.

3.8 Research techniques and procedures

This section answers three fundamental questions. The first is what the tools to be used in the data collection of this research are. The second is from where the data will be obtained. The third is how the data will be analysed. It might be important to mention that at some stages in this research a large number of documents are needed because the documents and other sources are not prepared specifically for this research. They contain relevant and irrelevant information. Thus, there is a need to navigate through this large amount of data to find relevant details.

3.8.1 Data collection tools

This section describes the nature of data in this research and the tools and the techniques that are mainly used to collect the data for this study. These tools are interviews, archival documents and video data.

3.8.1.1 The nature of data in this research

The data of any research may swing between two extremes. One is a data set prepared specifically for particular research. In this type the data is collected from the beginning in the required form for that particular study. Examples of such a type of data include data collected via structured interviews, questionnaires and laboratory trials. This type of data gives the researcher the advantage of focusing their effort in a particular direction from the

beginning. In the other extreme there is a data set that is not prepared for particular research. In this extreme the data is not collected in any pre-designed format. The researcher needs to go through the available data to extract themes and conclusions. Examples of such data include the data collected via unstructured interviews and archival documents.

In this research, as mentioned before, there is a range of data sources. Each source provides the data in a different form. Because the cases of this research are historical events the type of data available is closer to the second extreme; not prepared specifically for this study. For example the archival documents include information about a wide range of issues some of which are relevant to this research and some of which are irrelevant. Thus, there is a need to analyse and filter these documents; then it will be possible to find themes, make inferences, and draw conclusions.

3.8.1.2 Interviews

The research interview can be defined as a purposeful discussion between two or more people with the aim of gathering valid and reliable data relevant to the research question and objectives (Saunders *et al.* 2009) p318. Interviews are useful data collection tools when the research aims to understanding experiences, opinions, attitudes of the interviewee, understanding the process in which the interviewee took part and when there is insufficient knowledge about the subject that allow for a questionnaire to be well drafted (Rowley 2012). On the other hand, the interview as a data collection tool has its disadvantages such as being time consuming and needing more effort for the analysis.

Research interviews can be classified according to several dimensions such as the flow of the interview and the questions type. One of the widely used classifications of interviews divides them into three main types of interview namely; unstructured, semi-structured and structured interview (Gill *et al.* 2008).

- **Structured interview**

In a structured interview the researcher (or the interviewer) uses predetermined or standardized questions and records the response of the interviewee in a pre-designed format. It allows very little or no variation in questions or answers' format. This type of

interview is often used to collect quantifiable data so that it is called a quantitative research interview. Due to its nature it is easier to conduct, however, because it does not allow for follow up questions and it lacks the ability to get more depth (Gill *et al.* 2008)

- **Unstructured interview**

Opposite to the structured interview, the unstructured interview has no pre-designated path. It often starts with an open-ended question to ignite the conversation then follow up questions appear as the conversation flows. Because it evokes narratives and seeks description rather than numbers it is called (along with semi-structured interview) a qualitative research interview (Kvale 1996) p31-33 (Saunders *et al.* 2009). An unstructured interview is time consuming, difficult to manage and confusing as there are no guiding questions to help the participants in knowing what to talk about (Gill *et al.* 2008). On the other hand the main strength of this type appears when depth is required or when no knowledge exists about the subject.

- **Semi structured interview**

Between the two extremes, structured and unstructured, lies the semi-structured interview. It consists of several guiding questions to help in defining the key areas of exploration but at the same time allows the interviewer and the interviewee the flexibility to pursue certain ideas in more detail. This format of interview rectifies the drawback of the structured interview as this format allows for more elaboration. Also it rectifies the drawback of the unstructured one as this format provides guidelines on what to talk about.

- **The interviews of this study**

For this study qualitative interviews (semi-structured and unstructured) were deemed to be the suitable tools to collect some of the required data because the aim of this study is to understand the experience of the interviewees in relation to managing projects successfully during national crises. There are two sets of interviews in this study. One set is the recoded interviews that were conducted by someone other than the author. This set includes for example the interviews with industry veterans from the WW2 era and workers in the AHD projects. This set is considered unstructured interviews because the author had to pursue relevant information without any control over the interview itself. The second set of interviews is the interviews conducted by the author in Egypt with AHD veteran engineers

and contemporary project managers. This set is considered semi-structured interview because it contained few questions to guide the interview. However more questions were asked at each individual interview.

3.8.1.3 Archival records and documents

The archive is the place where historical (or sometimes recent) documents or records are kept. Usually archives contain records and documents generated as a result of activities such as legal correspondence, negotiation minutes, commercial activities and social memories. These documents and records are selected for long term preservation. Generally, these records are selected because of their significance such as historical, cultural and technical significance.

In the research world the usual use of archival document is in the types of research that deal with historical events (Saunders *et al.* 2009) p150 but it can be used in other research types. In the project management research the archival documents have been used in several research articles such as Engwall (2003), Kwak *et al.* (2013) and Lampel (2001) or in PhD works such as Pinney (2001) and Rorke (2003).

As with any data collection tool, the archival documents have advantages and disadvantages. Probably the most important advantage of using archival documents in the project management research is that they provide the details of historical projects that enable the contemporary researcher to understand such projects. In the 2000s this study which is about projects from the 1940s became possible because of the archival documents.

On the other hand one of the major disadvantages of using archival documents in the project management research is that they may not contain the precise data to answer the research question fully. To overcome this flaw there should be other sources of data to complement and to breach the possible gap in the data. Also the collection and the analysis of archival documents are very expensive and very time consuming. Moreover because archival documents are not prepared specifically for particular research a very large amount of documents are needed to extract serviceable data.

3.8.1.4 Video data: a novel application in project management research

In project management research, on site engagement is acknowledged as being good practice for gaining data and understanding the context of the projects being studied. However, it is not possible for researchers to be on site for every project they intend to research because projects can be difficult to access, or may be secret during the execution phase, or simply may have been completed a long time ago such as the cases of this research.

A substantial amount of information can be obtained by reading documents but there will be more to any project than written data alone, project practitioners are well aware of that. This gap in information needs to be addressed. To do so, this research included trying a data source that is unusual for project management research but has been used in other disciplines. This data source is moving visual images of any kind. The author refers to it in this study as video data (VD) (Howsawi *et al.* 2014f). The term video is used here because of its commonality nowadays.

The author reviewed a lot of project management literature and conducted project management research for some time; however, it seems to be that VD has not been used before in project management research. Therefore, this study may contribute in pioneering the application of this technique to project management research. This technique will be discussed here in detail. More details were published in two peer reviewed papers; one in the Australian Institute of Project Management national conference (AIPM2013) and the other in the Science Journal of Business and Management 2014.

3.8.1.4.1 Definition of Video Data

The word "video" means "a recording of moving visual images made digitally or on videotape" (Oxford Dictionaries 2014). It is derived from the Latin word (vide) which means to see. The word video in this study refers to all types of moving visual images of any kind such as films and digital media. Video data (VD) is defined here as "the information and messages that can be extracted from a certain video clip". These messages and information can be direct, such as news reportage, or indirect, such as the emotions revealed by peoples' gestures in the video clip.

3.8.1.4.2 Features of Video Data

Advances in technology since the beginning of the 20th century enable the filming of project works. Perhaps the main objective of that filming is to document the process for documentary production. However, because the camera can capture a wealth of details and rich complexity that is impossible or very difficult to capture by other means, and since the eye and ear can acquire a great deal of information that it is practically impossible to write down simultaneously, using VD to complement the written details might be beneficial.

VD exists in the form of video recordings which usually contain sound and moving pictures, although sometimes they can be silent. Video clips retain the following features:

- The richness of detail: video recording captures all the details exposed to the lens and the microphone. A human conscious mind cannot acquire these details simultaneously. Some events, such as accidents, happen quickly, their shocking nature distracts the observation process and they occur once and cannot be re-enacted. A video recording retains such events in rich detail.
- The ability to repeat the scene: in the real world, there is no way to see an event again except by means of recording. For example if a researcher is observing a phenomenon and misses some parts for any reason, such as the selective perception phenomenon effect, the only possible way to see missed parts is in a video recording. Because of the richness of details contained in VD and the inability of the human brain to acquire all these details simultaneously, the ability to repeat-view enables the performance of many data extraction rounds without losing high level data originality.
- Retaining a high level of data originality to allow re-examination without distortion: recording data in forms such as written documents usually carries the risk of distortion in one way or another. For example, if a researcher is taking notes from the field, these notes will be written in that researcher's style, while another researcher may interpret that style of writing in a different way because everyone has a distinctive way of writing. By contrast, there is no intervention by the observer in the field when an original event is recorded as it is, so any researcher will see exactly the same clip. On this basis, the consensus of researchers who use

the same original VD can be much stronger than if other forms of data, such as written field notes, are used.

- Ease of use, storage and retrieval: VD is very easy to use nowadays thanks to the availability of video playback systems almost everywhere. The process of recording is much easier than ever before, given that the video recording function is available even in cheap mobile phones. Also with digital technology being the main technology for processing, VD can be stored in small electronic mediums such as USB flash memory. A full day's broadcast by a television channel can be stored in a cheap USB flash memory that can retain this data for many years and make it available instantly. Moreover, being stored electronically, VD can easily be transferred through electronic communication mediums such as the internet.

These are the most notable features of VD that can be relevant and appealing to project management research.

3.8.1.4.3 Classification of Video Data

For the purpose of this research a variety of video clips were collected. These clips are overwhelmingly related to aviation projects in the UK during WW2, and there are few clips related to AHD project in Egypt. The clips total length exceeds 250 hours. These clips form a very wide array of collections and dealing with them as one segment is inefficient. To facilitate and make the process of analysing VD more efficient, therefore, a classification is needed.

"To classify" means "to arrange (a group of people or things) in classes or categories according to shared qualities or characteristics" (Oxford Dictionaries 2014). This implies that there are many classes to choose from. Moreover, there can be a combination of classification dimensions in one scheme.

Researchers and practitioners in different disciplines use different schemes for classification purposes; for example, medical practitioners may classify patients according to their age, ethnicity or illness type. In the project management discipline, many dimensions are used for classifying projects such as industry type (e.g. construction and defence), or product novelty (e.g. radical and incremental).

Video data can also be classified according to several dimensions such as the language, the length of the clip and the date of the clip. To help preparing VD for research purposes a classification scheme was proposed as shown in Table 26 which consists of three dimensions with two categories in each dimension. The dimensions were chosen because researchers need the information to be unbiased, true and original. The reporting type deals with information bias, the purpose of the recoding deals with information truthfulness and the originality dimension deals with information originality. It is worth noting that the categories in this classification are two ends of a spectrum and the clip can be anywhere in between, consequently, there might be some overlap between the types, but the researcher should categorise according to the overwhelming clip characteristics.

Table 26: VD classification scheme

The dimension	Description
Reporting type **Analytical vs. informative**	Concerning the type of information presented in the video clip. The analytical type presents content analysis of the video clip while the informative type presents straightforward information about the content.
The purpose **Propaganda vs. documentation**	Concerning the purpose behind recording the video clip. The propaganda type is a clip purposefully recorded for advertisement and propaganda, while the documentation type captures the event at face value without manipulation.
Originality **Original vs. reproduction**	Concerning how original is the recording? A clip that captures an actual event at the time of its occurrence is original, while a clip that contains a representation of the event through acting or reconstruction from various sources is a reproduction.

Each video clip can hold a description of three categories as shown in Figure 14. This scheme contains eight classification possibilities based on the binary combination of 2^3.

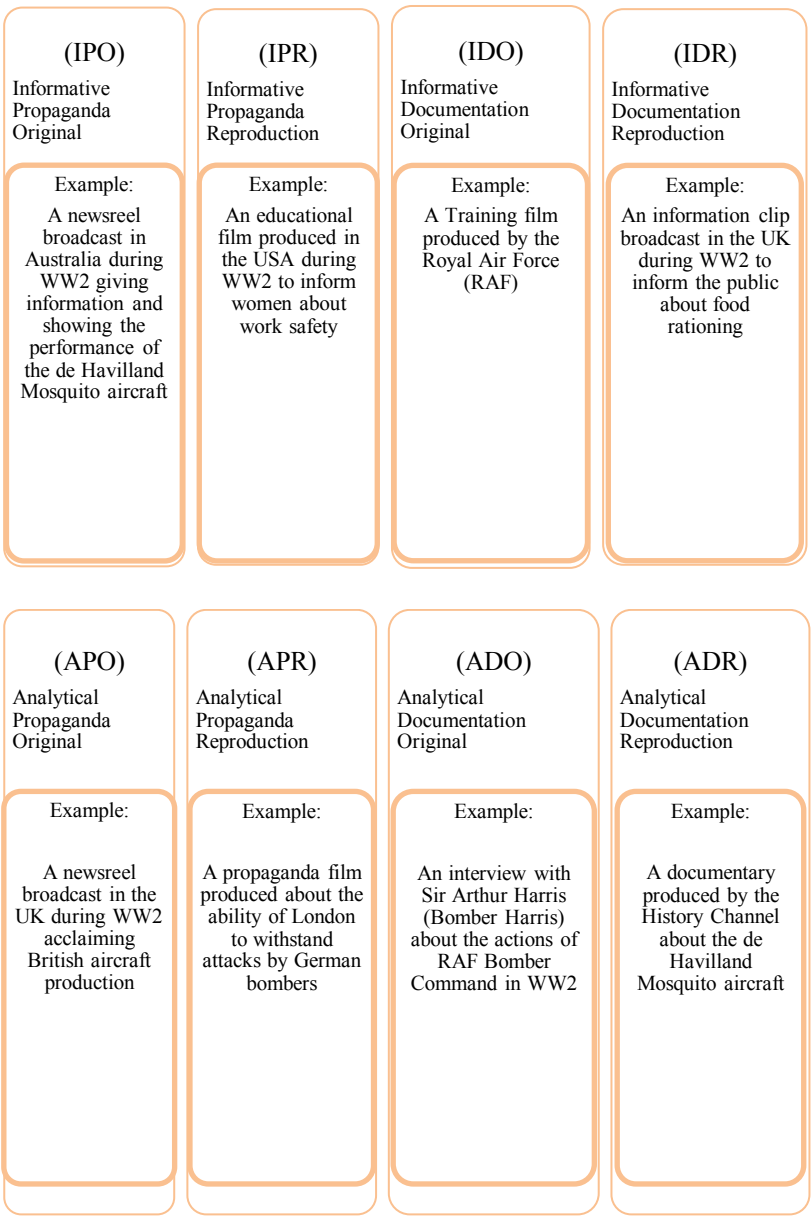

Figure 14: The eight classification possibilities

These categories have different characteristics from one another. The research objective determines the suitable category to use. Each category of VD in the classification scheme will be discussed below.

- **Analytical Propaganda Original (APO)**

This type provides the opinion or analysis of someone other than the researcher in a propagandistic way. This diminishes the research originality because the researcher may be directed toward a certain conclusion. The original visual scenes may provide useful details, but the propagandistic nature of this type threatens the research objectivity. There is little to gain from this type to aid original project management research.

- **Analytical Propaganda Reproduction (APR)**

This type has the drawbacks of APO type, plus it lacks original scenes. This type should not be used in original project management research.

- **Analytical Documentation Original (ADO)**

This type provides the analysis of someone other than the researcher but the visual scenes originality and the documentation nature of this type can provide a good deal of information. The researcher should be aware of the possible narrator bias.

- **Analytical Documentation Reproduction (ADR)**

This type provides the analysis of someone other than the researcher plus the drawback of reproduction. This type has very little to benefit original project management research.

- **Informative Propaganda Original (IPO)**

This type provides true information in a propagandistic way with original scenes. If the researcher can eliminate the propaganda exaggeration, good details can be extracted for original project management research.

- **Informative Propaganda Reproduction (IPR)**

This type is less useful than IPO because of the reproduction. There is little for original project management research in this type. Only the narrated information can be used.

- **Informative Documentation Original (IDO)**

This type provides true information that documents the event with original scenes. This type is the best for original project management research. The threat to objectivity is minimal because no analysis is provided to the researcher, and the original event details are presented.

- **Informative Documentation Reproduction (IDR)**

This type carries the advantages of the IDO type but has one drawback, which is the reproduction. Nevertheless, a good deal of information can be extracted from the narration.

3.8.1.4.4 The significances of Video Data in project management research

Video data can have several points of significance. First, it helps the researcher in gaining a deeper understanding of the project context that could not otherwise be gained than by being there. For example, in the 2010s the author is investigating projects from the 1940s which is a period before the birth of the author. Many of the projects' original documents are available, but from which there is no way to extract soft data such as the emotions and project team morale that may yield crucial insights into what makes projects successful during crises. VD provides soft data as if the event is live. Also, tiny details, such as workplace arrangements, cannot be fully understood from written data, but with VD a better mental image can be created about the projects under scrutiny. Another point of significance is that project management research is now being conducted internationally, researchers from one country study projects from another. VD facilitates this efficiently. It would have been impossible for the author who is doing this research in Australia to gain deep understanding of the British project context in the 1940s without using VD which enables the creation of a detailed understanding about these projects without the need of being a WW2 veteran.

3.8.1.4.5 Advantages and drawbacks

Video data has several advantages in project management research. First, the richness of detail in VD gives the researcher an ability to extract information better than many other sources of data. This feature demonstrates its importance when it is almost impossible to find an interviewee who can answer questions about workplace arrangements or project team morale during WW2. The rich details that existed in the video clips of those projects helped in extracting many details.

The ability to replay the scene and the ease of use, storage and retrieval gives the researcher the chance to conduct multiple rounds of analysis, with each round focusing on a single aspect. For example, in researching aviation projects from the 1940s, one round of

analysis may focus on how the materials were managed in those projects. Another round may focus on the security issues of those projects. Without this feature, it would be more difficult to conduct multiple rounds of analysis.

Another advantage of using VD in project management research is that it reduces the impact of distance or time. For example, this research is conducted in the 21 st century in Australia, researching projects in the 1940s in the UK thanks to the available VD from that era. VD also deals with multiple human senses, which increases the capacity to acquire the knowledge.

On the other hand perhaps the important challenge in using VD in project management research is that video clips are not usually produced to address particular research questions, so to acquire quality details to answer one question, a researcher needs to view many hours of clips, which is very time-consuming. In addition, the interpretation of the VD can be subjective if the data is not numerical, or if it is ambiguous, so the researcher must be aware of this possibility and use suitable techniques, such as triangulation, to reduce this problem.

3.8.2 Sources of data

The data is the backbone of any research and the availability of data may determine the fate of the research project. Typically in many research endeavours the published literature forms the first source of data and this study is not an exception. In this study primary and secondary data were collected from various sources to ensure the rigor of the research through the triangulation of the data sources. Beside the world wide access to secondary data through the internet, the main geographical locations from which the data is needed are the United Kingdom and Egypt because the cases of this research are based upon projects which belong to these two countries. The author travelled to these countries in 2012 to collect the data and to have some kind of contextual understanding by being in simulated circumstances of the case studies. Also, data from other geographical regions were used to support the argument of this study.

3.8.2.1 Sources of data from United Kingdom

The first group of cases in this research belongs to the British aviation industry during WW2. Since these cases are from the 1940s, the main available data are the archival documents. Also videos and recorded interviews with industry veterans are used to extract the data.

Because of the long time after the end of these projects, the variety of companies which performed these projects and the several changes of archiving regulations, the documents of the projects were dispersed in several sources. The documents needed to be collected from several sources. The main sources of data from UK are:

- **The National Archives**

The National Archives is a government department and an executive agency of the Ministry of Justice in the United Kingdom. It incorporates the Office of Public Sector Information and Her Majesty's Stationery Office. It also performs the Historical Manuscripts Commission's functions in relation to private records.

The National Archives is the official archive and publisher for the UK government, and for England and Wales. It has the role of capturing the historical record of government, preserving digital and paper records. It holds over 1,000 years of the nation's records for everyone to discover and use. It also provides effective services to researchers. More information is available on their web site at http://www.nationalarchives.gov.uk

- **The imperial war museums (IWM)**

IWM is a partially government-funded agency and is a national repository and is accredited under the Museums Libraries and Archives Accreditation scheme.

IWM is a family of five museums: IWM London; IWM North in Trafford, Greater Manchester; IWM Duxford near Cambridge; the Churchill War Rooms in Whitehall, London; and the historic ship HMS Belfast, moored in the Pool of London on the River Thames.

IWM holds a wide range of collections that cover all aspects of twentieth and twenty-first century conflict involving Britain, the Commonwealth and other former empire countries. The collections include a wide range of material, from film and oral history to works of art, large objects, and personal letters and diaries. These collections were created to record the

impact of war on every individual and all aspects of life. IWM supports research by making the collections open to the public.

For this research the author visited IWM London and Churchill War Rooms in Whitehall, London. These visits allowed the author to get documents and records as well as some taste of the wartime experience. More information is available on their web site at http://www.iwm.org.uk/

- **The Royal Air Force (RAF) Museum**

The RAF museum is a charitable organization and non-departmental public body sponsored by the Ministry of Defence. It is a house of permanent display of aircraft and their systems. In addition the museum holds many historic records and films about the British aviation industry from the early years of aviation through the era of WW2 to the 2000s. The Museum occupies two public sites at Colindale in North London, and Cosford in Shropshire, West Midlands. The author visited the London branch and received document from their collection. More information is available on their web site at http://www.rafmuseum.org.uk/

To enrich the understanding of the war contexts the author read many memories of people who worked through the war period. These memories were written by the people themselves and collected by the BBC and made available online at a web site called WW2 people's war - http://www.bbc.co.uk/history/ww2peopleswar/. Particular interest was on a section called working through WW2.

The data that was collected for this study consists of hundreds of pages of documents inherited from the ministry of aircraft production, air ministry, war cabinet, ministry of supply and several companies which delivered projects during the war such as de Havilland and Vickers. These documents are related but not limited to the industrial arrangements, product specifications, contracts, test reports, priority management, funding, staffing policies and practices during a time span from the year 1938 to 1945. Appendix A at the end of this thesis contains examples of such documents. In addition to the documents, recorded interviews with WW2 industry veterans, collection of visual material including films, newsreel and documentaries are used as sources of data. It was not possible to conduct personal interviews with any veterans from that era.

3.8.2.2 Sources of data from Egypt

In the second section of this research the author moved from UK to Egypt. In the case of Egypt similar types of data means were used such as documents and video data. However, fortunately it was possible to conduct interviews with high profile engineers who held key roles in the AHD project as well as contemporary expert Egyptian project managers. These interviews were rich in information and complemented the relatively small amount of documents available compared to the British cases. Main data sources from Egypt are:

- **Veteran Interviews**

Personal interviews were conducted with high profile veteran engineers who worked in the AHD project from its early phase (since 1958) through to completion. With the help of a small local association in Egypt (called the dam builders association) 30 veterans have been identified. However, due to health conditions of those old veterans and other obstacles only three of them were interviewed. One of those interviewees later after the AHD project became a high ranking government official while the other two continued their professional career until retirement.

- **Recorded interviews**

Several recorded interviews with workers who worked in the AHD project were collected. These interviews were recorded over a period of time by different producers. Ten of those interviews have been found useful. All of those workers were doing ordinary labour duties such as digging, operating machines and driving trucks.

- **Expert interviews**

The author visited Egypt in 2012 during a time of national crisis after the 2011 revolution. Many characteristics of the national crisis context were apparent such as security issues and loss of transportation. This situation enabled the experts who were interviewed for this research to make a good reflection on the current state of projects in Egypt and to link them to the AHD project. Eleven of the contemporary project managers in Egypt participated in this research. Those interviewees fulfilled the following selection criteria: having experience in project management, living and understanding the context and recent history of Egypt and being knowledgeable about AHD. Also all of them managed projects during the period of national crisis following the 2011 uprising and instability in Egypt. In this

way, the interviewees were able to make informed comparisons between managing projects during peacetime and crisis time, while referring to the AHD project to tell what is required for success during crisis time.

The two sets of interviews (veterans and experts) consisted of open-ended questions to allow the interviewees to express their thoughts freely. The author asked four core questions as follows:

- Do you think that the AHD project was a successful project during a difficult time in Egypt and why?
- Can you elaborate on the difficulties that threatened the project and how they threatened the project?
- What helped that project to achieve success despite these difficulties?
- How do you think the lessons learned from AHD project success can be applied to achieve the success in other projects in similar situations?

Other follow-up and clarification questions were asked throughout the interviews. The logic of the sequence of these questions was that the first question was to establish the common ground about the assessment of the project then the second question was to elaborate the circumstances surrounding the project which were the national crises. After having common assessment of the project and knowledge about the project context, the third question was to discuss the strategies that led to success in the given context. The fourth question was about the reflection the interviewees and the application of the results in other projects in similar situations.

Beside such sources, the author conducted an extensive literature review about the AHD and investigated a wide array of data sources which do not have a direct relationship to AHD but are necessary to understand the historical context in which the project was executed.

3.8.2.3 Extra group of interviews

The authors also approached a group of project management practitioners worldwide with an open-ended question survey to enhance the building of the concept of project management during national crises. Eleven experts responded to the survey. All of them are certified project management professionals (PMP) with experience ranging from10 to 35

years. These experts are from Greece, Australia, United Arab Emirates, Brazil, Poland, USA and Malaysia.

The practitioners were asked the following main questions:

1. What is meant by national crisis and project management in such context?
2. Are there any differences between peacetime project management and project management during a national crisis?
3. What are the characteristics of a national crisis that impact project management?

The response of those practitioners, in addition to the previous sources of data, contributed significantly in formalizing the concept of project management during national crises

3.8.3 Data analysis technique

In the research world the step that follows data collection is the data analysis. Data analysis is the process of extracting meaningful results, conclusions and decision from the data. To do so researchers follow many techniques and procedures. Some of these techniques work with quantitative data while others work with qualitative data. Examples of these techniques include regression analysis and Correlation analysis in the quantitative domain, content analysis and discourse analysis in the qualitative domain. In this study the main analysis technique is the content analysis. This section will discuss this technique.

3.8.3.1 What is content analysis

Content analysis is a technique that has a long history and is widely used in modern research. Some scholar dated the first documented use of this technique to the 18th century (Hsieh & Shannon 2005; Krippendorff 2004).

The definition of content analysis evolved over time from a mere word counting process (sometimes referred to as quantitative analysis of qualitative data) to a more comprehensive method to analyse data (Hsieh & Shannon 2005; Krippendorff 2004).

This techniques is defined as “a research method that provides a systematic and objective means to make valid inferences from verbal, visual, or written data in order to describe and quantify specific phenomena (Downe-Wamboldt 1992). One of the highly cited scholars

who defined content analysis is Klaus Krippendorff. He was cited more than 12000 times in Google scholar as of October 2013. Krippendorff defines Content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff 2004). Also content analysis is defined as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon 2005). Another more holistic definition came from Michael Quinn Patton in his book (Qualitative Research & Evaluation Methods) which has been cited in Google scholar more than 30000 times as of October 2013. Patton defines content analysis as "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton 2002) p453.

These definitions cover the characteristics of this technique. It is largely used for qualitative analysis but there is the ability to use it for quantifying the data. It is not meant to produce statistical correlations or so; rather, it is used to make valid inferences that are backed with verbal, visual, or written data or to describe a phenomenon and its dynamics.

These definitions could be summarized into the following definition:

Content analysis is a data analysis technique that uses qualitative data as input and produces supported inferences and descriptions as output through the processes of classification and interpretation.

3.8.3.2 Was it used in project management research

The answer to this question is "yes". Its use has been documented in many project management research articles irrespective of whether the research looks to project management from a business perspective or an engineering perspective. For example, from the business perspective content analysis was used to analyse the research on culture within the leading project management peer review journals (Henrie 2005), to investigate the issue of motivation in project management (Schmid 2008) and to understand the value of values and meaning in the context of project management implementation and project environments (Mengel 2009). From an engineering perspective the content analysis technique was used in many research projects such as studying how public sector owners

articulated the requirements for design quality management in design/build projects (Gransberg & Windel 2008), exploring the use of observational methods and their potential use within the field of construction project management research (Leicht *et al.* 2010), investigating the benefits of email to engineering project managers (Wasiak *et al.* 2011) and investigating the role of participatory project management for improved disaster resilience (Crawford *et al.* 2013).

Moreover, this technique was used in PhD thesis such as "The current state of project risk management practices among risk sensitive project management professionals" (Voetsch 2004) and "Construction project administration and management for mitigating work zone crashes and fatalities: An integrated risk management model" (Enz 2009).

These examples show that the use of this technique is popular in project management research and this supports the adoption of this technique in this study.

3.8.3.3 Why content analysis was chosen in this research

Perhaps one of the main determinants of choosing the analysis techniques is the type of data available for the research. If the data comprises numbers then a quantitative technique might be more suitable and if the data consists of narratives and verbal description then a qualitative technique might be more suitable.

Each technique has its own strengths and weaknesses. It is the responsibility of the researcher to exploit the strengths and to mitigate the weaknesses.

Content analysis has at least four main advantages: it is an unobtrusive technique, it has the ability to handle unstructured material, it is context sensitive and has the ability to cope with large volumes of data (Krippendorff 2004). Each of these advantages benefits this research from different angle.

This study deals with large amount of unstructured data from sources such as documents, interviews and videos. This amount of data consists mostly of descriptive narratives which contain pertinent details embedded in the text. Content analysis is a very suitable technique to deal with this type of data (Hsieh & Shannon 2005; Zhang & Wildemuth 2009).

Also this study is primarily directed to produce description and reasons of the project success during national crises rather than producing numerical results. In this case the content analysis technique might be a very helpful technique (Hsieh & Shannon 2005).

Saying that this technique is good for this study does not mean the technique is immune from weaknesses and criticism. Probably the most important criticism against content analysis is the trustworthiness of the research that adopts this technique. To eliminate this criticism and to enhance the trustworthiness of this study several steps were adopted. The details about these steps are in Section 3.9 Research trustworthiness.

3.8.3.4 How to conduct content analysis

The execution of content analysis in a research project differs based on the objective of that research. Some researchers aim to find a trend in the data so that they may focus in counting the appearance of certain themes. Others may aim to find answers to particular questions, in this case the frequency is not the primary target but the valid and supported inference is more suitable. This highlights the fact that there is no simple single right way to do content analysis, however the researchers should judge what is appropriate for their problem (Weber 1990) p13. This flexibility can be one of the strengths of the content analysis technique and make it more compatible with the pragmatism philosophy.

In this study each set of data is analysed at least twice. The aim of the first round is to explore the nature of that set of data and the possible categories to be identified from such data. The following rounds of analysis aim to allocate the relevant content into each category.

The processes of the analysis through the course of this research differ from one stage to the next depending on the type of data used and the proposition to be evaluated in that stage. The details of the analysis as well as the results of this study will be presented in Chapters 4, 5 and 6.

3.9 Research trustworthiness

This section will explain the measures and the steps which were adopted to ensure the quality of this research.

3.9.1 Research trustworthiness concept

Conducting a trustworthy research and presenting authentic results are fundamental pillars which the researcher needs to think deeply about. To establish such trustworthiness there are two basic concepts; validity and reliability and several derivatives of these concepts that try to ensure trusted research and results. The linguistic meaning of validity is "the quality of being logically or factually sound" and reliability is a noun of the word reliable which means "consistently good in quality" (Oxford Dictionaries 2014). In a quantitative research approach these two concepts are well established. Validity describes the truthfulness of findings while reliability describes to the stability of findings (Whittemore *et al.* 2001). There is a wide agreement upon the definitions and the criteria to measure validity and reliability in quantitative research. However, in qualitative and mixed method research reliability and validity are not as clear as they are in quantitative research (Golafshani 2003; Onwuegbuzie & Leech 2007; Sinkovics *et al.* 2008; Whittemore *et al.* 2001). The measures of quantitative research are not straight forward applicable to qualitative research because both types of research deal with different types of data and have different underlying assumptions (Shenton 2004; Whittemore *et al.* 2001).

Several research methodology experts presented criteria and measures to assure the validity and reliability of a qualitative research (Lewis 2009; Tracy 2010). Examples of such criteria and measures include Guba's four trustworthiness criteria (Guba 1981), Maxwell's five types of validity (Maxwell 1992) and the holistic validity view framework by (Cho & Trent 2006). However, there is no single set of criteria which can claim the hegemony (Onwuegbuzie & Leech 2007). Also several leading qualitative method scholars rejected the idea of having a unified criteria for all qualitative studies suggesting that unified criteria are problematic (Tracy 2010). Based on that, perhaps a careful compilation from those suggested criteria and measures can provide an optimum framework for a specific study.

3.9.2 Research trustworthiness approach for this study

For trustworthiness assurance in this research, the trustworthiness approach was compiled consisting of four quality dimensions namely; credibility, transferability, dependability and

confirmability to establish the equivalent qualitative criteria to validity and reliability. This approach is based on several works such as Guba (1981), Lewis (2009), Onwuegbuzie & Leech (2007), Shenton (2004) and Tracy (2010). Table 27summarizes this approach.

Table 27: Summary of the trustworthiness approach of this study

Quality dimension	Suggested action to establish the quality dimension
Credibility	Triangulation of data + multiple samples + personal experiences
Transferability	Providing background data (thick description) to establish the context of the study for the readers+ providing examples and evidence from the literature showing the results application in different cases
Dependability	In-depth methodological description + peer review
Confirmability	In-depth methodological description + peer review

3.9.3 Credibility

Credible research (or internally valid in quantitative terminology) means that the research was conducted with trusted data and a deep understanding of the phenomenon under study. This research is about project management during national crises so to establish credibility the national crises context needs to be understood and enough trusted data about projects executed during these crises need to be collected. In applying the triangulation, the data have been collected from different countries mainly UK and Egypt. The data also were obtained from different sources such as government documents, industry documents, video data and personal interviews. Also the data belong to different industries; mainly aviation and construction. This triangulation of data could reduce bias by having the data presented from different sources so that no one perspective dominates.

To understand the context and the nature of national crises and to build a good mental image the author, in addition to the traditional literature review and reading, engaged the context of WW2 in the UK and the 1960s Egyptian crises by watching hundreds of hours of documentaries and listening to many audios about all aspects of life in these eras such as

society, industries, military and religion. Also the author visited places and exhibitions that simulate the crisis and bring the experience of the crisis to the audience. Among the places visited are the Imperial War Museum in London, the Royal Air Force museum in London, Churchill war rooms, and the Britain at war experience museum. Moreover, the author travelled to Egypt during the political turbulence and the national crisis that followed the 2011 revolution. During that visit many meetings with ordinary people and project managers have been carried out to discuss the context of the crisis and its impact upon socioeconomic aspects. These actions have been taken to enhance the credibility dimension.

3.9.4 Transferability

Transferability (or it may be called external validity/generalizability in quantitative terminology) judges the extent to which the findings of certain research can be applied to other cases. It is a gradient concept; the higher transferability the results have, the better the research is. This research is about project management during national crises so to establish good transferability the findings should be applicable to other cases. Thick description of the cases and findings of this research will be provided. The main cases of this research belong to the aviation industry during the national crisis of WW2 in UK. In this case war was chosen as an example of a national crisis and the aviation industry as the industrial context of the projects and UK as the cultural and political context of the projects. To test and demonstrate the transferability of the findings of the previous cases, different cases will be used for evaluation. To do so mainly Egypt was chosen as a different cultural and political context from UK and the construction industry as a different industrial context from the aviation industry. War remains the prime example of a national crisis because war covers almost all the characteristics of national crises at their extreme and any other example of a national crisis could be less intense. However, examples from other countries, other industries and other types of national crises are used to support the transferability of the findings of this research.

3.9.5 Dependability

Dependability (reliability in quantitative terminology) refers to the stability, coherence or consistency of the research processes used over time. The more consistent the research processes have been the more dependable are the results. Shenton reported that "In order to address the dependability issue more directly, the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results" (Shenton 2004). The supervision of the supervisors' panel and the peer review provide a dependability check.

3.9.6 Confirmability

Confirmability answers a fundamental question; did the results really come from the data and can other researchers confirm them or reach a similar conclusion? Because this research is a supervised research it is inherently confirmable by the panel of supervisors. Moreover, peer review was adopted as a confirmability enhancing technique as it was suggested by (Hammond & Wellington 2012)

3.9.7 Peer review as a quality assurance approach

A peer review process is highly regarded by a considerable majority of researchers and considered by most to be essential to the communication of scholarly research. In particular, most of the researchers considered double-blind peer review the most effective form of peer review (Mulligan *et al.* 2013). Peer reviewed conferences and journals are examples of a scholarly research communication medium. Thus, peer review is regarded as a suitable quality assurance mechanism (Link & Vonortas 2013) p115-134. To build upon this well-established tradition in research quality assurance, it was planned that all major contributions of this research must be published in double-blind peer review conferences and journals before the final compilation of the thesis. The peer reviews work as an external audit to scholarly value and quality of the research procedure and results. Furthermore, other indices are also added to ensure the quality of the journal. For example, some journals are accredited by Excellence in Research for Australia list (ERA). This list is issued by the Australian government through the Australian research council. ERA

evaluates the quality of the research undertaken in Australian universities against national and international benchmarks.

3.10 Research ethics

Ethics are fundamental pillars in any well-regarded research. UTS adopts strict guidelines and rules to ensure ethical research. The UTS Responsible Conduct of Research Policy and The UTS Human Research Ethics Committee (HREC) policy and guidelines are the reference for research ethics in the university. It is stated in these guidelines that anonymous research does not have to have a formal ethics approval. This research is totally anonymous so that no formal ethics approval was needed. However, the basics of ethical research such as the collection and the use of genuine data and high standard referencing practice have been taken into account.

3.11 Summary

This chapter presented the design of this research. By adopting a well-established framework the foundation of this research could be well-established. This chapter discussed the following main points:

- The research framework
- Research philosophy
- Research approach
- Research strategy
- Research choice
- Research time horizon
- Data collection and analysis process
- Research trustworthiness
- Research ethics

All the details under these points were presented to enable the reader to understand the direction, the steps and the processes of this research.

4 The four-level project success framework

4.1 Introduction

The discipline of project management is all about helping projects to succeed. Nevertheless, there is no single universal project success definition that fits all projects all the time. This fact is a driving force behind the first proposition in this research, that is:

***P1**: The definition and assessment of project success are subject to multiple viewpoints, and are context-dependent and sensitive to many factors beyond the direct control of a project team.*

In order to study the success of projects the meaning of success itself should be addressed first.

This chapter addresses the topic of project success through providing a success framework that fills a niche in the question of project success definition and evaluation. After that, the first research proposition will be discussed.

The work included in this chapter comprises two stages. In first stage, the core idea of this chapter -which is the four-level project success framework- was first published in The IEEE International Conference on Industrial Engineering and Engineering Management in 2011. The second stage included more application and evaluation of the framework including evaluation done by external experts. The result of the second stage was published in the journal of Organisational Project Management in 2014.

4.2 The Four-levels Project Success Framework

As presented in Section 2.4, the review of the literature showed that the definition of success evolved from a simple definition to systematic success frameworks. These frameworks contain the success criteria and factors at different levels or dimensions. However, these frameworks did not take into account the environment or the context surrounding the project. Many factors that affect project success (such as culture) lie outside the levels mentioned in the previous frameworks, namely, project, product and

business. This highlights the need for introducing the context to the levels of success frameworks. This proposed additional level is important but not explicitly mentioned in the process of formulating the concept of project success in the literature. What is meant by the context here is the circumstances surrounding the project. Each project or a set of closely related projects has its own contextual circumstances that have a significant impact upon the project's success. For example, a project in an East Asian context is certainly different from one perspective or another to a project in a European context. Also, construction projects are considerably different from software projects.

In addition, in the literature the success criteria were distributed into many groups or dimensions such as the project efficiency criteria group. However, these groups of criteria have varying impact on the overall project success definition and upon each other. Some groups may have a greater impact than others. It is not very clear in the literature which groups have the greater influence. Based on these observations, a new level, 'context', is added to the three existing levels described in the literature (namely; project level, product level and business level) to formulate the four-level project success framework. This framework is a proposal to guide the process of project success definition, to facilitate planning for success, and to aid in judging and evaluating projects after completion. This framework is aimed at fulfilling a wider spectrum of assessment and evaluation needs.

4.2.1 The Four levels

In the project success literature, the idea of grouping the success criteria or factors in distinct groups is not new. There are several attempts for such a grouping approach as mentioned in Section2.4 and 2.5. The criteria can be named differently between authors, however, regardless of these differences; these criteria can be allocated to one of the following levels:

- **Project process:** this level represents the activities and processes taken to deliver the project such as planning and resource allocation. This level contains the criteria used to judge the actions taken to provide the required deliverables. Examples of such criteria are: meeting budget and schedule, and efficiency of execution.

- **Products and deliverables:** this level represents the specifications and the technical requirements of the products or deliverables resulting from the project. It contains the criteria used to judge these technical requirements and qualities. Examples of such criteria are: technical validity, manufacturability and technical performance.
- **Business:** this level contains the criteria used to judge the benefits and returns (or losses) of the project to the immediate stakeholders. For example, the parent organization of the project, project owners and sponsors are immediate stakeholders. The criteria that belong to the business level can include, for example, the contribution of the project to the strategic mission of the firm, preparing for the future, and satisfying the needs of the users.
- **Context and externalities:** this level represents the broader circumstances or groups other than the immediate stakeholders that affect or are affected by the project. This level contains the criteria used to judge the project based on compliance with the contextual circumstances and externalities that affect it or it affects. Examples of such criteria include compliance with the political situation and regime and compliance with the climate. The project team or organization has little or no control over these externalities so that this level has the highest impact upon all levels.

The framework proposed in this study consists of these four levels. They are called 'levels' because this term implies the vertical and sequential relationship between the levels. In this way, the relationship between them can be made clearer.

4.2.2 The Framework Construct and Characteristics

The four levels described above are linked in a systematic framework to reveal their practical advantage. Figure 15 depicts this framework.

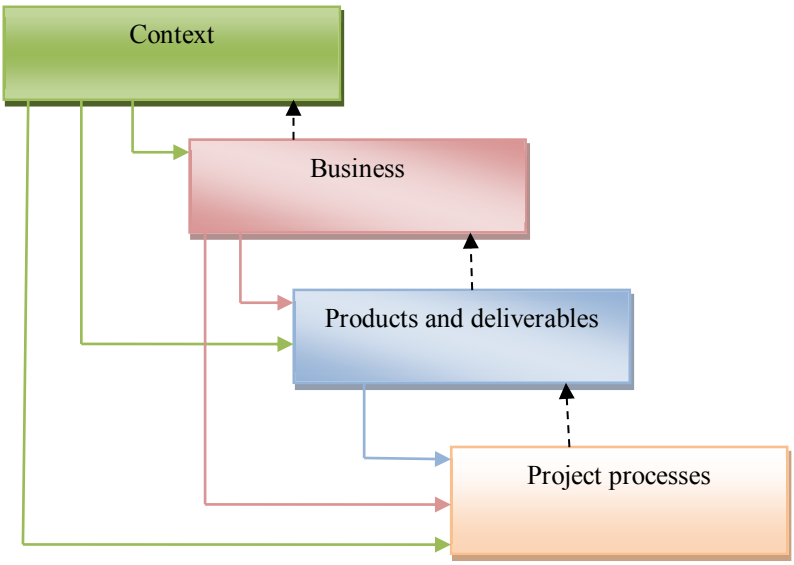

Figure 15: The Four-level Project Success Framework

The following characteristics describe this framework:

- The project can be assessed at each level separately as well as overall. The nature of assessment at one level might be different from that at another level. Consequently, different decisions might be made about the overall project or about certain levels of the project. For example, the Sydney Opera House was significantly over budget and behind schedule so it is a failure at the *project processes level*. However, it is considered one of Australia's greatest icons and it is a world-renowned building so that it is a success at the *products and deliverables level*.
- The higher the level is the higher is its influence in the perceived success or failure of the project. For example, the success of the Sydney Opera House at the *product level* eliminated the failure at the *project processes level* and altered the overall perception of the project. Today, the fact that the project suffered time and cost overruns is hardly remembered; the overwhelming majority of people talk about its beauty.
- The impact of a lower level on a higher level is probable (dashed lines) but that of a higher level on a lower level is certain (solid lines).The overruns of the Sydney Opera House could have destroyed the project but its outstanding success at the *product level* eliminated the probable negative impact of that probable impact.

- All levels can contain a particular criterion simultaneously; however, the measures of this criterion can differ from one level to another. For example, if time is important, the measure at *context level* might be (how short is the time taken to get the product to the market), at the *business level* might be (how quick is the decision-making strategy), at the *product level* might be (how quickly the product can be manufactured) and at the *project level* might be (is the project on schedule).
- The assessment criteria at a lower level are linked to those at a higher level. Any change at the higher level alters those at the lower level. The significance of any alteration at the lower level depends upon the significance of the change at a higher level. For example, 'compliance with government human resource policies' might be a criterion at the *context and externalities level*. Any change in these policies will require changes at lower levels. For instance, if a policy changes at the *context level* in regards to women's empowerment or annual leave, changes must be made to gender balance in the recruitment process, or to work schedules, at the *project level*.
- The assessment of a certain level is time dependant and will be subject to change during the life cycle of that level; however, if the life cycle ends, the assessment will remain regardless of the change at higher levels. The case of the P-51 Mustang aircraft project can be a good illustration. This project was an outstanding success at all levels until the end of World War II. From that war until today, judgement at *the project level* has not changed because there was no change at the context level during the project's execution. At the *product level*, the aircraft was among the most successful fighter aircraft in the world in 1945. However, it was rendered obsolete in 1950, just a few years later. The main reason for this change is that there was a change at the *context level*; that was the introduction of jet fighters which had much more capabilities.
- Criteria at a lower level may not explicitly appear at higher levels. However, all the criteria at higher levels must be fulfilled through the criteria of at least one of the lower levels. For example, a project to produce a car might have 'emission level' as a criterion at *product level*; this criterion may not appear with the same title at the

project processes level or the *business level* but it may appear at the *context level* as 'compliance with government emission regulations'.

- If contradicting criteria exist, the criterion with links to a criterion at a higher level must be prioritized. For example, if 'leading the competition' is a criterion at the *business level*, several criteria can exist at *product level*, such as 'cheap product' and 'high quality product'. These two criteria are contradictory to some extent because usually increasing the quality increases the cost, consequently, increasing the price. To prioritize them, the *business level* criteria must be clarified first. If the criterion at *business level* was rewritten as 'leading the competition by being most affordable', now it is clear that the 'cheaper product' criterion has higher priority than the 'high quality product' criterion at *product level*. In case the contradicting criteria have no link to any criterion at a higher level, then the criteria with greater impact upon lower level should be prioritized.

4.2.3 Setting the Success Criteria

The process of setting the success-measuring criteria needs to be performed sequentially from upper to lower level in order to capture the impact of one level upon another. According to this framework, the upper level success criteria must be set first. Any business must be performed within a certain context. Whether it is a geographical region, a political system, a social environment or an industry, the project is tightly linked to its context. Therefore, the contextual success criteria must be set prior to those at the business level. Any product must serve a certain business and, in order to set the success criteria for this product, the business success criteria must be set first. Any product is an outcome of a project and, in order to set the success criteria for the project, the product success criteria must be set first. This descending order allows the impacts of higher level criteria upon lower levels to be captured. It also aids in criteria prioritization at each level depending on the prioritization approach mentioned in the characteristics of this framework. Moreover, having the criteria linked in this way may help to produce the specific success model for a particular project. Then by using a suitable weighting approach, an operationalized success model can be created for each single project.

4.2.4 The Framework's Applications

A project is by definition a unique endeavour. Therefore, the meaning of success for a particular project should have some sort of uniqueness. Because of this uniqueness, this framework was designed to be used in the process of defining the specific meaning of success of individual projects as well as evaluating the success of projects. In the course of this study, this framework was used to define and evaluate the success of the projects in the main case studies included in this research namely; the case from the British aviation industry projects during WW2 and the AHD project. Also it was used to evaluate the success of other cases investigated and published by other researchers. The following sub-sections demonstrate the application of this framework.

4.2.4.1 Application cases

- **Application case one: Project success definition in the cases about project management in the British aviation industry during World War 2**

The first main set of case studies in this research is from the British aviation industry during WW2. This case of application shows how the four-level project success framework was used to define, evaluate and understand project success in this retrospective research about the success of project management in the British aviation industry during World War 2 (Howsawi *et al.* 2014e). The context of WW2 in the United Kingdom contained at least six conditions as follows:

- Government control over business practices and the market
- Security threats
- Urgency to complete projects
- Disturbance of material supply
- Shortage of skilled manpower
- Changing requirements

The criteria at *context level* are derived from these contextual conditions. Failure to deal with any of the above conditions would mean certain failure to a project. Therefore, the

success at the context level concerns projects that managed to deal with these contextual conditions successfully.

At the *business level*, a successful project is one that attracts enough production to generate the revenue that keeps the business running given the contextual conditions. At the *product level*, success is achieved by satisfying client requirements given the conditions at the *context level*. At the *project level*, success is achieved by producing a satisfactory prototype within specified constraints such as cost and time given the contextual conditions. Therefore, a successful project can be defined as one that manages to deal with the contextual conditions and produces a product within the specified constraints and that product attracts reasonable production orders. This definition can be customised to suit the specific case of the British aviation industry as follows: an aviation project that managed to deal with the circumstances of WW2 in the UK and complied with the specified constraints of time and cost and specification to produce an aircraft that satisfied the government enough to issue a quantity production order. This definition encapsulates the criteria of success at all levels in a subjective way.

Then an objective or operationalisable indicator is needed to evaluate the project. The production figure can serve this purpose because during World War II no aircraft was authorised to be manufactured unless it satisfied the British Government standards. The production quantity was also subject to government authorisation. Moreover, the continuous evaluation of an aircraft could result in a halting of production if an aircraft was discovered to be flawed. Consequently, only aircraft with proven efficiency were ever produced in large quantities. For example, the Avro Manchester bomber went into production but when it proved unreliable, production was ceased after only 209 units had been produced. This number is very low when compared to the production figure of other comparable bombers which exceeded 6000 units of production.

This indicator also illustrates the logic of the four-level project success framework. A project is more likely to reach the mass production phase if it managed to deal with the contextual requirements. This was the case in many projects in the British aviation industry. For example, to reach the goal, those project teams must comply with the government control of raw materials and they must work under the threat of bombing and

sabotage. The large production quantities also were a good source of revenue to the manufacturing companies, so their businesses succeeded as a result of this revenue.

Business success is likely if the business offers a satisfactory product to the customer. This was certainly the case in the UK because the circumstances of the time determined that only satisfactory products would pass into production. All the aircraft that were produced in large quantities — more than 500 units — were beneficial to the Royal Air Force. Given the circumstances of the time, efficient project management processes were likely to produce a good product, within the budget and on time. During WW2 in the UK, the circumstances were unforgiving and delays or overruns could cancel a project. For example, the Martin-Baker MB3 aircraft was a good aircraft during tests but it was considered outdated because of delays and late delivery. Eventually that aircraft never progressed to production.

The production figure can also indicate the following:

- **Ease of production:** this feature satisfies the urgency. This means more units can be produced quicker with little extra effort. For example, the de Havilland Mosquito aircraft could be produced using simple carpentry tools because it was made of wood. Also, it was constructed in modules. These modules could be produced in many small workshops. The final assembly was also an easy process, comparable to the assembly of a model plastic aircraft kit.
- **Client satisfaction**. The only requirement was to satisfy the British Government because it was the sole customer and the only body that could authorise production and specify the quantities.
- **Good utilization of available manpower:** this feature helps to overcome the shortage of skilled manpower. Good utilization of manpower means the ability to produce more units of the product.
- **Versatility:** this feature helps to cope with changing requirements since the same aircraft could serve different roles. Suitability for more roles means more units of the product are needed.

- **Good utilization of available materials:** this feature helps to overcome the disturbance of material supply. Good utilization of material means ability to produce more units of the product.

This is an example of using the four-level success framework to create a customised definition of success.

- **Application case two: Project success definition in the case study about the management of the Aswan High Dam construction project**

The second main case study in this research is the successful construction of the Aswan High Dam in Egypt in the 1960s. Here is another example of using the four-level project success framework in defining, evaluating and understanding project success within the context of that mega project (Howsawi *et al.* 2014a).

Success in the AHD project is defined as satisfying the following criteria:

- The product is delivered despite all the difficult and threatening circumstances surrounding the project
- The advantages of the project vastly outweigh the disadvantages
- The project provides economic benefits to the owner and good revenue to the contractors
- The project provides an excellent product to the specifications, within the specified time and budget.

Table 28 shows how this definition fits the AHD project according to the four-level project success framework.

Table 28: The definition of success in the AHD project

Level	Criterion	Success indicator
Context level	Delivering the desired product despite all the difficult and threatening circumstances surrounding the project	Completed or not? Despite all the complications of the 1960s crises, the project was completed
	The advantages of the project vastly outweigh the disadvantages	The opinion of the majority? The majority of experts consider the benefits of the AHD to be far greater than the disadvantages
Business level	Providing economic benefits to the owner and good revenue to the contractors	Measures of economic benefit? On completion, the AHD provided more than 50% of national electrical power, and the company that built the dam is still in business today
Deliverables level	Providing an excellent product to specification	Technical specifications? The AHD is considered by many experts to be one of the finest engineering constructions in the world
Project process level	Providing an excellent product within the specified time and budget	Time? Cost? The project met the time frame of 10 years and the estimated cost of one billion dollars

- **Application case three: The case of the F-20 Tiger Shark fighter aircraft**

This case is external to this research. External cases are used to demonstrate the applicability of the framework beyond this study. In this example the framework is used to analyse the case and to point out the possible causes for success or failure. This example shows the different judgments of success between different levels.

In the early 1960s the Northrop Company privately designed and produced the F-5 Freedom Fighter aircraft as a low-cost, less-sophisticated fighter for export. The aircraft achieved great success in the export market. The production figure exceeded 2000 units. The F-5 aircraft project was a great success at all levels. The company wanted to build upon this success so that in the early 1980s, it started another privately financed project to produce the F-20 Tiger Shark. The company succeeded in producing the aircraft which was one of the best of its day in terms of capabilities and cost efficiency (success at *product level*). The project also met the constraints of budget, time and quality (success at *project process level*). Nevertheless, at *business level*, this project was a failure and not a single aircraft was sold. An analysis of the project attributed the failure mainly to an unexpected change that happened at the *context level*. That unexpected change was in the government weapon export policy. The government lifted the export ban of more sophisticated aircraft such as the F-16. This change ruined the basis on which the project was set, which was "less sophisticated aircraft for export". Eventually the project was terminated (Martin & Schmidt 1987). The impact of the *context level* and the resulting failure at the *business level* (higher levels) influenced the fate of the project despite the success at *project* and *product levels* (lower levels).

- **Application case four: The case of the de Havilland Mosquito aircraft project**

The de Havilland DH.98 Mosquito aircraft project in the UK during WW 2 is an example of a remarkably successful project. This framework is used to analyse the success of this project and to obtain possible causes of that success.

The context of the war imposed many demanding restrictions. Among the most important demanding conditions were: the scarcity of material needed for aircraft manufacturing, especially aluminum alloys, the lack of trained labour in metal manufacturing, and the need

for quick aircraft production. These conditions belong to the *context level* in the four-level project success framework. The de Havilland Company recognized these conditions and adopted a business strategy that depended on using innovative and radical ideas to comply with the contextual conditions and to exploit the core expertise of the company which was the high speed aircraft production experience. As a result of this strategy the company built a wooden aircraft instead of using metal at a time when the wooden aircraft was considered a thing of the past. This shift in the material use provided several advantages at the *project level*:

- The ease of obtaining work authorisation from the government as the project would not consume precious and scarce material such as aluminium.
- The availability of professional wood workers who worked in trades less essential to the war effort, such as furniture-making so that those workers can be easily redirected to work in this aircraft production.
- The plentiful supply of wood because most projects had abandoned wood in favour of metal. In addition, wood was available within Britain, unlike aluminium, of which more than half was imported
- The simplicity in production because wood work was relatively easier than metal work

As a result, the company was able to deliver the aircraft in just 11 months after signing the contract.

Several innovative design features also helped the Mosquito to achieve success at the *product level*. Some of these features were:

- Speed: the Mosquito was the fastest aircraft in its class. Indeed it remained the fastest aircraft in the bomber command until mid 1951.
- Manufacturability: the aircraft was designed in modules so it could be produced in many small workshops.
- Versatility: the Mosquito was labelled as “one aircraft for all purposes”.

Overall, the project was a success at all levels. The Mosquito contributed significantly to the war effort and the company enjoyed huge revenue with more than 7000 aircraft produced.

4.3 Discussion

4.3.1 The first research proposition

This thesis is a result of a research about the success of project management during national crises. The research questions are answered through the evaluation of three research propositions.

This chapter concerns first research proposition. That is:

P1*: The definition and assessment of project success are subject to multiple viewpoints, and are context-dependent and sensitive to many factors beyond the direct control of a project team.*

Two approaches were attempted to validate this research proposition. The first was through literature synthesis. The basic premise here is that the consensus of the opinions and findings of researchers and experts in a field is an acceptable benchmark to validate a proposition.

The second is through an original research conducted particularly for this thesis.

Based on the literature review which was presented in Section 2.4 and 2.5, the findings and opinions of many researchers in the field of project management including renowned experts in the field showed agreement upon a similar conclusion; that is project success meaning and definition is not universal to all projects. This is what the first research proposition claims.

Traditionally, project success is defined as meeting the triple constraints of cost, time and quality. This is widely used today. However, meeting these constraints is not always sufficient for the project success. Many researchers call for defining specific success criteria for individual projects. Instead of chasing an impractical universal set of success criteria for all projects, the researchers offered models and frameworks to guide the process of success definition. This is the recent trend in the project success definition research and this approach has the required flexibility to cope with the uniqueness of individual projects. Following this recent trend, this study proposed the four-level project success framework as a new tool for defining and evaluating project success.

4.3.2 The validation process

This framework passed through two stages of validation. The first stage was the creation of the framework and presenting it for academic discussion and evaluation in the IEEE International Conference on Industrial Engineering and Engineering Management in 2011 (see appendix S for full copy of that paper). After passing the peer review and the presentation in that academic setting, the framework was used in defining the success for the case studies of this research. In the second stage of validation of this framework, and to avoid the possibility of bias, the framework and its applications were sent to external experts and project management practitioners. The basic premise of this step is that if a group of randomly and anonymously selected experts can see the merits and the correctness of the framework and its application then it is a valid framework and the applications are correct. The techniques and validation approaches were left to the individual expert's choice to make the process totally independent.

The evaluation requests were sent to 91experts worldwide. Seven agreed to take part in the process. Those experts were not known to each other. They have years of experience in project management ranging from 5 to 35 years and all are certified project management professionals (PMPs). They are from the US, India, Norway, Poland, the United Arab Emirates (UAE) and Germany. They have expertise in information technology (IT), telecommunication, construction and management consultation.

The evaluation request focused on two areas: the knowledge contribution of the framework and its possible future development. The discussion took several correspondences with each expert separately

Regarding the knowledge contribution of the framework, the discussion with the experts concluded that:

- The framework helps significantly to achieve a customised success definition for any particular project. It expands the thinking about success beyond the triple constraints. It is adaptable and easy to modify to any particular situation. This feature is particularly important because, by definition, a project is a unique endeavour and the definition of success should consider this uniqueness.

- The framework articulates the context level, which is not well articulated in the existing literature. It shows the impact of the context level on project success. By considering and reviewing the environment and the wider context of a project, the project is better understood and better stakeholder identification can be performed. Moreover, a more detailed risk coverage and assessment of the project can be undertaken as a result of the contextual awareness. The framework facilitates a better understanding of the bigger picture.
- The framework combines the levels of project success in a new way that adds to the existing literature. Previously, professionals have been aware of these levels particularly the lower three and have used them in isolation, but the four levels have not been available for reference as a single group. The framework provides a systematic method by bringing together the various criteria that are in use in different circumstances and facilitates the addition of more criteria to create a more comprehensive set.

In terms of future development, the experts raised the following points:

- Change is often encountered in project management practice; consequently, the definition of success may change. For this reason, developing a strategy to respond to change and incorporating it into the framework will increase the usefulness of the framework in practice.
- The framework is not a standalone project management methodology; rather, it is a tool to supplement a well-established project management methodology such as PRINCE2. Even though the framework can be used separately, further details are required to include it in existing well-established methodologies. In addition, educational material should be developed to demonstrate how to use this framework with certain methodologies. This may increase the usefulness of the framework.
- Despite all projects being unique, there is a level of similarity between them in terms of success criteria. For this reason, the framework could be populated with common criteria at each level; then, the relationship between various criteria at different levels and the measurements of these criteria could be explained further. In this way, users can choose the common criteria from a menu rather than starting

from scratch for every project, making the framework a timesaving and effort-reducing tool.

These points regarding further development are thought provoking and worth consideration. However, they may be addressed in future research.

The second approach to validate the first research proposition is through the application of the four-level project success framework. The applications of the framework in the case studies of this research that were presented above confirm the first research proposition. These applications show the different customised success definitions. These definitions may share some criteria such as meeting cost and time but they are significantly different in other criteria such as achieving economic benefits vs. achieving military strength. Also these applications show that the success is context dependant. Defining success for a construction project in Egypt is different from defining success for aircraft projects in the UK even though the objective is the same; that is defining success. Also these applications show how conditions beyond the control of the project team determined the fate of projects. Because of that, the success definition should be customised around these conditions first then taking more controlled conditions into account for defining success.

4.4 Summary

The concept of success is vital in the project management practice and research. This chapter presented the validation of the first research proposition. In doing so, this chapter makes its contribution to the topic of project success by providing the four-level project success framework and, in particular, by highlighting the effect of a project's context on the definition of its success. The framework is generic and is designed to be used in creating a customised success definition for any particular project. Although the framework is new, it has been validated through several applications and external expert evaluations. This chapter demonstrated the application of this framework in the definition and evaluation of project success in the case studies of this research and other external cases. Also this chapter presented the conclusion of the experts' evaluation and suggestions regarding the contribution and future development of the framework.

5 Project management during national crises: concept development

5.1 Introduction and objective

Project management is the art of applying knowledge and skills to successfully deliver the required products or services. This art is affected by many factors that impact the outcome of a project. Among these factors is the project context, defined here as the circumstances and conditions surrounding a project. Many scholars have directly or indirectly said that as was presented in Section 2.7.

Because projects are unique by definition and each context has its own set of characteristics that distinguishes it from others, thus, in order to study project success it is essential to define the context in which the topic will be discussed.

As mentioned in Section 2.7, a project context can take many forms such as the geography, the industry type and the culture; each of which can be considered as a context. The impact of one context on a project may differ from the impact of another; consequently, each context may require different project management approaches to achieve success. For example, the recruitment processes in a defence project may differ from that in a construction project because national security is an important element in the former, but not in the latter. In another example, a construction project manager must be physically unimpaired, while a project manager with some mobility limitations can manage a software project.

Among the wide variety of possible project contexts, the context of a national crisis is unique and has significant impact on projects, and indeed, on all aspects of a nation's socioeconomic life. During a national crisis, most segments of the nation (if not all) are subjected to difficult circumstances that bring about many forced changes. For example, fundamental regulatory and institutional changes are approved as a result of the pressure of such crises. Project management then is supposed to be different in some regards from project management in peacetime. However, there is little of such distinction in the literature of project management. There is an evident gap in knowledge and literature

available about project management during times of crises. This gap is a driving force for the second research proposition; that is:

***P2**: National crises are unique contexts that require a project management approach that is different from a peacetime approach.*

This chapter presents the conceptual work to develop the concept of project management during national crises. Also it will present the examples of the application of this concept in the case studies of this research followed by discussion to evaluate the research proposition.

The topic of this chapter is relevant and important because, when observing the situations worldwide, it is found that national crises are more prevalent in the 21st century than before as presented in Section 1.1. The core idea of this chapter has been published in the peer-reviewed journal of International Review of Management and Business Research 2014.

5.2 The definition of project management during national crises

Because the notion of national crisis can have multiple meanings it might be better to define it first and then to define the project management in such a context. It was mentioned in Section 2.8 of the literature review about the meaning of a national crisis and its impact upon a project but in this section specific definitions from relevant literature will be included. Then the finalized definition of project management during national crisis will be presented.

In the relevant literature such as crisis management literature, a crisis is an out of ordinary situation which creates a new situation that cannot be dealt with using the existing or old rules. It contains urgency and has the capacity to make or break an organization (Kuklan 1986). Another definition of a crisis is "an unexpected event in an organization's life, which represents a significant threat to its high-priority values and demands a time-pressured response" (Loosemore 1998a). Also, it is defined as a situation faced by an individual, group or organization, which they are unable to cope with by the use of normal routines and procedures, and in which stress is created by sudden change (Booth 1993). Another author defines the crisis as an abnormal situation, which presents some

extraordinary and high risks to the business (Shaluf *et al.* 2001). The crisis is also described as a period of sudden change during which a totally new system is formed. In fact, the meaning of a crisis includes opportunity as well as risk, uncertainty, threat, conflict, accident, and instability (Öcal *et al.* 2006). As can be seen, there are several attempts to define a crisis. Despite these attempts, similarities exist among various attempts such as urgency and threats. However, a common definition needs to be presented and customised to form a sound basis for investigation. If it is not tailored to a particular context of study it might be problematic. This study is discussing the notion of national crisis. The word national means "relating to or characteristic of a nation; common to a whole nation" (Oxford Dictionaries 2014). Also it means "relating to or typical of a whole country and its people" (Cambridge Dictionaries 2014). Thus, the term "national crisis" can be defined as "a situation or time at which a nation faces intense difficulty, uncertainty, danger or serious threat to people and national systems and organizations and a need for non-routine rules and procedures emerge accompanied with urgency". In Table 29 part 1 and Table 29 part 2 this definition is examined on several examples of national crises.

Table 29: The definition and examples of national crises

	National crises examples		
Aspects of the definition	**WW2 in UK**	**2004 tsunami Indonesia**	**9/11 USA**
Difficulty, uncertainty, danger or serious threat to people and national systems and organizations	Convoys of goods were being attacked throughout the war	The capital of Aceh province was totally damaged	Terrorist attack threat continued for years to come
Non-routine rules and procedures emerge	Rationing was introduced	Most of the local government members died in the crisis, so the central government took charge	The introduction of the USA Patriot Act 2001, which gave law enforcement officials sweeping new powers to conduct searches without warrants, monitor financial transactions and eavesdrop; and to detain and deport, in secret, individuals suspected of committing terrorist acts
Urgency	Urgent measures were needed and adopted to protect the convoys	Urgent measures were needed to avoid the spread of diseases	Urgent measures were needed to counter the terrorism threatens USA Patriot Act 2001was prepared and voted on in one month despite being a major change to many US laws

Table 29 (part 2): The definition and examples of national crises

	National crises examples	
Aspects of the definition	**2011 Japan tsunami**	**Financial Crisis 2008 USA**
Difficulty, uncertainty, danger or serious threat to people and national systems and organizations	The tsunami caused a nuclear crisis in Fukushima power plant	The crisis triggered prolonged unemployment
Non-routine rules and procedures emerge	Following the crisis most of the nuclear power plants were shut down causing a national power shortage so that power rationing was introduced. The government asked companies to reduce power consumption by 15%.Some companies moved their weekends to weekdays to smooth power demand	The Federal Reserve dropped the interest rate to a record low of .25 %, which was averaging 6% before the crisis
Urgency	Urgent decommissioning of several nuclear reactors took place Urgent evacuation was needed due to the radioactive substance contamination in the area	Urgent bailout packages were needed and offered to support the economy; otherwise, it would collapse e.g. USA Emergency Economic Stabilization Act of 2008

Now the definition of a national crisis is set, but one step is still needed: linking the definition to the discipline of project management. Project management in general is defined as "the application of knowledge, skills and techniques to execute and deliver projects effectively and efficiently" (PMI 2008). By joining the definition of a national crisis which was proposed above and the definition of project management, the complete definition of project management during national crisis becomes "the application of knowledge, skills and techniques to execute and deliver projects effectively and efficiently in a situation or time at which a nation faces intense difficulty, uncertainty, danger or serious threat to people and national systems and organizations and a need for non-routine rules and procedures emerge accompanied with urgency." This definition could pave the way for making or discovering the practices that are more relevant to the contexts of national crises than other context. However, a fundamental question arises at this point; is there any difference between peacetime project management and project management during national crisis time? This question will be dealt with in detail in the next section.

5.3 Is there any difference?

A basic and straightforward answer to this question is *yes*. This answer is based on the premise that there are some conditions that emerge during a national crisis time and these conditions have impact upon the processes of project management and upon the common project success factors so that there could be some differences. In order to elaborate on the previous answer, this section presents a literature synthesis to shows many of these different conditions.

First, the pressure of a national crisis brings people closer to each other and increases the attitude of collaboration between them (Rodríguez *et al.* 2006; von Dawans *et al.* 2012). Increased collaboration leads to increased project team effectiveness, which, in turn, increases the likelihood of success (Gemuenden & Lechler 1997; Hoegl & Gemuenden 2001; Yang *et al.* 2011).

Second, the national crisis period is often associated with disruption of supply, either a shortage of materials required for projects or the inability to deliver them on time to the required area (Chang *et al.* 2012). These shortages and disruptions diminish an important

success factor, which is the availability of resources (Belassi & Tukel 1996; Do Ba & Tun Lin 2008). Consequently, the likelihood of success decreases as a result of the national crisis.

Third, a need for policy changes is associated with a national crisis period. For example, the crises of WW1 and WW2 enabled women to undertake jobs such as aircraft manufacturing, which were not widely open to women prior to such crises (Bloomfield & Bloomfield 1997; Littlea & Griecob 2011). This change has a positive relationship to the availability of human resources, which is an important project success factor (Jo & Barry 2008; Pinto & Slevin 1987). Another example of a national crisis time is the aftermath of a natural disaster, such as an earthquake. Le Masurier *et al* (2006) investigated the reconstruction project after a natural disaster in New Zealand, and concluded that legislation prepared for routine peacetime projects is not effective enough for projects during a national crisis following a natural disaster. Those peacetime policies are not sufficient to cope with the urgency imposed by a national crisis situation (Le Masurier *et al.* 2006).

Fourth, as a response to the new reality that emerged during the period of national crisis, The Project Management Institute (PMI) has developed a Project Management Methodology for Post Disaster Reconstruction following the 2004 Indian Ocean tsunami which triggered national crises in several countries (Curlee & Sterling 2008). This new methodology is an acknowledgment from one of the biggest institutions of project management in the world that the national crisis time (post disaster) needs special methodology, somehow different from the ordinary peacetime PMBoK.

Fifth, war is an example of a national crisis. During such situations, an employee's continuance commitment (willingness to stay working for the organization) is negatively affected by the event of war (Messarra & Karkoulian 2008). It is reported that commitment to the project is an important project success factor (Chua & Kog 1999),(Nguyen *et al.* 2004), and the national crisis situation reduces this commitment, consequently reducing the likelihood of project success.

Sixth, a national crisis (particularly war) brings about new types of risks and threats that are unlikely to exist during peacetime, such as sabotage (Öcal *et al.* 2006). This may bring

new types of stakeholders which are unlikely to exist in peacetime, for example, national security agencies. These new types of stakeholders need a different stakeholder management approach from ordinary ones.

These are several points from the literature to support the answer to the question of this section. The following section presents the major characteristics of a national crisis that impact project management.

5.4 Major characteristics of national crises

In the course of analysing the sets of data mentioned in Section 3.8 five characteristics or conditions were found to constitute a national crisis and to have an impact upon project management processes. These conditions can exist individually in contexts other than national crisis but they only co-exist all together in any national crisis. These characteristics are:

- **The urgency**: time is described by many interviewees as the highest pressing factor during a national crisis. Things need to be done quickly; otherwise, the cost will be very high. An example to illustrate this can be found in WW2. During that crisis in the UK, the circumstances were unforgiving and delays could cancel a project. For example, the Martin-Baker MB3 aircraft was a good aircraft during tests, but it was considered outdated because of a few months of delay and late delivery. Consequently, it did not progress to mass production. The value of time during a national crisis may escalate from costing mere financial value to costing lives. In the aftermath of the Japan tsunami disaster in 2011, when urgent measures were issued to contain the Fukushima Daiichi nuclear disaster, each hour of delay increased the risk of nuclear explosion which might have killed thousands.
- **Government intervention**: since a national crisis is a national event, the government is an influential stakeholder. Any national crisis inevitably involves government intervention, whether through legislative effort or various types of support or even direct involvement in particular projects. Rationing is a form of government intervention during a national crisis. During WW2, the British government controlled the raw material such as the aluminium. During the global

financial crisis in 2008, several governments paid from taxpayer's money to private firms to prevent the economy from collapsing. For example, the US Government paid billions to auto manufacturers to avoid millions of layoffs.

- **Emerging threats and opportunities**: almost all contexts have threats and opportunities, however, there are particular threats and opportunities that emerge or gain high probability during a national crisis. Perhaps the most serious threat that increases dramatically during a national crisis is the threat to lives. During wars or the aftermath of natural disasters, people die in hundreds or even thousands. Even during financial crises, which do not show a direct threat to lives, the reports showed dramatic increase in the suicide mortality rate during the financial crisis in East/Southeast Asia in the 1990s (Chang *et al.* 2009) and in the 2008 global economic crisis (Chang *et al.* 2013). On the other hand, one of the most important opportunities that increase during a national crisis is the tendency of people affected by the situation to collaborate.
- **Resources and supply disturbance**: the national crisis is often associated with disturbance in the supply chain or in the resource availability, either material or human resources. For example, natural disasters usually destroy the transportation and communication networks such as what happened in the aftermath of the 2004 tsunami in Indonesia. Another example is in the UK during WW2. Because of the call of duty, the human resources were affected, as many experienced workers left their jobs in various industries to serve in the armed forces.
- **Uncertainty**: national crises are by nature uncontrollable and the series events and their consequences during national crises are least predictable; thus, a national crisis is characterized by uncertainty. The requirements of certain work change rapidly and new realities can emerge suddenly. For example, during WW2 the citizens of the UK were relatively uncertain about the timing at which a bombing raid will arrive and the potential consequences of such a raid.

These are the major characteristics of a national crisis that can affect the project management. In the following section, the particular examples of national crises of this study and their impact upon projects will be presented.

5.5 Case studies of national crises

This research is based upon two case studies. In each case there is an example of a national crisis in which the project success was investigated. In each example the impact of the characteristics of that national crisis upon the projects will be presented.

5.5.1 The national crisis of WW2 in the UK and its impact upon the British aviation projects

World War 2 was a crisis that affected almost every nation on earth with unprecedented difficulties. For example, the casualties of that crisis exceeded 50 million (Harrington 2002). That means a death every 3 seconds during nearly six years of the conflict from 1939 to 1945. This statistic tells how horrible this crisis was.

The impact of WW2 was international. However, some nations and areas suffered more than others. The UK was among those countries that suffered most. UK is a good example from the allied countries in WW2 to represent the difficulties of the war. The socioeconomic system in the UK was significantly affected during the war years due to many events. For example, in the Battle of Britain in 1940 Germany bombed British strategic targets such as industrial facilities and infrastructure. Also in the Battle of the Atlantic, which continued from 1939 to 1945, maritime convoys to the UK were threatened and attacked by German naval vessels such as U-boats.

During this crisis, the characteristic of a national crisis as context for project management materialized and impacted the aviation projects. First one of these characteristics that materialized is the government intervention. The British government controlled many aspects of British life such as business practices, material supply and employment even in private firms. One of the obvious examples of government control is the rationing of several commodities. The British government -through the ministry of food that was created at the outbreak of the war- rationed several commodities such as bacon, butter, sugar, meat, tea, jam, eggs, and milk. This is a form of government intervention in civilian life due to that crisis. In the industrial sector the British government intervened by supporting the aviation industry more than any other industry. Conscription -mandatory

recruitment- was introduced and the government was deciding who works where. This is a form of government intervention in the industrial human resources arrangement.

Another characteristic that accompanies national crises is the emergence of threats and opportunities. In the UK during WW2 this took several forms such as bombing and sabotage. These were threats that disturbed work in several ways. They prevented workers from reaching their work site, or they destroyed the work site itself, or they killed or wounded workers. The aviation production facilities were among the key targets for the enemy and this means the work in these facilities was under constant threat. This continuous threat exerted huge psychological pressure on all project team members. Furthermore, the destruction of a production facility due to a bombing raid causes the work (either projects or production) to stop, wasting some precious time. Also securing project sites from saboteurs and spies or defending them against air raid was a great challenge that exceeded the capacity of normal business firms; it required coordination with national security agencies.

Urgency is also among the national crises characteristics that materialized in the UK during WW2. Many British aviation projects needed to be delivered as quickly as possible because the changing situation might render the product obsolete if it was delayed. For example, the German forces advanced so rapidly that it took less than seven weeks to occupy France. That created a new tactical reality which significantly changed British weapons requirements. Aviation projects needed to be completed quickly otherwise they would be obsolete even before entering production.

Resources and supply disturbance is among the highly influential characteristics that materialized during WW2. The UK is a group of isles dependant to a large degree on imports of raw material from overseas and continental Europe (Edgerton 2011). With the fall of Europe into the hands of the Germany and the sinking of convoys, there was a notable shortage of raw material that affected aviation projects. This disturbance in the materials supply affected the progress of aviation projects and forced the government to control the use of important material such as the aluminium. Also due to the call of duty to serve in the armed forces, many experienced workers left their jobs in industry. An example of such a disturbance is in the mining industry when several tens of thousands of

workers left the industry leaving it suffering from a severe workforce shortage. This shortage led to reduction in coal production which was needed to run the power plants and factories. Also, the war-pushed rapid development of new technologies such as metal works led to a shortage in personnel with required skills.

Uncertainty is a fundamental characteristic that accompanies national crises. This characteristic materialized during WW2 in many forms such as when the citizens of the UK were uncertain about the timing at which a bombing raid will arrive and the potential consequences of that raid on workforce and production facilities. In the aviation industry, the designers of many projects were uncertain about the final specifications. The rapidly changing tactical situation made it difficult to set the final specifications for an aircraft design. This changing situation imposed changes in the specifications and the role of an aircraft. Consequently, the designers struggle to cope with these changes. For example, in March 1940 the scope of the de Havilland Mosquito aircraft project was to produce a reconnaissance-bomber aircraft and 50 units were ordered. Then, the tactical situation changed after the fall of France in June 1940 and the threat of invasion of the mainland Britain becomes a real threat. Consequently, in July 1940 the scope changed, a fighter version of the aircraft was ordered and the amount of production was divided into 20 bombers and 30 fighters. A few months later the tactical situation changed once more when Germany lost the Battle of Britain and the threat of invasion passed away. The order changed once more to become 10 reconnaissance, 10 bombers and 30 fighters. Several variants emerged later in response to other tactical requirements.

All projects during that time were affected by the above mentioned circumstances. The projects which handled these circumstances well succeeded while those which mishandled the circumstances failed.

5.5.2 The national crises surrounding the AHD project and their impact upon the project

While the first set of case studies comprises one crisis and multiple projects, the second case study comprises one mega project threatened by a series of national crises.

In 1952, a military coup led by army officers overthrew the royal regime in Egypt and the country entered a phase of turbulent political and socioeconomic turmoil. In 1954, an ambitious leader called Gamal Abdel Nasser seized power. In 1956, Nasser nationalized the Suez Canal, a decision that triggered the Suez Canal crisis in which Egypt was attacked by Britain, France and Israel. In 1962, the Egyptian army engaged in a war with Yemen. That crisis is known as the North Yemen civil war and continued until 1967. In June 1967 Israel waged a surprise attack on Egypt and destroyed almost 90% of the Egyptian armed forces. This war is known as the Six-Day War. In response to this defeat, Egypt waged a war of attrition against Israel which continued until 1970.

This series of national crises impacted the AHD project and made it vulnerable to high probability high impact risks. If any of these threats and risks materialized the fate of the project would be a failure. The new government after the coups was a totalitarian regime in which the government intervened in every aspect of the Egyptian socioeconomic system. For example, this new regime nationalized private firms.

Economic threats hit the country following the Suez Canal crisis in 1956. For example, the Egyptian assets in UK, France and USA were frozen. This, alongside increased military expenditure because of the war, squeezed the Egyptian economy and affected its ability to finance mega projects such as the AHD. Then, while the Egyptian economy still suffered from the consequences of the 1956 war and the AHD project had already begun in 1960, another burden was placed on that economy by the North Yemen civil war. The expenditure caused by the Egyptian occupation forces in Yemen, which exceeded 70 thousand troops in addition to thousands of support personnel, consumed a sizable portion of the Egyptian economy. This made it even more difficult for the Egyptian economy to support mega projects such as AHD. Then, after the destruction of a considerable portion of the Egyptian armed forces in the 1967 six day war, the rearmament effort and the dedication of the whole nation to the revenge war and the liberation of occupied land placed a huge burden on the Egyptian socioeconomic system. Indeed due to the war, Egypt lost its total income from the Suez Canal and also lost much of its income from tourism, petroleum production and foreign investment. This situation would prevent the country from supporting civilian projects such as AHD and consequently put the entire project at

risk of running out of resources. Also the project and its logistics were at risk of sabotage or bombing because the country was in a continuous state of war from the beginning of the project until its completion. For example, after the 1967 war Egypt possessed very little air defence and the Egyptian skies were almost open to enemy air forces which could reach the project site and destroy it. Moreover, the supplies of project equipment from overseas such as the electricity generators and turbines were under continuous threat of sabotage by the enemies and this needed abnormal measures in the supply management.

Also urgency accompanied the project because of the state of war and several other accumulating problems. There would be catastrophic impacts on the country if the solution of these problems was delayed in addition to the potential risks and consequences of the war. The dam was a very important and urgent solution to these problems. First, the 1952 revolution regime introduced very large economic reform to transform the country from an agricultural to an industrial society. This reform required sources of energy and the best option at that time for the government was hydropower. Reform would not be possible without the cheap power the AHD provided and if the project was delayed the reform would be delayed. The second and more severe problem was that before the dam Egypt was dependant on the Nile River for drinking and agricultural water. When the river's flow decreases the country suffers from drought and when the flow exceeds the limit the country suffers from flood. In both cases there were deaths and economic losses. The solution to this problem was to control the river's flow through the AHD. Any delay in constructing this dam would mean extended vulnerability to the threat of flood and drought. The consequences of these two problems were getting worse each year because of the rapid population growth. Throughout the 1960s the population increased by more than 2.5% annually or on average 0.75million people per year (Awad & Zohry 2005); consequently the demand for food, water, electricity, jobs and other services increased. This rate of population growth would be unsustainable without developing new agricultural lands, producing more energy and modernizing the economy to create jobs. The solution was the AHD and any delay would put the country at great risk.

5.6 Discussion

This chapter has attempted to evaluate the second research proposition. That is,

***P2**: National crises are unique contexts that require a project management approach that is different from a peacetime approach.*

In doing so, the concept of project management during national crises was presented.

Generally, the first step in investigating any concept is to set the definition of that concept in a way that distinguishes it from others. The definition of project management during a national crisis that was proposed above takes the popular definition of project management set by PMI and adds to it the national crisis definition that was compiled from the literature and the language references. By doing so, the resulting definition keeps the new concepts within the bigger umbrella of project management discipline. This creates the opportunity for benefiting from the already well-established tools and techniques in the field of project management and modifying them if necessary to accommodate the new concept.

The concept of project management during a national crisis started to gain momentum in the literature under several titles of research, such as post-disaster project management and non-routine project management. However, a universal comprehensive definition is missing and it is in filling this gap that this chapter has contributed.

The concept and the definition proposed here are for national crises in general. However, there is a need to investigate and classify the national crises further, as each type of national crises can have a specific set of characteristics. This classification is beyond the scope of this research. However, an observation that might enlighten the idea of further classification is that during national crises the threat of death increases dramatically, however the reasons for death differ between different types of national crises. For example, during war people die mostly because of the acts of aggression such as bombing and shooting, while in economic crisis suicide is the main reason for increased deaths as mentioned in Section 5.4.

Presenting the concept of project management during a national crisis opens the debate as to whether there are any differences between the new concept and the already existing

concept of ordinary project management. While this chapter presented some of these differences, the implication of such differences and the characteristics of a national crisis is that they alter the assumptions of the project management processes; for example, due to the urgency accompanying a national crisis context, the time will almost always be the priority for project management during a national crisis. This change in assumptions significantly affects any project feasibility study when it comes to the trade-off between time and cost or other constraints. Moreover, when drafting project procurement procedures for a national crisis situation, the idea of *doing things faster* should be highly prioritized. Also, due to the pressing urgency, the approach of project planning during national crisis should change from *planning ahead* to *planning on the move*. Likewise, this change in the planning approach is a result of the high uncertainty accompanying a national crisis when actions need to be taken based on incomplete knowledge.

The level of government intervention in a project is also an important factor that affects some aspects of the project management processes. For example, the government intervention in the staffing process during peacetime is assumed to be limited to, for example, the general laws of employment in the country, while during a national crisis that level can increase to a point where the government decides who works where. This actually happened in several situations such as the aviation projects in UK during WW2 when the government was assigning priority officers to manage the issues of priority in projects. In addition, the British Government was appointing workers (by name) to different industries and companies. Another example is that during peacetime, raw materials might be available in the market for those who can purchase them, while when rationing is introduced due to a national crisis, the quantities available for use are determined by the government not by the purchasing power. This level of intervention fundamentally affects the level of control a project manager (or a project owner) has over several aspects of the project such as the supply chain.

One of the important characteristics of a national crisis is that new types of threats and opportunities gain higher probability. This has an impact on several project management processes. For example, the risk management plan is based on the type of the risks and their probability. This determines the action needed to deal with such risks. When new types of

risks (such as sabotage) gain higher probability due to a war situation, for example, a higher level of coordination with security authorities is needed to secure the project works and sites. This may alter the level of control a project team has over some aspects of the project such as working hours. Also, there are opportunities that emerge during a national crisis and they should be exploited thoroughly in the project management processes. Among these opportunities is that people tend to be same-minded and think about a common destiny. This makes it easier to direct and motivate them. Consequently, some of the pressure of team management will be minimized and the project manager can focus on other more important aspects of the project.

However, these emerging threats and opportunities are also general and they form an introductory step in building the body of knowledge about project management during national crises. They need to be investigated further to develop a comprehensive set of these threats and opportunities. Then each of these threats and opportunities can be associated with particular types of national crises in order to suggest the best practices to deal with such a threat or an opportunity during a particular type of national crisis. A question that can provoke ideas to assist in this effort is: What are the best practices a project team can apply to deal with security issues in projects during wartime? Another suggested question is: What are the best practices a project team can adopt to exploit the prosocial attitude that emerges during and after a natural disaster?

5.7 Summary

This chapter presented the uniqueness of the national crisis as a project management context to demonstrate the validity of the second research proposition. By doing so, this chapter contributes to the project management literature by presenting the concept of project management during national crisis. It presented a definition of the concept and points of differences between this concept and ordinary project management. It also presented the common characteristics of national crises and their impact upon project management. Two examples from the case studies of this research were used to encapsulate the concept and its implications.

6 Project management during national crises: effective strategies and a success model

6.1 Introduction and objective

In project management, success is an ultimate goal that requires tools and techniques to achieve it. Given the multi dimensions of uniqueness in projects, success tools and techniques should be customized to suit a particular project or a set of closely related projects based on some dimensions such as the project context.

As mentioned in Chapters 4 and 5, the context, or in other words, the environment and circumstances of a project can influence the aspects of project success such as the success factors and strategies. Different contexts may have different influence; consequently, project success aspects may differ from one context to another. In this study managing projects in the context of national crises is the particular interest as this management may require a different approach from that of peacetime as mentioned in Chapter 5. It has been shown in the literature review in Section 2.8 and 2.9 in particular the importance of addressing project management during national crises and the limited knowledge about it. This gap is a driving force behind the third research proposition. That is:

P3: *There are several strategies or techniques which, if adopted, will increase the likelihood of project success during national crises.*

The evaluation and validation of this proposition may include the discovery of several success strategies. The study of the success of a particular project in a national crisis context or any other context may lead to the extraction of the factors or strategies that led to the success of that particular case. However, when the success is repeated in different cases of similar contexts then the search can be for the pattern or the model that enables repeating that success. Based on that, the objective of this chapter is to discover the success strategies for projects during national crises then developing these strategies into a success model (Howsawi *et al.* 2014d). This model is a qualitative generic success model that can be applied in managing projects during national crises so the chances of successful delivery

of those projects may increase. As mentioned in Section 3.5.1.3, this objective will be achieved using multiple case studies for the creation, and the validation of the model. The two main stages of case studies are sufficiently different from each other. These differences are summarized in Table 30.

Table 30: The differences between the main two stages of case studies of this study

	The first portfolio of case studies (The British aviation projects)	**The second case study (The AHD project)**
The context	National crisis	National crisis
The type of the national crisis	War	War
Number of projects included in the analysis	24 small projects	Single mega project
The industry	Aviation - aircraft	Construction- dam
The cultural surrounding	English- European- Industrialized nation	Arab- Middle Eastern- Agricultural nation
The political regime	Democratic	Military
The geographical location	UK-Europe	Egypt- Middle East
The time period	1940s	1960s

Perhaps the creation of a good model requires theoretical and practical work. In the theoretical part after reviewing the notion of project context, success factors and project strategy in Section 2.4, 2.5, and 2.6, this chapter aims to provide a theoretical explanation and a generic model of the relationship between project strategy, success factor and project success.

Following this explanation the practical work comes and the analysis and result of the first main stages of case studies, that is the British aviation project, will be presented. The resulting success strategies and their dynamics form the foundation for creating the initial success model for project management during national crises. The model will contain the strategies and success factors needed for successful project management in such contexts. Then the analysis and the results of the second main stage of case studies, that is the construction of the AHD, will be presented. This second case study works as a validation and refinement case for the initial model.

For extra validation and to demonstrate the applicability of the new model, a third stage that consists of cases different from the two main stages of case studies will be used to discuss the application of the model. The basic premise of these three stages is that if the model can fit the three very different stages then it is a valid model.

This chapter comprises three papers published in the peer-reviewed journal of International Review of Management and Business Research 2014.

6.2 Project success, success factors and success strategies: definition and relationship

The definitions and meanings of project success, success factors and success strategies have been presented and discussed in Section 2.4, 2.5, 2.6, and in Chapter 4. That discussion concluded that the strategy is a higher-level driver to enhance or diminish a particular factor or factors. In turn the success factors, as defined earlier, contribute to the success of a project. Using a general influence diagram, Figure 16 illustrates the strategy-factor relationship in regards to project success.

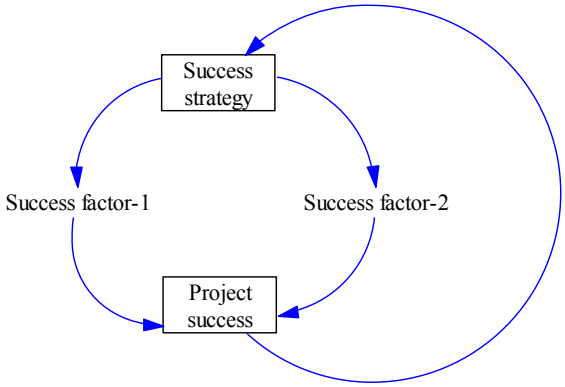

Figure 16: Basic project success-factor-strategy relationship model

The success strategy enhances the success factor which in turn increases the likelihood of project success. When a project succeeds, this success supports the strategy and endorses its correctness.

In reality there are multiple strategies that can be applied simultaneously in a project. These strategies can have mutual impact upon each other. Also a factor can be supported by more than one strategy. This leads to a more complex model to describe the strategy-factor relationship to project success as shown in Figure 17.

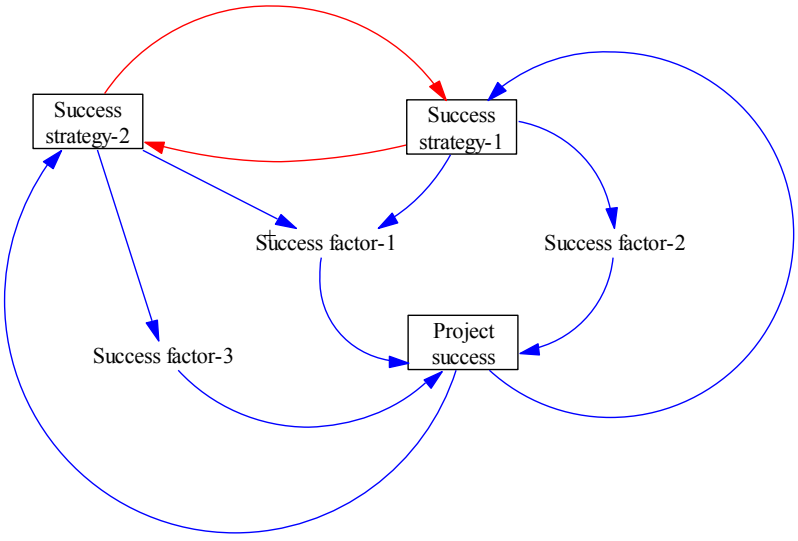

Figure 17: Multiple links project success-factor-strategy relationship model

The complexity of the model increases by increasing the number of strategies included, the number of factors included and the number of relationships between each factor and the supporting strategies. This complexity is illustrated in Figure 18. For abbreviation at this point, this model will be called the generic success model. This is model describes the relationship between project success, success factor and success strategy

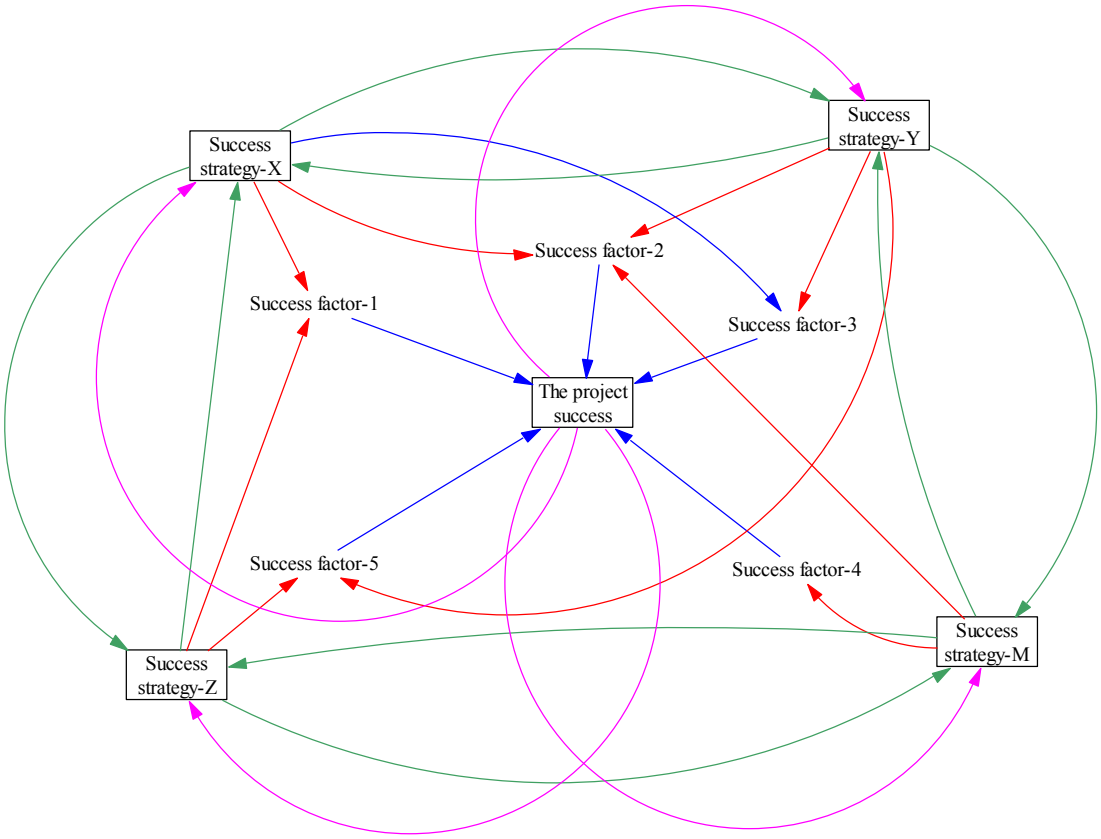

Figure 18: The generic success model

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6.3 Effective strategies for successful project management during WW2 in the British aviation industry

The first stage of this chapter comprises investigating the successes of British aviation projects during the crisis of WW2. The characteristics and the impact of this crisis upon the British aviation projects were discussed in Section 5.5.1.

The case studies of this stage are 24 aviation projects as mentioned in Section 3.5.1.3. The aviation industry in the UK in the 1930s was one of the most advanced in the world. Nevertheless, the inter-war period between WW1 and WW2 witnessed slow progress in this industry. With the signs of war looming on the horizon in the late 1930s, the industry started to shift towards preparation for war. An example of this preparation is the shadow factories plan which aimed to expand the manufacturing capacity of British factories, but this preparation was limited because the threat of war was at anticipation stage, and political effort was focused on the maintenance of peace. However, with the outbreak of war in 1939, the country entered a state of national crisis. The aviation industry was responsible for providing aircraft of all types to support the war effort, and in doing so, many aviation projects were issued. Some projects were an outstanding success, such as the construction of the de Havilland Mosquito and Avro Lancaster, and others were failures, such as the Hawker Tornado. The success and failure of these projects was analysed using the four-level project success framework as mentioned in Section 4.2.4.1. The data of these cases were obtained from various sources and collected using different means as mentioned in Section 3.8.

In Section 3.4 it was mentioned that the research approach used here to answer the main research question is a combined inductive-deductive approach as illustrated in Figure 19. The inductive approach was used at the beginning of the research and was based on an observation followed by a derivative question from the main research question to build the proposition. Then the deductive approach with content analysis techniques was used to extract the results that validate the proposition.

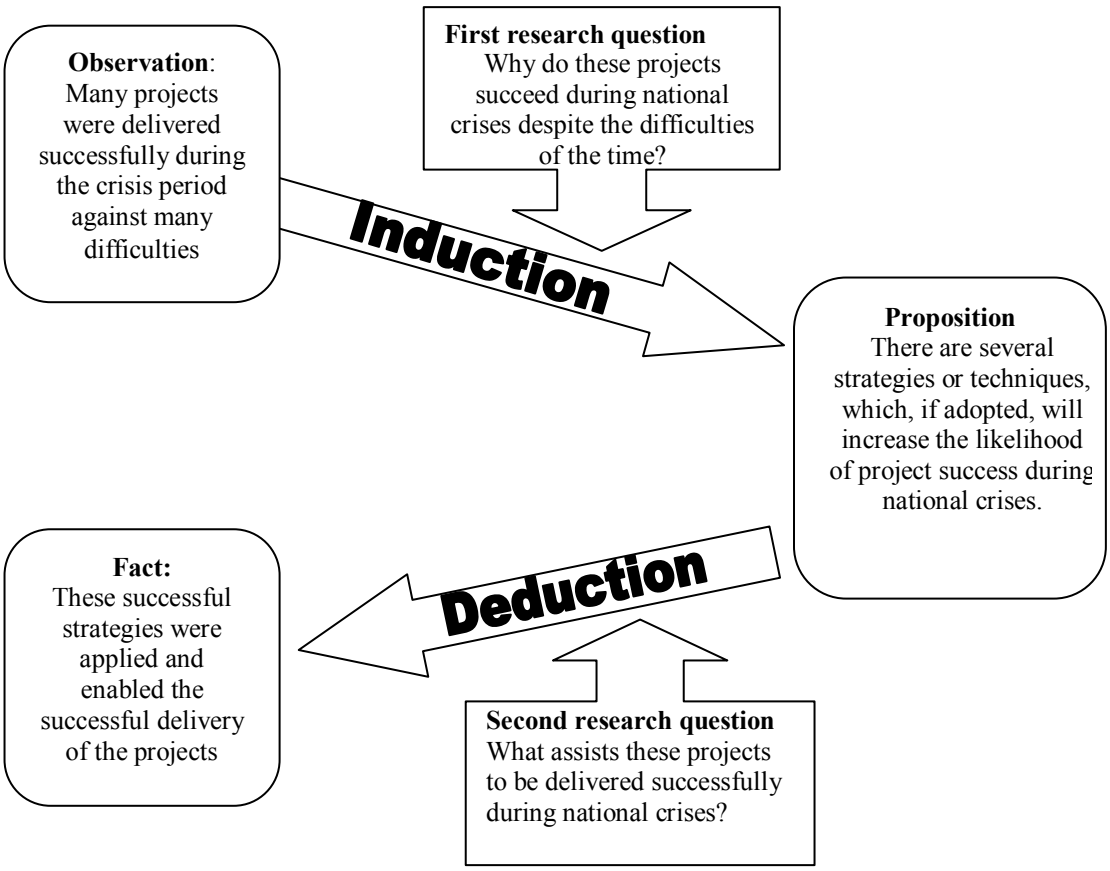

Figure 19: Inductive-deductive approach for this stage of the research

Content analysis was the main data analysis technique used here as mentioned in Section 3.8. For the purpose of conducting the analysis, an analysis framework was designed. The data was coded into four main categories:

- The influential conditions
- The influential decisions
- The influential practices
- The results

The logic for choosing these categories is that the conditions (the context characteristics) induce stakeholders to take decisions in response to these conditions. The applications of the stakeholders' decisions are practices. These practices produce results. Consequently,

the results reflect on the conditions. Figure 20 illustrates the analysis framework designed for this study.

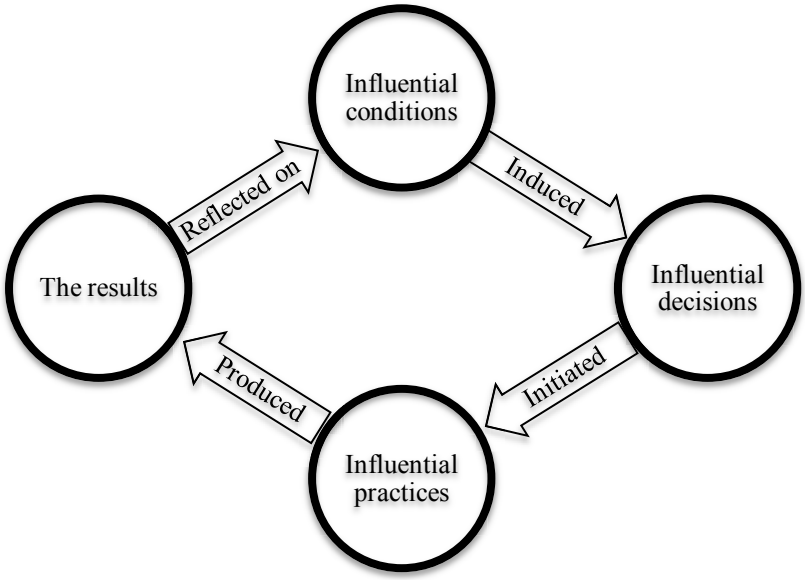

Figure 20: The analysis framework for this study

The influential conditions category contains the main themes or characteristics of the context of the phenomenon under analysis. The influential decisions category contains themes that represent the decisions that stakeholders take in response to the influential conditions. The influential practices category includes the practices that are applied in response to the decisions taken. The results category contains the results generated totally or partially through the practices applied. The success strategies resulting from this study are statements compiled based on the content of the influential decisions category and the influential practices category. An example of the analysis and the application of the analysis framework is that in a collection of Government documents from 1940, reviewed in this study, the discussion about aircraft allotment for development works contains the statement "it is clearly impracticable to attempt to impose a limit on the number of aircraft…. Air staff and operational problems require high speed solutions which can only be obtained on the basis of a separate aircraft for each experiment" (The-National-Archives 1940a). The phrase "require high speed solutions" represents the urgency and was coded in

the condition category. The section that says “it is clearly impracticable to attempt to impose a limit on the number of aircraft” means allowing more aircraft for development work, and this statement was placed in the decision category, The section that says “a separate aircraft for each experiment” means the simultaneous development and testing of subsystems. This statement was placed in the practices category. Figure 21 illustrates the application of the analysis framework to the statement above.

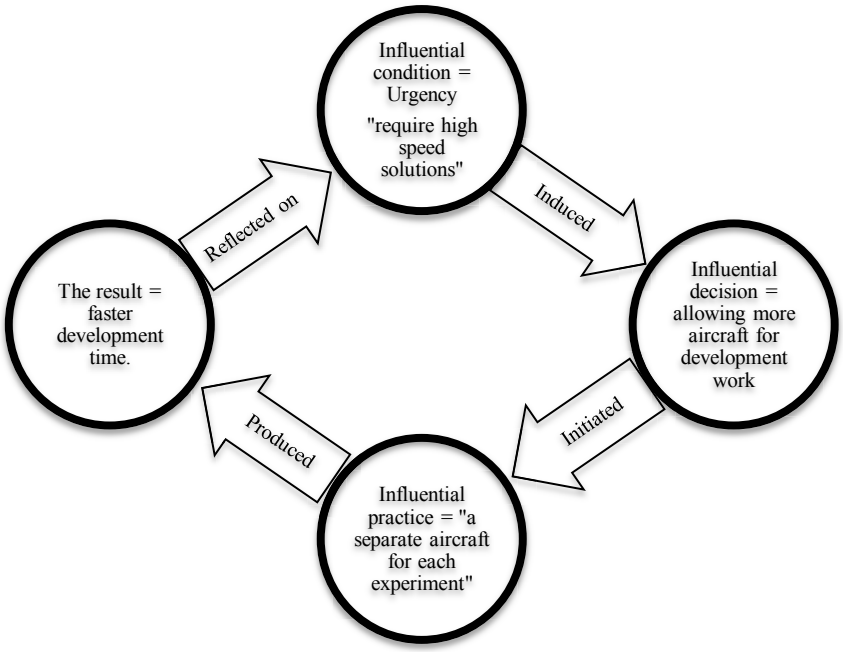

Figure 21: The application of the analysis framework

In another report from the British Air Ministry in 1940, the opening paragraph of the report stated the deficiency in the output of aircraft production in the UK during the month of February, 1940. The statement exactly said “The output of aircraft in this country during the month of February, 1940, was 719 as compared with the planned output of 857” (The-National-Archives 1940b). This statement means a disturbance in the supply and it was coded in the condition category. Following the brief statistics about the output, the report stated several decisions taken to increase the production capacity. The report stated: “The following are the more important measures approved during February to increase capacity for the production of aircraft:

(i) The works of Cunliffe Owen Aircraft Ltd. near Southampton which were established as a commercial venture for the manufacture of civil aircraft, will be extended and equipped by the Air Ministry for the production of Tornado (fighter) aircraft, at an estimated cost of £227,000" (The-National-Archives 1940b).

This quote includes the influential decision which is changing the civilian company (Cunliffe Owen Aircraft) to military production. Also it includes the influential practice which is the government support when it stated "will be extended and equipped by the Air Ministry". The result of such decisions and practices was an increase in the production capacity of the British aviation industry. Appendix A contains examples of the archival documents from which many quotes were used to make inferences.

The analysis revealed six strategies that are effective in delivering successful projects during a time of crisis. Table 31 summarizes these strategies and nine common success factors supported by these strategies. These factors are common success factors mentioned in the literature of project management. Each factor appeared in many studies; at least three references are mentioned here for each factor. There might be some paraphrasing in the factors but the meaning is the same as what the original authors intended.

Table 31: Summary of the success strategies based on first set of case studies

Success strategies resulting from this study	Success factors considered in this study	References from which the success factors were extracted
1.Obtaining Government support. A dedicated ministry for aircraft production 2.Depending on nearby alternative material and workforce 3.Consolidating interagency collaboration 4.Applying a common platform strategy in new product development projects 5.Implementing the strategy of simultaneous development and testing of subsystems 6.Incorporating versatility in the product design	Adequate material supply	(Belassi & Tukel 1996; Fortune & White 2006; Nguyen *et al.* 2004; Pinto & Slevin 1987)
	Adequate work force (includes competent, committed, motivated project manager and team members as well as sufficient staff)	(de Wit 1988; Pinto & Slevin 1987); (Belassi & Tukel 1996; Gemuenden & Lechler 1997) (Chan *et al.* 2001; Chua & Kog 1999; Dvir *et al.* 2006; Fortune & White 2006; Kwak *et al.* 2014; Salleh 2009; Yong & Mustaffa 2012)
	Reduced bureaucracy	(Nguyen *et al.* 2004; Pinto & Prescott 1988; Pinto & Slevin 1987)
	Having priority and authority	(Belassi & Tukel 1996; Fortune & White 2006; Gemuenden & Lechler 1997; Kwak *et al.* 2014; Nguyen *et al.* 2004; Pinto & Prescott 1988; Pinto & Slevin 1987; Yong & Mustaffa 2012)
	Short time for assessment and rework	(Fortune & White 2006; Ika *et al.* 2011; Pinto & Prescott 1988; Yong & Mustaffa 2012)
	Adequate funding	(Chua & Kog 1999; Dvir *et al.* 2006; Fortune & White 2006; Kog & Loh 2012; Nguyen *et al.* 2004; Kwak *et al.* 2014; Yong & Mustaffa 2012)
	Having appropriate expertise, knowledge and equipment as needed	(Nguyen *et al.* 2004; Pinto & Prescott 1988; Dvir *et al.* 2006; Fortune & White 2006; Jo & Barry 2008)
	No communication or transportation loss	(Dvir *et al.* 2006; Gemuenden & Lechler 1997; Kwak *et al.* 2014; Nguyen *et al.* 2004; Pinto & Slevin 1987)
	Having public support	(Ika *et al.* 2011; Jo & Barry 2008; Kennedy 2005; Nguyen *et al.* 2004; Yong & Mustaffa 2012; Yu & Kwon 2011)

Putting these strategies and factors into the generic success model illustrated in Figure 18 resulted in the specific model for the case of the British aviation industry during WW2 as shown in Figure 22. The six strategies of this model are explained below.

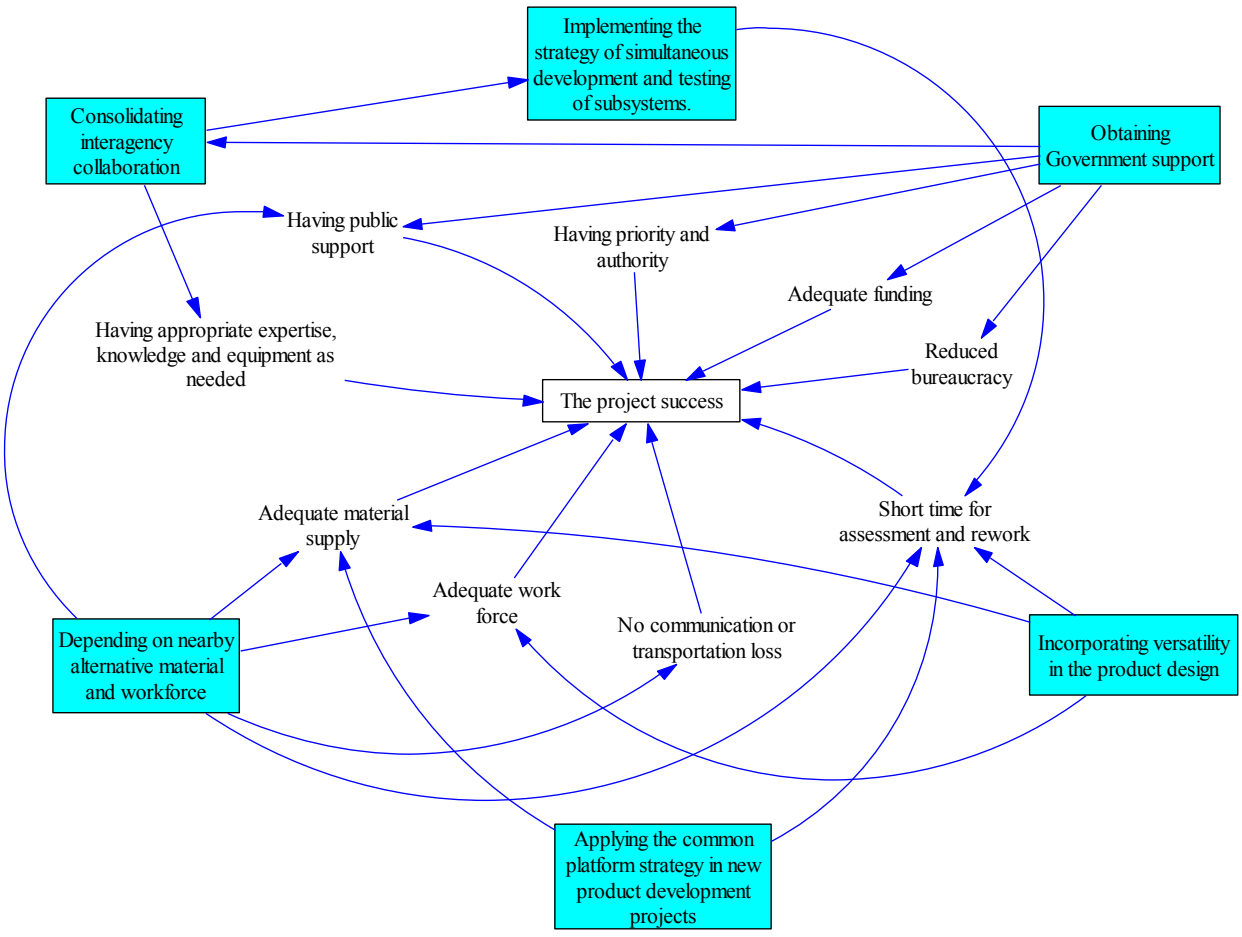

Figure 22: Specific success model for the British aviation projects during WW2

Strategy No.1: Obtaining government support: A dedicated ministry for aircraft production.

During times of crisis, businesses face difficulties in obtaining the required resources, permissions to work, or special services. This was the case in the UK during WW2. Because the nation was at war, the Government imposed many restrictions on the British socioeconomic system. Government support in such a situation is an essential ingredient for success. The aviation industry enjoyed the privilege of having exclusive support at the

highest governmental level. There was a dedicated ministry to exclusively support aviation projects, an action which was somewhat similar to the cheetah teams proposed by (Engwall & Svensson 2004). This ministry was called the Ministry of Aircraft Production. All other war-related projects came under the jurisdiction of the Ministry of Production.

The impact of this support was that the obstacles hindering aircraft projects were discussed at Cabinet level. The reports of the War Cabinet reviewed in this study show that many discussions about aircraft projects took place. Decisions made by the War Cabinet were translated into priority for aircraft projects, which meant they were afforded extra resources or special permission. The Ministry of Aircraft Production was exclusive to the crisis period. It was created a few months after the outbreak of WW2 and before the Battle of Britain in July 1940. Three months after the war it was attached to another ministry, and eight months later it was abolished.

Other forms of government support were the security services the Government provided to projects. This was essential, because during national crises new types of threats emerge (such as sabotage) which exceed the capacity of normal business firms to handle. For example, national security agencies participated in deception plans and camouflage to disguise projects sites and production facilities against air raids.

Seeking a strong project supporter such as the government is not an exclusive strategy for times of crisis. However, it is very important to seek a supporter who can grant the project the required authorities, priorities and resources. Perhaps during national crises government is the best to offer that support. Without the priority the aviation industry was granted during the years of WW2, it might not have achieved all that it did.

Strategy No. 2: Depending on nearby alternative material and workforce

One important condition that emerges during national crises is the disturbance of supplies and the shortage of skilled labour (Howsawi *et al.* 2014c). In addition, the risk of transportation loss increases dramatically; for example, a bombing raid can paralyse transportation for days. So that, reliance on sources of materials and workforce that require long distance transportation to the project site put the whole project at risk of running out of resources due to transportation loss.

This was a condition of considerable impact on the British aviation industry during WW2. Nevertheless, some projects overcame this condition and succeeded in producing some of the finest aircraft of the war period. One of these projects was the de Havilland Mosquito. One of the main strategies that contributed to this project's success was the use of available nearby alternative material – wood instead of aluminium. The wood supply was plentiful because most projects had abandoned wood in favour of metal. In addition, wood was available in Britain (Edgerton 2011), unlike aluminium, of which more than half was imported (Weir 2003). By using wood, the project and the company also benefited from the availability of carpenters who worked in trades less essential to the war effort, such as furniture-making so those workers could be easily redirected to work in this aircraft production. This strategy reduced the impact of the shortage of skilled metal workers. Furthermore, the carpentry shops around the country could easily be modified to produce this aircraft's parts. This style of innovation is required to help projects to benefit from the available local resources to avoid running out of resources due to scarcity.

Strategy No. 3: Consolidating interagency collaboration

In the course of managing a project, there might be phases that require information, knowledge, or technologies that are not in-house; for example, the results of the research and development phase of a product component. In peacetime, companies usually retain their information, knowledge and technology – especially the secrets of their R&D – as a competitive advantage and may refuse to collaborate with rivals no matter what the immediate financial benefits might be.

In the UK during WW2, interagency collaboration was well-practiced; consequently, the development time was reduced. This collaboration was ordered and enforced by the Government. In the document reviewed in this study, there were many Government orders to companies to share the results of their R&D or their facilities with other companies (peacetime rivals) to reduce development time. For example, The Fairey Aviation Company and Vickers were rival aircraft manufacturers yet they were encouraged by the government to collaborate in the pressurized cabin for high altitude bombers.

Failure to collaborate during national crises may lead to delays and overruns when they are least welcome. The consequences of delays during national crisis time exceed the financial losses to causing greater losses such as lives.

Recent examples that support this strategy are the reconstruction projects in Afghanistan following the 2001 war. The lack of sufficient interagency collaboration led to delays and overruns in reconstruction projects funded by the US (Sopko 2012).

Strategy No. 4: Applying the common platform strategy in new product development projects: The conservative approach.

Greater uncertainty is one of the conditions of a national crisis. There are plenty of sources for uncertainty in such a context, and there is a consequent need for uncertainty reduction strategies.

The aircraft industry during WW2 was in its early stages and the major components of aircraft were limited. These major components were at that time, the engine and airframe. It is much easier to modify, adapt or rework the airframe than the engine, so the engine has greater criticality in respect of the fate of an aircraft project.

In the UK during WW2, the project design teams followed one of two approaches when a project to develop an aircraft was initiated:

- To design an airframe around an existing and fully operationally tested engine. This approach can be called the conservative approach; or
- To design an airframe based on a perceived engine where the engine was at either the specification stage or the factory test stage, but was not in full operational use. This approach can be called the pioneering approach.

All the projects in this research that succeeded in achieving more than 500 units of production were the result of projects that followed the conservative approach; that is, 13 out of 24 projects. On the other hand some of the unsuccessful aircraft which scored less than 250 units of production followed a pioneering approach, namely the Avro Manchester and Hawker Tornado projects. For example, the Avro Manchester failed because the Vulture engine was under development when the aircraft was designed. The same design was later modified to accommodate the Merlin engine, which was fully operational, and the

result was the Avro Lancaster, which was one of the most successful bombers in British aviation history.

Following a conservative approach may reduce the uncertainty that might result from using new, untried complex components in a new product development project. It is observed that the British aviation industry followed the conservative approach as a guiding rule. The Government documents used in this study showed many orders enforcing this approach.

Nevertheless, although the majority in the industry followed a conservative approach, this does not mean that there was no research or pioneering trials. Some works, such as R&D, are pioneering by nature. Also, following this approach does not conflict with the uniqueness of a project because by definition the combination of proven vital components (the engine) with a new, less vital component (airframe) will result in new aircraft that perform a unique set of tasks.

Strategy No. 5: Implementing the strategy of simultaneous development and testing of subsystems

During national crisis time is considered to be among the top pressing factors as mentioned in Chapter 5. Things need to be achieved quickly otherwise the rapidly changing circumstances may bring unwanted surprises. This was the case during WW2; the urgency to produce weapons was a pressing condition for British industries. To deal with this condition, the British aviation industry adopted a strategy of simultaneous development and testing of subsystems to reduce the overall development time. In applying this strategy, they developed and tested the subsystems of an intended aircraft on multiple experimental aircraft before assembling them all in the intended airframe. For example, a gun might be tested on an experimental airframe even before the intended airframe was finished, rather than waiting until the airframe was complete then mounting the gun on the finished frame for test and trial.

This strategy by the British aviation industry during WW2 has now evolved into a more sophisticated technique called concurrent engineering which considerably reduces development time (Smith 1997). Although this strategy works in crisis time as well as

peacetime, the pressing urgency during crisis time makes this strategy essential for meeting time requirements and achieving project success.

Strategy No. 6: Incorporating versatility in product design

During times of crisis, a common problem is that requirements change rapidly. This requires many changes in specification during the development or application of the product. One strategy that helped some British aviation projects to neutralize the impact of changing requirements during WW2 was the versatility of the product. The de Havilland Mosquito and the Avro Lancaster, for example, were easy to modify to serve new roles. This feature gave them a high level of success at the product level of the four-level success framework. This feature considerably reduced the response time needed for changing requirements. For example, in the case of the de Havilland Mosquito, several changes to the aircraft specifications were requested after the contract was signed, yet the company managed to deliver the required quantity on time due to the versatility of the aircraft design.

These six strategies were found to be notable in helping the British aviation projects to succeed during the crisis of WW2.

6.4 An initial success model for project management during national crises

The model presented in Figure 22 is a particular model for the British aviation cases. Some re-writing might be needed to make the model generic. The strategy (obtaining government support) is general so that there is no need for re-writing. The strategies (applying a common platform strategy in new product development projects), (incorporating versatility in the product design) and (implementing the strategy of simultaneous development and testing of subsystems) are components of what is known now as concurrent engineering. For example the journal of concurrent engineering research and application contains many articles that address topics similar to these strategies. Also, concurrent engineering advocates for strong communication and information sharing (Pardessus 2004) and multiple expertise or cross functional teams in projects (Smith 1997). Because of that these strategies were combined under the title (adopting concurrent engineering). This could be more compatible with the terminology of modern research and also the readers may easily

know which literature they should review for more knowledge about this strategy. The strategy (consolidating interagency collaboration) is actually a specific form of collaboration which is a subtype of national collaboration. This collaboration can be between agencies, professionals or general public. It is the matter of having the nation interested and committed to support the project. Thus, this strategy will be re-written as (consolidating national interest and collaboration for the project). The strategy (depending on nearby and alternative material and workforce) is about making the best possible use of the material available in the area of the project and also having the personnel either from the area or in the area of the project. The material is not necessarily (an alternative) but it could be the main type and yet available nearby. Thus, this strategy will be re-written as (depending on nearby material and workforce). Also some success factors will be paraphrased as in Table 32 for the sake of better wording.

Table 32: Paraphrasing the success factors

Success factors as mentioned above	Paraphrased success factors
Adequate material supply	Adequate material supply
Adequate work force (includes competent, committed, motivated project manager and team members as well as sufficient staff)	Adequate work force
Reduced bureaucracy	Reduced bureaucracy
Having priority and authority	Having priority and authority
Short time for assessment and rework	Timely response to incidents and change
Adequate funding	Adequate funding
Having appropriate expertise, knowledge and equipment as needed	Availability of appropriate expertise, knowledge and equipment as needed
No communication or transportation loss	Efficient communication and transportation
Having public support	Sufficient public support

Figure 23 represents the generic success model for project management during national crises. The colours in the diagram are for enhancing the presentation only.

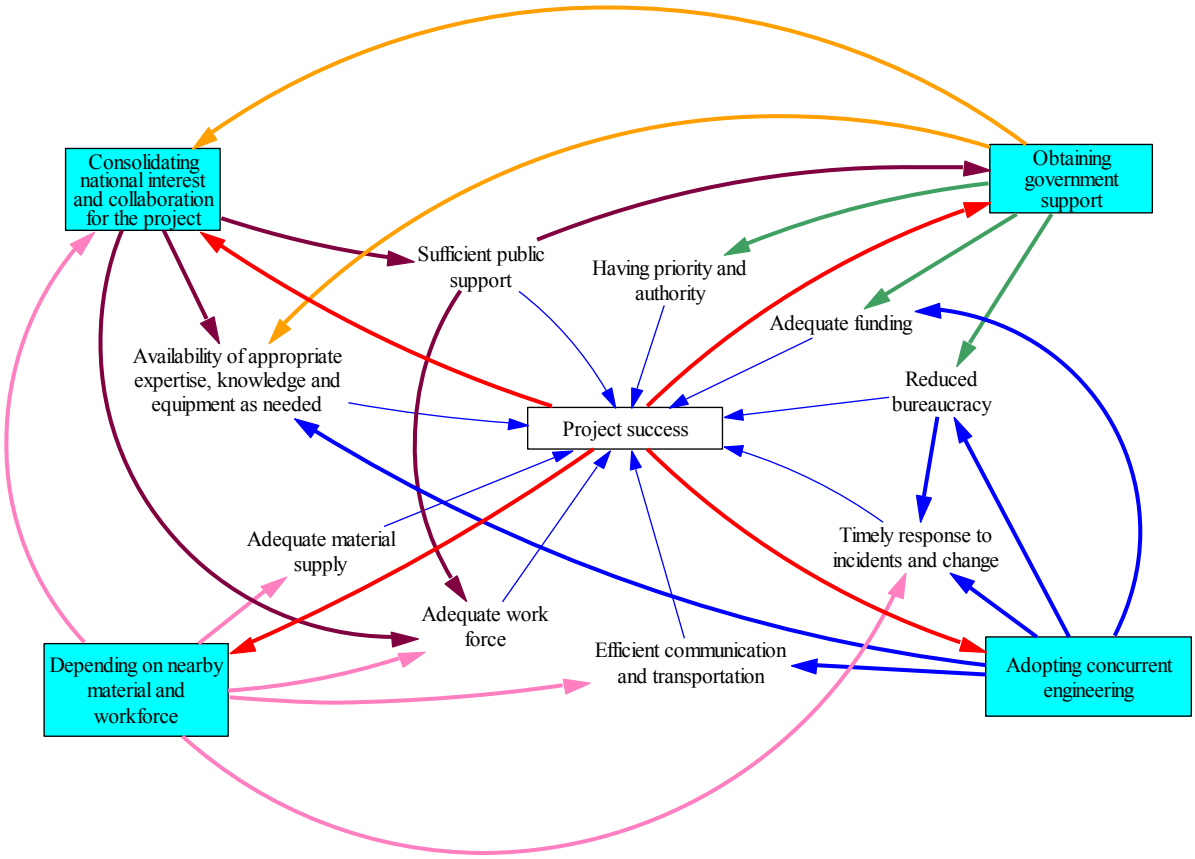

Figure 23: Generic success model for project management during national crises

6.5 Effective strategies for successful project management during the 1960s crises in Egypt

The second stage of this research consists of a single but very large project as mentioned in Section 3.5.1.3. This stage comprises investigating the success of the construction of the AHD in Egypt during a series of national crises in the 1960s. That era involved many national crises such as the North Yemen civil war, the Six-Day War and the war of attrition. Section 5.5.1 contained the elaboration and discussion about the characteristics and the impact of these crises upon the project.

The dam was a successful construction project in the 1960s, nevertheless, it is still yielding economic benefits to the country and it is a source of national pride for the Egyptians. The four-level project success framework was used to evaluate the success of this project as mentioned in Section 4.2.4.1.

Here also, the data of this case was compiled from various sources, obtained from various sources and collected using different means as mentioned in Section 3.8. to benefit from the advantages of the data sources triangulation.

In this stage the research approach is similar to the one in the first stage but a few modifications were inserted in the framework to suit this stage as illustrated in Figure 24.

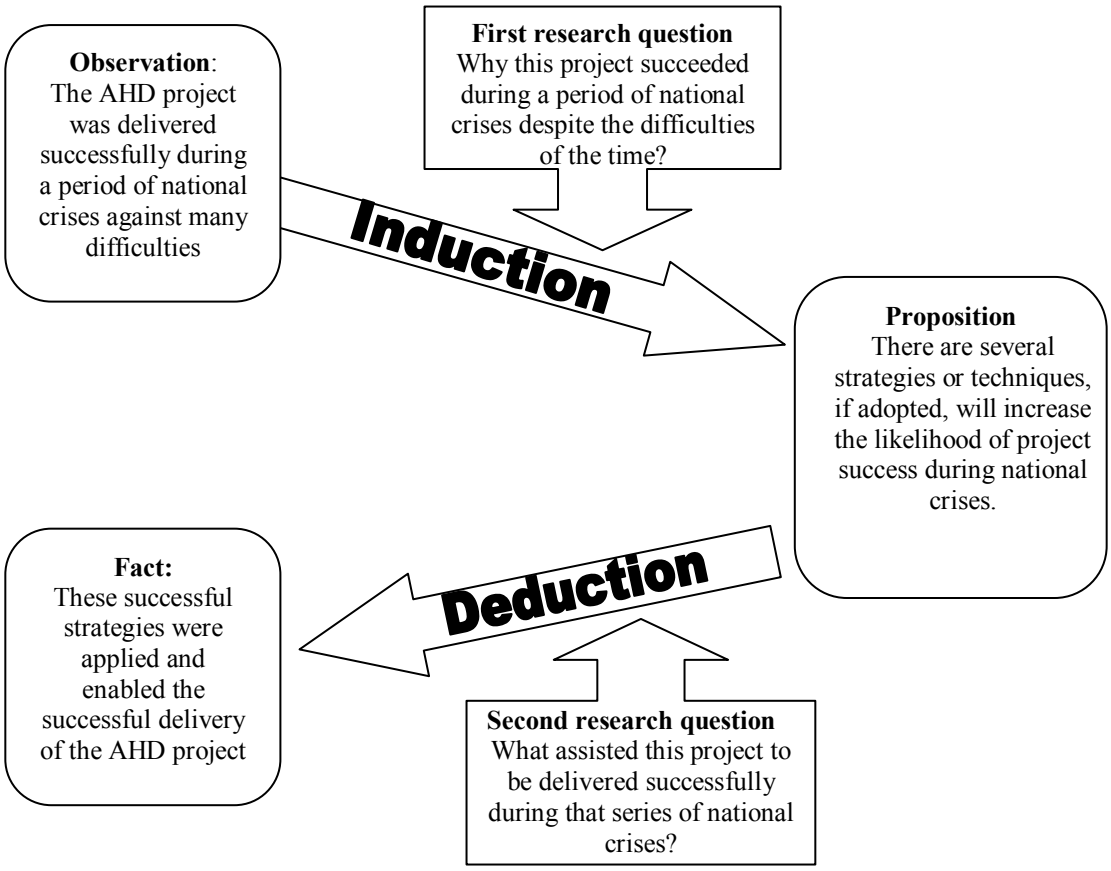

Figure 24: Inductive-deductive approach for this stage of the research

In this stage, content analysis was also the main data analysis technique used here as mentioned in Section 3.8. A similar analysis framework as the one in Figure 20 was used and the data was coded according to the categories of this framework.

The application of the analysis framework in this stage is illustrated in Figure 25. For example, an interviewee described the onsite supervision of the Minister of High Dam as an important practice in the success of the AHD project. From other documents, it is discovered that the Ministry of High Dam was established exclusively to supervise this project. Also from another source, information about the political instability during the 1960s in Egypt was revealed, and finally, there was information that the success of the AHD supported the government politically. The relationship between these disparate pieces of information was established by placing "political instability" under the category of influential conditions. The government, which is the owner of the AHD project, responded to this instability with a decision to establish an exclusive ministry called "Ministry of High Dam" operated by a powerful minister who reported directly to the President of Egypt. This ministry brought all the required support and authorities including the minister himself, to the AHD project site. The result was a very fast decision cycle which enabled corrective action to be taken on the spot as problems occurred. This result contributed to the success of the project and this success supported the image of the government and helped it in bringing political stability in the country.

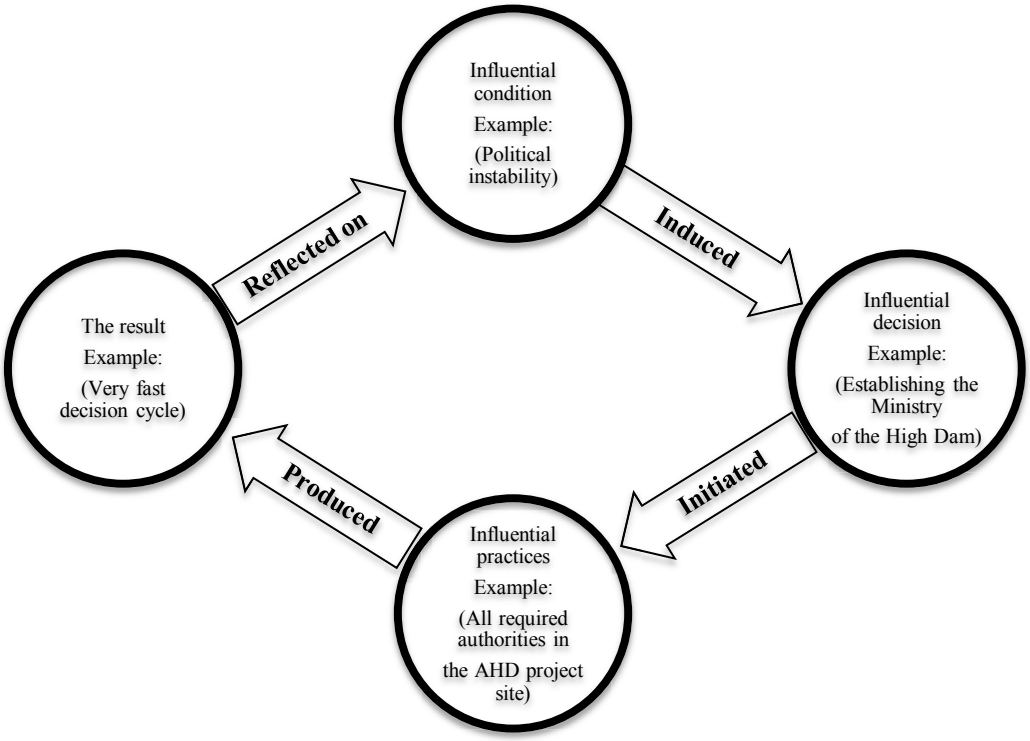

Figure 25: The application of the analytical framework in this stage

In another example one interviewee said "the project slipped one year behind schedule"; this quote means urgent measures were needed to rectify this problem so that this quote was placed in the influential condition category. The project management took several decisions to rectify the problems of the project, among which was that the work should continue for 24 hours a day 7 days a week. This decision was placed in the influential decision category. The workers, in response to that decision, worked for three shifts 8 hours each and a worker did not leave his post until the next worker arrived. If the next worker did not arrive, the first worker continued in his job. Many workers exceeded their scheduled hours to keep the work in progress. This was an influential practice by the project team members. Consequently, the result of such decision and practice was that the project returned on schedule and continued as such until the end of the project.

Four success strategies resulted from this analysis namely; consolidating national interest in the project, obtaining government support, co-locating all personnel and equipment at the project site and depending on local material and workforce. These strategies and the

factor they support are mentioned in Table 33. The factors are similar to those mentioned in Table 31 with very minor differences.

Table 33: Summary of the strategies identified in this stage and the success factors they supported

Strategies	Factors
1. Consolidating national interest in the AHD project 2. Obtaining government support for the AHD project 3. Co-locating all personnel and equipment to the AHD project site 4. Depending on nearby sources of material and workforce	1. Adequate material supply 2. Adequate work force 3. Reduced bureaucracy 4. Having priority and authority 5. Short time for assessment, decision and action 6. Having public support 7. Adequate funding 8. High morale in the project team 9. Availability of appropriate expertise, knowledge and equipment as needed 10. No communication or transportation loss

These strategies and factors formed the specific success model for the AHD project as shown in Figure 26 using a general influence diagram.

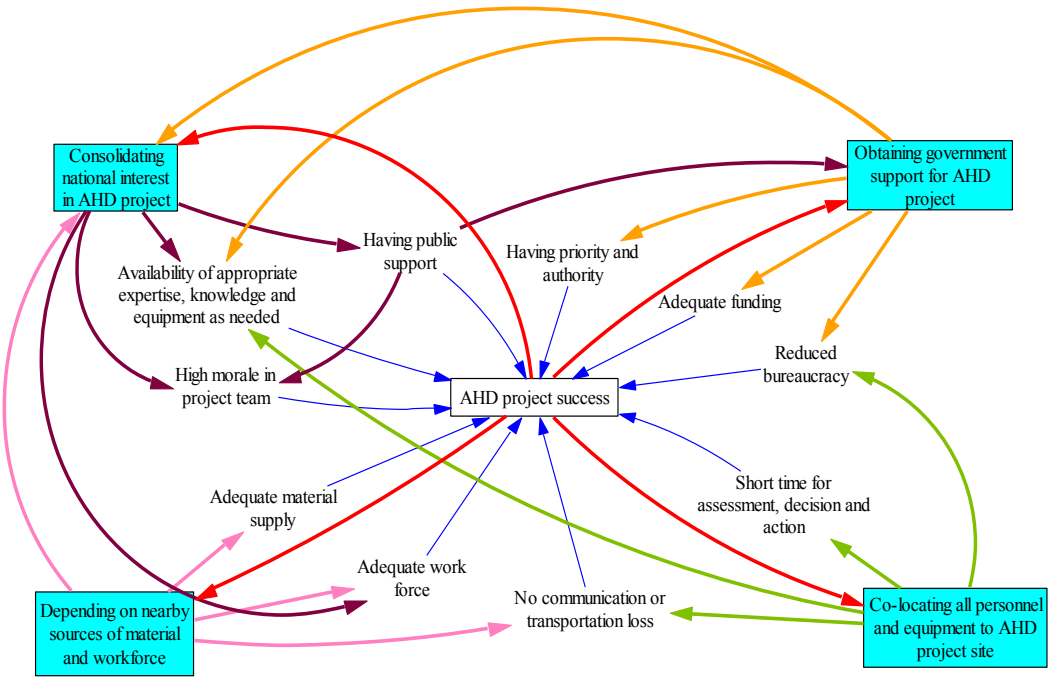

Figure 26: The specific success model for the AHD project

Below is the explanation of the four success strategies extracted from the case of the AHD project.

Strategy No.1: Obtaining government support for the AHD project- an exclusive ministry called the Ministry of High Dam

As mentioned before, during times of national crisis, businesses face difficulties in obtaining required resources or permissions to work or special services. In such circumstances, there is a keen need for a strong sponsor who can obtain the required resources or permissions or special services for the project. The AHD project enjoyed the strongest sponsorship possible at that time. Unlike any other project or major endeavour at that time, a dedicated ministry called the Ministry of High Dam was created. This ministry was established exclusively to oversee all aspects of the AHD project. This is similar to the case of the British aviation industry discussed above.

The Ministry of High Dam was authorized to take any necessary executive, financial or political decisions in relation to the project and reported directly to the President. This gave the project priority all over the country.

Another form of government support was the security services the government provided to that project. For example, national security agencies participated in deception plans to protect the shipment of vital project components such as the turbines and generators against possible sabotage by the enemy.

Strategy No.2: Co-locating all personnel and equipment to AHD project site

One important aspect of any project is schedule management. Faster response to incidents means a higher likelihood of the project staying on schedule. The AHD project was a monumental project, yet it was completed on time despite all the difficulties. A strategy that helped to facilitate this schedule achievement was the co-location of all personnel and equipment to the site. Prior to applying this strategy, the project's top management was located in Cairo, some 1000 km away, and they relied on casual visits to the project site and reports sent to them to keep abreast of progress. As a result, the project slipped more than one year behind schedule. By applying this strategy, all personnel, including the Minister of High Dam, were housed adjacent to the project site. Consequently, the response time to any incident was reduced to a minimum possible. All technical and managerial decisions were taken on the spot. For example, if any incident arose, the Minister of High Dam called for an "on the spot meeting" to assess the incident technically and make an immediate corrective decision. Having all responsible personnel on site also kept bureaucratic correspondence to a minimum, which in turn supported faster action.

This strategy is also not exclusive to the crisis context, but because during a crisis period time becomes a very pressing factor, applying such a strategy becomes critical. Also other risks associated with national crises, such as the loss of communication and transportation affect the progress of projects but applying this strategy mitigates the negative effect of such risks.

Strategy No.3: Consolidating national interest in AHD project

As mentioned in Section 5.3 one of the effects of a national crisis and the stress accompanying it, is that it draws people closer to each other. The Egyptian Government (as the AHD project owner) exploited this phenomenon and used the national crisis of the 1956 war to create a national interest in the AHD project through extensive propaganda. This generated very considerable public support, making many of the citizens keen to help, and many bright minds in the country wanted to work on the project.

At first glance, this strategy does not look like a PM strategy. However, when after investigating the reasons for the high morale of that project's workers, it was found that many of the project personnel believed in the AHD as their own family project. Despite the harsh work conditions, such as temperatures above 50 C° and poor safety, the number of workers exceeded 30 thousand and more were waiting to join the workforce. The workers often exceeded their shifts without overtime pay.

Strategy No.4: Depending on nearby sources of material and workforce

In managing projects during national crisis, reliance on sources of materials and workforce that require long distance transportation to the project site put the whole project at the risk of running out of resources due to transportation loss. Also the people who are not indigenous to the place may face more problems in coping with the environment or the social system.

In the AHD project, most of the workforce and the material used in the construction were from the Aswan area. This reduced the risk of transportation loss and also guaranteed an adequate supply of workforce and materials such as concrete and sand. Transporting workforce or importing materials from far away can be cheaper, but the risk will be very high and during a national crisis, mitigating the risk of failure has a higher priority than the cost. Also, the people from Aswan were more capable of coping with the environment of the project site. The workers from the Soviet Union for example, who were from a different environment, faced difficulties in coping with the project site environment.

6.6 Does the initial success model accommodate the validation case?

As mentioned above the model in Figure 23 is a generic model constructed based on the case studies from the British aviation industry during WW2. The next step is to validate this model on a case sufficiently different from those used to create it. The model in Figure 26 is a specific success model for the AHD project. The differences between the aviation cases and AHD case are mentioned Table 30.

The first strategy in the AHD success model is (Obtaining government support for the AHD). This is exactly the same strategy in the generic model in Figure 23 and also the same strategy in the aviation projects in Figure 22. Furthermore, the application of the strategy is identical; creating a dedicated ministry to supervise a particular endeavour for a limited time bounded by the life cycle of such an endeavour. Nevertheless, government support is not limited to the creation of a particular ministry but it can be in many forms such as financial and legislative support.

The second strategy in the AHD success model is (co-locating all personnel and equipment to the AHD project site). This strategy is comparable to the strategy (depending on nearby material and workforce) in the generic model and in the aviation projects. As explained above, this strategy is about having all required personnel, equipment and material nearby the project to enhance several success factors such as the availability of material and response time to incidents.

The third strategy in the AHD success model is (Consolidating national interest in the AHD project). This is comparable to the strategy (consolidating national interest and collaboration for the project) which includes the strategy (consolidating interagency collaboration) from the aviation projects. The national interest and collaboration took different forms between the AHD and the aviation projects. At the AHD the national interest was observed in the individuals who were eager to collaborate in the project. For the sake of national pride workers in that project bore the harsh work conditions, such as temperatures above 50 C° and poor safety. In the British aviation projects the national collaboration was observed in the collaboration between companies who were rivals in peacetime. For example Vickers and Avro were heavy bomber manufactures who competed during peacetime but they turned to full cooperation during the crisis of WW2. In

both cases, the AHD and the aviation projects, the government supported and encouraged this national collaboration and this is why the strategy (consolidating national interest and collaboration for the project) is supported by the strategy (obtaining government support).

All the four strategies of the AHD model are included in the generic model but the generic model still has one strategy that does not appear in the specific model of AHD; that is (adopting concurrent engineering). The reason is that the data available for the research did not show concrete evidence of such an approach. Also, the AHD is a dam project. A dam is unique construction in itself so that it cannot be versatile and the major component which is the dam's body cannot be shared. However, the importance is that the generic model accommodates the AHD case and other cases. It is not necessary that all the strategies of the generic model appear in every case all at once.

The success factors in the generic model are 9 while in the AHD model are 10 but this is a negligible difference. The extra factor in the AHD model is (high morale in project team). In the generic model this factor is included in the factor (adequate workforce) as this factor means competent, committed, motivated project manager and team members as well as sufficient staff.

Apparently, the generic success model in Figure 23 accommodates the initial case studies of the British aviation industry and the validation case of the AHD project but will it be able to interpret the success of other cases? This will be addressed in the discussion to come.

6.7 Discussion

The Generic success model for project management during national crises presented in this study in Figure 23 can interpret the success of many cases other than those used to create it. For example, the great depression in the United States in the 1930s was a typical example of a national crisis. During that crisis the Hoover dam construction project was completed successfully (Kwak *et al.* 2014). Kwak *et al*. (2014) reported that "the concept of the project was well understood by both public and private agencies leaving no doubt about approving the project idea" and this is comparable to (consolidating national interest and collaboration for the project) in this study's success model. Furthermore, it was proposed in

this study that the collaboration can take several forms such as interagency collaboration. Interestingly, Kwak *et al*. (2014) reported that "cooperation between six companies' project personnel and the resident construction engineer assigned by the Bureau of Reclamation helped the project team overcome various technical and operational difficulties of the project". Also they reported the following points:

- The Bureau of Reclamation, as the government agency in charge of the project helped the entire project team overcome serious challenges, such as debates and critics during review of the legislation in Congress, labour strikes during the construction phase, lobbying to secure the adequate annual funds
- The Hoover Dam project team enjoyed a supportive relationship with the federal government during the course of the project from the initiation phase to the final stages of the construction".

These two points are exactly what is meant by the strategy (obtaining government support) in this study. Moreover, the authors proposed the strategy of (adopting concurrent engineering) and interestingly, Kwak *et al*. (2014) reported that "the contractor worked on the four diversion tunnels at the same time during winter 1931–1932 and finished the job before spring; this strategy contributed to the project completion two years ahead of the schedule". The success model proposed in this study could- almost completely- interpret the success of the Hoover dam project.

Other broad cases which can be explained by the success model of this study are post-disaster reconstruction projects. The post-disaster context (e.g. post-war, post-flood, and post-earthquake) is another typical example of a national crisis which contains conditions mentioned in Chapter 5 such as "emerging threats and opportunities" and "resources and supply disturbance". In such context, community empowerment and participation are critical to the success of the reconstruction project (Sadiqi *et al.* 2013). From a post-war reconstruction case study it is concluded that developmental approaches to reconstruction must be culturally rooted and dependent to a large extent on the empowerment of local communities (El-Masri & Kellett 2001). This is exactly comparable to the strategy (consolidating national interest and collaboration for the project) in the success model of this study. Also it is reported that "local government support" (Sadiqi *et al.* 2013) and

"Government response and intervention" (Chang *et al.* 2012) are essential for reconstruction project success. This is identical to the strategy (obtaining government support) presented in the success model of this study. The scattered distribution of the materials is reported as a major problem for post-disaster reconstruction projects (Baradan 2006). Also, the transportation is a major concern in a post-disaster context because of the loss of the transportation means or roads due to the disaster (Chang *et al.* 2012). The strategy (depending on nearby material and workforce) in the model of this study is a remedy for such a problem. In a post disaster reconstruction project it is reported that effective communication and coordination among stakeholders would result in enhanced project performance (Kim & Choi 2013). Also, Sidiqi *et al*. (2013) reported that "communication and information dissemination" is an important factor for the success of reconstruction projects. In fact these recommendations are essential parts in the concurrent engineering strategy which was presented in the success model.

Also other particular cases can be interpreted using the success model of this study; the Chilean miners rescue project in 2010. The context of a rescue endeavour is an example of a crisis that has not only a national but an international impact. The characteristics of a national crisis mentioned in Chapter 5 appeared in this short-term, high-impact project. The government intervened and took over the rescue operation, the operation was urgent and uncertain and the 33 lives trapped more than 2000 feet below ground were under extreme threat. Nevertheless, the rescue endeavour lasted for 69 days and was a great success; all the 33 lives were saved. In that project, the country's president was the topmost responsible person in the rescue endeavour. This brought the whole government support to the project. The mining minister was on site 24 hours a day, seven days a week and this is comparable to the strategy (depending on nearby material and workforce). By the support of the government and the relocation of the minster and his team to the site, all the required authorities, expertise and priorities were thus brought directly to the project. Also this project enjoyed the collaboration of more than 20 companies which volunteered their equipment, personnel and expertise. This a practical application of the strategy (consolidating national interest and collaboration for the project) mentioned in the success model. Furthermore, the mining minster formed a top crisis management team with diverse

expertise and specialties (e.g. mining engineering and psychology) from different companies and government departments to oversee the rescue effort. This action is at the heart of the concurrent engineering mentioned in the success model. These actions strongly supported the success of that project (Crenshaw 2010; Useem *et al.* 2011).

As shown above, the generic project success model can interpret the success of cases other than those used to create it. It can interpret a particular case such as the Hoover dam project or a broad type of cases such as post disaster reconstruction. This gives the model better generalizability.

Now, the third research proposition can be discussed. That proposition is:

P3: *There are several strategies or techniques which, if adopted, will increase the likelihood of project success during national crises.*

It has been shown above that indeed some strategies contributed to the success of the main case studies of this thesis. Moreover, when these strategies were arranged in the success model for project management during national crises they appeared to contribute to the success of external cases other than the main cases of this study. This is an evidence to support the validity of this proposition.

It worth mentioning that these success strategies have no significant order between them and they are not dependent upon each other. However, they are mutually supportive to each other as shown in the model. Also the positive relationship of these strategies to the success means the existence of a strategy will enhance the chances of success while the absence of such a strategy will reduce the chances of success.

6.8 Summary

The success of projects during national crises can be achieved through the application of several strategies as stated in the third research proposition. This chapter has attempted to validate this proposition. To do so, this chapter provided a new theoretical explanation of the relationship between project strategy and project success factor; that the strategy is a higher level driver to enhance or diminish a success factor or a set of success factors.

Second, based on this theoretical foundation and the concept of project management during national crisis which was presented in Chapter 5, a generic success model for project management during national crisis was presented. This model links four strategies to nine common success factors that contribute to the success of projects. The model was constructed based on a portfolio of case studies from the British aviation industry during WW2 then refined and validated based on the case of the AHD construction project in Egypt in the 1960s. The validated model interpreted cases other than those used in the creation and refinement of the model. The practice recommendations and limitations of this model will be presented in the conclusion chapter.

7 Conclusion

7.1 Introduction and objectives

This thesis draws its importance from the fact that national crises in recent years have increased in frequency and severity, yet the literature of project management is lagging in providing insights for successful project management in such contexts. When a national crisis occurs, new dynamics appear and there is no time for learning from trial and error. The costs and consequences of trial and error in such a context are very high, so there is a need to acquire knowledge and present it for the benefit of current and future projects in a similar context. The research in this area has started to gain momentum; however, it is still at the early stages,

This thesis has tried to investigate the success of projects in the national crisis context. In doing so, it started with an introductory chapter that established the research problem and provided the overview of the research, the research idea, the research questions, the research proposition and other details that aimed to make the research problem clear. Chapter Two provided the literature review to form the basis of knowledge on which this research will build while Chapter Three provided the details of the research design and how the work would progress. The results of this research study were divided into three chapters. Each chapter deals with one research proposition. The sum of the validation of these propositions will form the answer to the research question.

In this concluding chapter, the research design will be reviewed and the research propositions will be revisited to highlight the answers to the research question. Following that, the results and the contribution of this research will be discussed. Next, the finding will be compared to existing theories and the recommendations and of suggestions this.

7.2 The research steps summary

This thesis in general is about project success which is one of the popular themes in project management research. However, this theme is quite broad so that this research was focused on the sub-theme of project success during national crises.

In any research project there are some steps towards achieving the objectives of that research. Some of these steps are common to the majority of research projects such as establishing the research problem, the literature review and research design. On the other hand, there are some steps that are specific to each individual research project. Because the common steps are generally known to many people, only the specific steps for this study will be mentioned here.

The first step in this research is to clarify the concept of project success itself. Since there is no consensus upon a universal meaning or definition for project success, it was crucial to set the required approach for defining project success in this thesis.

The second step is to develop the concept of project management during national crises. This step is important because the concept is relatively new and needs to be defined. This step eliminates the assumption that might exist; that is project management during peacetime is similar to project management during national crises. By presenting the differences between the two types of project management, the preparation is made to present the success strategies during national crises.

The third step is to extract the success strategies and to create the success model for project management during national crises. This step is the essence of this thesis.

These steps are based upon multiple case studies. The idea behind this choice is that the results which come from multiple case studies are more generalizable particularly if the cases are sufficiently different from each other.

The research design is governed by a well-established research framework known as "the research onion". Following a well-established research framework can increase the rigor of the research project. Also triangulation is known for enhancing the rigor of the research so that the data of this research was compiled from different sources using different means.

7.3 Research questions and propositions revisited

This thesis was designed to answer two main interlinked research questions. The questions are:

Why do some projects succeed during national crises despite the adversity of the circumstances?

What assists projects to be delivered successfully during national crises?

These questions were clarified and answered through the validation of three research propositions. The first research proposition was:

P1*: The definition and assessment of project success are subject to multiple viewpoints, and are context-dependent and sensitive to many factors beyond the direct control of a project team.*

The aim of this proposition in relation to the research questions was to clarify the meaning of project success mentioned in the questions. The propositioned was validated thorough the presentation and the application of the four-level project success framework as presented in Chapter four.

The second research proposition was:

P2*: National crises are unique contexts that require a project management approach that is different from a peacetime approach.*

This proposition aimed to clarify the meaning of national crises and project management in such context. This proposition was validated through the development of the concept of project management during national crises in Chapter five.

The third research proposition is the essence of this research. The proposition stated:

P3: *There are several strategies or techniques which, if adopted, will increase the likelihood of project success during national crises.*

The validation of this proposition encapsulates the answers of the research questions. For the first research question "Why some projects succeed during national crises despite the difficulties of the time?" the answer in general is "because of the application of the success

strategies". For the second research question "What assists projects to be delivered successfully during national crises?" the general answer is "the success strategies presented in this study". The details of theses answers have been presented in Chapter six. Moreover, to make the answers more practical, the success strategies and a group of the common success factors were joined to formulate a success model for project management during national crises.

7.4 Research result summary and the contribution of this research

The contributions of any research generally can be divided into two types; minor and major contribution.

The minor contribution can be for example, in the form of literature review that identifies a knowledge gap in the previous research or the endorsement of a certain research framework. This research made this type of contribution by presenting the traditional literature review. Also this research endorsed the use of "the research onion" as an effective research framework for project management research.

The major contribution is the original contribution that the research provides. It is widely known in higher education that original contribution is a central concept for the PhD award. In the following sections, the contribution of this research will be discussed.

7.4.1 Promoting the use of video data in project management research

The first major contribution of this research is that it promoted the use of video data in project management research. This is a contribution to the research methodology. It was presented in detail in Chapter three particularly Section 3.8.1.4.

Video Data is a significant type of research data in many areas of research. It offers a quality resource for observational and investigational study. Although the video data is used in other disciplines such as psychology and media, this study tried to bring the benefits of video data to the project management discipline.

As a result of the trial that took more than three years and more than 250 hours of video data analysis, a genuine classification scheme and practice guidelines of the video data use for the research purpose were introduced to the body of knowledge. Probably this is one of

the early attempts to promote the use of video data in the project management research because the author could not find previous references in this regard.

This contribution was indorsed by first presenting it in The Australian Institute of Project Management National Conference AIPM 2013 then publishing it in the peer reviewed Science Journal of Business and Management 2014.

7.4.2 Presenting a new framework for project success definition and evaluation

The second major contribution of this research is in the field of project success frameworks. It was concluded from the literature review about the definition and evaluation of the project success concept is that a current trend is to provide systematic frameworks to define and evaluate the success for individual projects. Since there is no single framework that can fit all projects, the opportunity existed to provide a new framework to fill a gap in the project success frameworks field.

This research contributed to this field by providing the four-level project success framework and more specifically by highlighting the effect of a project's context on the definition of its success. The framework is generic and it is designed to provide a customised success definition for any particular project. This framework helped in the definition and evaluation of the success of the case studies in this thesis. Also it was evaluated by external practitioners as detailed in Chapter four.

This contribution was endorsed by first publishing the framework in The IEEE International Conference on Industrial Engineering and Engineering Management 2011. Then a second paper that included more applications and evaluation of the framework including evaluation done by external experts was published in the journal of Organisational Project Management in 2014.

7.4.3 Developing the new concept of project management during national crises

The third major contribution of this research is in developing a new theoretical concept; namely, project management during national crises. This concept is relatively new in the field of project management. While there are several attempts to define project management during particular types of crises such as post-disaster project management and

non-routine project management, this research contributed to the body of knowledge by providing a universal comprehensive definition for such a concept. The differences between this concept and ordinary project management were presented. Also this research presented the common characteristics of national crises and their impact upon project management. By doing so, this research is expanding the focus of crisis management in the field of project management beyond the internal project crises to include external contextual crises such as national crises.

This contribution was endorsed by publishing it in the peer reviewed journal of International Review of Management and Business Research (IRMBR) in 2014.

7.4.4 Presenting a set of success strategies for project during national crises

This research is about project success strategies so that the fourth major contribution of this research is the presentation of project success strategies during national crises. This research presented four main strategies found to be effective in helping the project teams to deliver their projects successfully during national crises. These could improve the immunity of the project against the impacts of national crises. These strategies resulted from two case studies as detailed in Chapter six.

This contribution was endorsed by publishing two journal articles in the peer reviewed journal of International Review of Management and Business Research (IRMBR) in 2014. One article was about the success strategies in the British aviation industry during WW2 and the second was about the success strategies in the AHD construction project in Egypt during the crises of the 1960s.

7.4.5 Developing a new model for project success during national crises

The fifth major contribution of this research is the development of a new success model. As a foundation, this research provided a new theoretical explanation of the relationship between project strategy and project success factor; that the strategy is a higher level driver to enhance or diminish a success factor or a set of success factors. Then, based on this theoretical foundation and the concept of project management during national crisis, this research presented a generic success model for project management during national crises.

This model links the four success strategies presented in this study to nine common success factors that contribute to the success of projects. The model was constructed and validated based on the main case studies of this research. Nevertheless, the model interpreted cases other than those used in its creation and refinement. This ability to interpret external cases supported the generalizability of the model.

This contribution was endorsed by publishing it a journal article in the peer reviewed journal of International Review of Management and Business Research (IRMBR) in 2014.

7.4.6 A set of minor contributions

Beside the major contributions, this research also provided several minor contributions to the body of knowledge.

First, perhaps it is in this research that for the first time in project management literature the success of the AHD construction project was addressed with focus on the context of national crises surrounding the project. The significance of this is that, in a generation, there are few projects of such size and context worldwide so when they occur there is no time for learning from trial and error. The costs and consequences of trial and error in such projects are very high, so there is a need for understanding the proven strategies of success and presenting them for the benefit similar projects.

It could be also that for the first time the successes of the British aviation projects during WW2 were addressed with a focus on the context of the crisis surrounding them. This historical approach in these case studies along with the AHD case expanded the historical knowledge about project management.

Also this research strengthened previous research findings related to project success during national crises. Previous studies suggested strategies to increase the likelihood of mega project success during a national crisis. For example, the results of this study support the findings of other case studies such as that of the Hoover Dam. This mutual support between different studies makes the results more generalizable to the context of national crisis rather than individual project cases. Furthermore, it is widely acknowledged that national crises promote some social changes. The results of this study show how a project can benefit from this social change. It is very useful to utilize the phenomenon of an

emerging collaboration attitude between people during national crisis as this phenomenon can be turned into valuable resources and support for the project.

Moreover, this research supported the argument of investigating historical cases to extract lessons for project success in present and future projects.

Finally, this research endorsed the use of "the research onion" as a main framework for project management research. This research benefited well from this framework.

7.5 Comparison of the findings with existing theories and practical recommendations from this research

This research provided several major contributions and another set of minor contributions. These contributions have several implications and recommendations for the theory and practice of project management.

This research promoted the use of video data in project management research. This could lay the foundation for the beneficial application of the video data in project management research as this type of data has the potential to carry details that are invaluable to researchers. The classification scheme of video data which was proposed in Chapter 3 could help the user to choose the appropriate type of video clips for a particular research need. Also the features of video data could enable the research to perform multiple researches on the same event and less effort would be needed to handle the data.

This research also presented the four-level project success framework. This framework has the potential to serve the purpose of defining the meaning of success for any particular project. In theory, the presentation of this framework endorses the argument that project success is not universal to all projects. The presentation of this framework also supports the trend of developing frameworks or models to describe project success in the project management field. For practice, it is an extra new tool available for practitioners to use beside the arsenal of project management tools available in the body of knowledge. Since projects are different from each other, the need for different tools might be necessary.

Another contribution of this study is the development of project management during national crises as a different concept from ordinary peacetime project management. In theory, this research supports the diversification of the concept of project management and

having sub-specialties in the project management discipline instead of having plain project management for all situations. For use practice, this research presented key points of differences between ordinary project management and project management during national crises. These points are key suggested points on which the practitioners should focus their attention when managing projects during a national crisis.

Project success strategies during national crises are also among the major contributions of this research. Several practical recommendations can be suggested based on these strategies as follows:

- The project stakeholders or the management team should obtain government support, because the government is probably the strongest authority during national crisis. The intervention of the government is reported to be decisive in solving problems that face projects during crises such as resourcing bottlenecks (Chang *et al.* 2010, 2012). Government support can grant the project required permissions, priorities and some special services such as security services when the environment is in chaos. This can mitigate the crisis making factors mentioned by Öcal *et al*. (2006) such as sabotage and government policies that act against the project.

- Locally available resources should be prioritized in project resourcing to guarantee the supply as required because crises disrupt transportation (Chang *et al.* 2010; Natarajarathinam *et al.* 2009). This recommendation could mitigate the risk of transportation and communication loss. Also it can be a practical solution to the ironies mentioned by Loosemore (1998) "at a time when effective communication is important it is less likely" (Loosemore 1998b). Also locally available substitutes should be seriously considered to utilize the maximum available materials and workforce.

- All project personnel and equipment should be housed in or adjacent to the project site. This recommendation could reduce the amount of bureaucratic correspondence to increase the communication effectiveness, increasing the response time to incidents, and mitigating the risk of transportation loss. Also this is a practical

application of the success pillar "responsive and functioning structure at the organizational level" mentioned by Geraldi *et al*. (2010). Furthermore, it is reported that the successful management of projects in the crisis context may need a project manager who is indigenous to the place (Mallak *et al.* 1997). Actually it is not only the project manager but other project team members are better to be indigenous to the place because they are more adapted to the environment and more sensitive to the social aspects.

- The project management team should establish an effective interagency collaboration system. This system should allow the required information, knowledge and technology to flow between projects as needed. By doing this, important lead time reduction can be achieved. As mentioned before, time is among the most pressing factors during national crises.

- The project stakeholders should spend a portion of the resources to build nationwide interest in the project. This may attract various types of help to the project that are otherwise difficult to obtain directly. This may also induce more support from the government based on public support for the project. The effect of this recommendation can be seen in the Apollo program in the 1960s. The US found itself lagging behind the Soviet Union in the space race after the Soviets successfully launched the first ever satellite; the Sputnik. This situation was considered " a national crisis" and it was titled as "sputnik crisis" (Kennedy 2005). In response the US government launched several projects, one of which was the Apollo program. This project was very expensive to tax payers money yet it enjoyed huge public support because of the effort made to consolidate national consensus upon the project (Gisler & Sornette 2009). Without that public support such a project might not have succeeded

- The project team should be aware that the requirements of a product change rapidly during national crises, leaving the team with very limited time to react. The team

should design the product from the outset with the idea of versatility in mind if possible. A versatile product means the ability to fulfil new and emerging needs with minimum cost, time and effort.

- The project management team should adopt time reduction techniques such as concurrent engineering. This can be more complicated but it saves much precious time. During national crises, saving time almost always wins the trade-off with extra effort.

The other major contribution of this research is the success model for project management during national crises. This model was based on the theoretical explanation of the factor-strategy relationship for project success. This theoretical explanation can be a suitable foundation for further studies about the impact of project strategy upon project success factor. In practice, the model (which links four success strategies compiled in this research to nine common project success factors) can work as a guiding tool for what to do to achieve the success in the context of a national crisis. Also, it can be used as a diagnostic tool to evaluate cases of projects implemented during national crises to extract lessons. The application of this model can improve the immunity of the project against the impacts of national crises. Nevertheless, there is no single model that can perfectly fit all projects, so this model is not the ultimate answer to the success of all projects during all types of crisis. Rather, it is an important and well-evaluated addition to the literature of project management.

It is hoped that these recommendations can make a positive difference to the body of project management knowledge.

7.6 Limitations and further research

While the objective of any research is to answer research questions and to create new knowledge, it is often found at the end that more questions arise and further research directions appear. Moreover, the research almost always has its limitations. It is important to highlight these limitations and to suggest further researches. With each point of

contribution from the research comes a point or a set of limitations and further research suggestions.

This research promoted the use of video data; however, the video data which was used is mostly related to national crises and in particular WW2. Using video data in other settings needs to be done with caution. The classification scheme which was proposed in this research is a step in the pathway to develop a comprehensive methodology for using video data in project management research. Further research and development is needed as more dimensions might be included in the classification process so the scheme can evolve to a more comprehensive form. Since the attempt of using video data in project management research is an innovative effort, more research is needed to enhance the understanding and practices of such a method. Other fellow researchers in the field of project management are encouraged to employ and test video data in their research projects. If they report their experience, a better body of knowledge can be built about the use of video data in project management research.

Also this research presented the four-level project success framework. This framework can serve the purpose of defining and evaluation project success but it cannot be claimed that the framework is the optimum tool for the job. Practitioners should try this framework and other frameworks and the users are the best equipped to decide what the optimum for any particular situation is.

Moreover, this study presented the concept of project management during national crises. Because this concept is relatively new, other researchers are encouraged to enhance this by addressing the definition proposed here, and presenting enhancements or even alternative definitions to add to the development of the concept. Moreover, more empirical work is needed to solidify the concept and to develop operational measures, which can be used in real- life situations. Both theorists and practitioners of project management may need to develop their theories, assumptions, mental models, tools and techniques to better manage projects during a national crisis.

Also this research presented some project success strategies; however, the research was limited to a macro view of project success during national crisis. This means that the results

are top level strategies. The investigation at micro level detail is needed to enrich the knowledge about successful project delivery during national crises.

This study also addressed a set of case studies from a few industries during limited examples of crises. More case studies from different industries during different crises are needed to enhance the understanding of project management during national crises. Moreover, the results were extracted from the data set available for this study. Other results might emerge from different sets of data.

This research also presented a success model for project management during national crises. While the model contained a set of success strategies and factors, there are other factors which were left out as it was not possible to include all possible success factors in one model. The factors which were included in the model are among the most common success factors in projects.

The model was created and evaluated for project management during national crises. A possible direction for future research is to examine the applicability and effectiveness of the model in other contexts such as peacetime. It might be effective there as well.

Finally, several recommendations were suggested based on the results of this study; however, these recommendations require more evaluation, which can be the subject of a new research endeavour.

7.7 Final remark

This thesis draws its importance from the importance of its topic; that is, project management during national crises. Because the world is facing an increase in national crises in terms of severity and frequency, creating knowledge about how to survive such crises becomes essential for all aspects of socioeconomic activities, and among these activities are projects. However, until recently the project management literature has provided little knowledge for project success during national crises.

With several strategies and a practical model, this thesis contributes to breaching this gap. Additionally, it has contributed by providing a new success framework and has made other minor contributions to the field of project management in general.

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Appendices

Appendix A: Samples of archival documents used in this study

In this research hundreds of pages of archival documents were used to extract the meaningful information. While it is not practical to include the entire documents in the thesis, this appendix contains samples of the titles of the documents as archived by the National archives in the UK. Also several samples of the actual documents used in the research are included in this appendix with many marks from the analysis and coding process. This a sample list if the documents titles:

1. AVIA 15/13: Description available at item or other catalogue level
2. AVIA 15/13: AIR MINISTRY (Code 3): Special review of AMDP `Fleet'. Temporary allotment of aircraft for development work: 1939-1940
3. AVIA 15/13: AIRCRAFT: Design and Development: General (Code 6/1): Special review of AMDP `Fleet' temporary allotment of aircraft for development work: 1939-1940
4. AVIA 15/24: PRODUCTION AND MANUFACTURE: Policy (Code 38/2): Priority of manufacture arrangements: 1939-1941
5. AVIA 15/40: DIRECTORATES (Code 20): Directorate General of Production: re-organisation: 1939-1940
6. AVIA 15/113: DIRECTORATES (Code 20): Directorate of Equipment: Proposed war organisation: 1939-1940
7. AVIA 15/144: AIR MINISTRY (Code 3): Decentralisation of A.M.D.P.'s Dept. and establishment of Area Boards: 1939-1940
8. AVIA 15/147: COMMITTEES AND COMMISSIONS: Home (Code 15/1): Aviation fuel: minutes of meetings of Technical Sub-Committee on research and production: 1939-1946
9. AVIA 15/148: COMMITTEES AND COMMISSIONS: Home (Code 15/1): Aviation fuel: minutes of meetings of Technical Sub-Committee on research and production: 1939-1946

10. AVIA 15/170: AIRCRAFT: GENERAL - Identification and Recognition (Code 5/5): Committee for Scientific Survey of Air Warfare; minutes and papers of Sub-Committee on Recognition of Aircraft: 1940
11. AVIA 15/179: PERSONNEL: Training (Code 35/4): Labour training schemes for aircraft industry: 1940
12. AVIA 15/192: AIRCRAFT: Design and Development: Bombers (Code 6/2): De Havilland light reconnaissance bomber: design branch specification No. 1/40/DH: 1940-1945
13. AVIA 15/193: AIRCRAFT: Design and Development: Bombers (Code 6/2): Bombs and bomb gear for the Barracuda bomber; design and trials: 1940-1942
14. AVIA 15/193: BOMBS AND BOMBING: Trials and development (Code 12/2): Bombs and bomb gear for the Barracuda bomber: design and trials: 1940-1942
15. AVIA 15/193: BOMBS AND BOMBING: Bomb Gear (Code 12/7): Bombs and bomb gear for the Barracuda bomber; design and trials: 1940-1942
16. AVIA 15/194: AIRCRAFT: Design and Development: Bombers (Code 6/2): Bombs and bomb gear for the Barracuda bomber; design and trials: 1942-1943
17. AVIA 15/194; BOMBS AND BOMBING: Trials and development (Code 12/2): Bombs and bomb gear for the Barracuda bomber: design and trials: 1942-1943
18. AVIA 15/194: BOMBS AND BOMBING: Bomb Gear (Code 12/7): Bombs and bomb gear for the Barracuda bomber; design and trials: 1942-1943

The following copies are samples from the documents

Printed for the War Cabinet. November 1942.

31

MOST SECRET.

Copy No. 22

W.P. (42) 526.

November 14, 1942.

TO BE KEPT UNDER LOCK AND KEY

It is requested that special care may be taken to ensure the secrecy of this document

WAR CABINET.

THE AIRCRAFT PROGRAMME.

Policy for the Replacement of the Wellington and the Warwick.

Note by the Lord Privy Seal.

AT their meeting* on Tuesday, the 6th October, 1942, at 6 P.M., the War Cabinet—

"Invited the Minister of Production, in consultation with the Lord Privy Seal, the Secretary of State for Air, and the Minister of Aircraft Production, to investigate the proposal in D.C. (S) (42) 89, for the introduction of a new four-engine bomber, to replace the Wellington and Warwick, taking into consideration the Admiralty need for Wellingtons. If thought fit, this enquiry should be extended to cover other points in regard to the aircraft programme."

2. A thorough examination of the problem has taken place under the Chairmanship of the Minister of Production, and was completed before he left for the United States. He has requested me to submit the resulting Report† for consideration by the War Cabinet.

R. S. C.

Gwydyr House, Whitehall, S.W. 1,
November 14, 1942.

ANNEX.

REPORT.

The proposal put forward by the Secretary of State for Air and the Minister of Aircraft Production in their joint Memorandum (D.C. (S) (42) 89) was that a new Vickers-designed aircraft with 4 Merlin engines should be introduced, first at Weybridge, and later, if desired, at Blackpool and Chester, to supersede the Warwick and the Wellington. The new aircraft is known as the B. 3/42. The first of the new type should appear in October 1944, and there would be an output of about 20 a month by the Spring of 1945 rising to 50 a month by the end of the year. The last Warwick would be made at Weybridge in July 1945.

* W.M. (42) 133rd Conclusions, Minute 1 (i).
† Annex.

Alternative Proposals.

2. The main alternative proposal which has been examined is that the Vickers organisation should be switched to the production of Lancasters. The Lancaster is, from every point of view, the most satisfactory heavy bomber now in production. It is a well-established type and it has been suggested that it could consequently be brought into production at Messrs. Vickers much earlier than the B. 3/42, the prototype of which is unlikely to be flying before next Autumn. An extension of this plan would be the development of a re-designed Lancaster, *i.e.*, a Lancaster which would be in essentials the same as the present aircraft, but improved and developed to the maximum extent possible. If this could be evolved fairly readily, and if it were found to have a performance comparable to that expected of the B. 3/42, it could then be introduced both into the Vickers organisation and elsewhere to replace the present Lancaster at about the same date as that forecasted for the introduction of the B. 3/42.

3. A further proposal was that we should adapt for production in this country one of the new large American bombers, namely, the B. 29 or the B. 33, which are in an advanced stage of development in the United States.

4. The results of investigation of these proposals are given below.

The switching of the Vickers organisation to the Lancaster.

5. There is no doubt that this proposal is feasible, and if it were decided upon, the full co-operation of the Vickers organisation would be forthcoming. It is estimated that the first Lancaster might emerge about April 1944. *i.e.*, six months before the first B. 3/42. At first sight, therefore, this proposal has some attractions. Closer examination shows, however, that it would be inadvisable to adopt this proposal for the following reasons :—

(*a*) The advantages of six months gain in time would be more than counter-balanced by the fact that we should be introducing an aircraft which by then would be obsolescent, and which could not by improvement or re-design be given comparable operational efficiency with that of the B. 3/42. (See paragraphs 6 and 7 below.)

(*b*) Although we might all be satisfied if the entire heavy bomber industry were turning out Lancasters *now*, it would be a very doubtful proposition to bring this about in 18 months' or two years' time. To do so would make us entirely dependent for progress on the success of a Lancaster replacement which does not yet exist, even on paper. We should be in a much stronger position if at that time the B. 3/42 were about to come into production, as we should thus have two strings to our bow.

(*c*) While the change-over from geodetic to stressed skin construction in the Vickers organisation could no doubt be done, unforeseen delays would probably result, and the introduction of the Lancaster might be later than suggested above.

The introduction of a re-designed Lancaster comparable in performance to the B. 3/42.

6. If the Lancaster could be re-designed quickly, so that a new version comparable in performance to the B. 3/42 could be introduced over the whole range of Lancaster production, this would constitute a strong argument for switching the Vickers organisation. Investigation shows that the best re-design which can be worked out will not give adequate performance for this purpose. The table given in the Appendix shows the latest comparison between a re-designed Lancaster and the B. 3/42. The former falls short of the latter in the following important respects :—

(*a*) The rate of climb with full load is much less. This greatly affects the manœuvrability, and thus the casualty rate.

(*b*) The armour is only proof against ·303, whereas the B. 3/42 will have armour proof against cannon.

(*c*) The armament will not be so powerful.

7. This comparison shows that a suitable replacement for the Lancaster cannot be got on the basis of the re-designed Lancaster referred to in the annexed table.* It would be necessary to design an entirely new aircraft, probably with

* Appendix.

six engines. The success, or otherwise, of this cannot yet be foretold, and, therefore, it would be very unwise to reject the B. 3/42, which holds out every prospect of being a great advance on anything else in sight.

The adaptation of the B. 29 or the B. 33.

8. Of these two types, the B. 29 is believed to have flown, but neither of them is yet clear for night work. The production of either of them in the United Kingdom would require a large quantity of special tools and floor space such as few factories here possess. A great deal of work would be required to anglicize the drawings and standards, and it is estimated that it would take one year longer to introduce either of them than it would to introduce the B. 3/42.

Comparison of man-hours for the construction of the B. 3/42 and the Lancaster.

9. In view of the labour stringency, an important factor in deciding the policy to be pursued in replacing the Wellington and the Warwick is the question of the man-hours necessary to construct the replacement. The comparison between the B. 3/42 and the Lancaster is as follows :—

B. 3/42 (estimated)	40,000	
Lancaster	40,798	(It is hoped to reduce this eventually to 37,000.)

These figures are for the airframes only, and that for the B. 3/42 must, of course, be treated with reserve in this early stage of development. It does not, however, appear that there would be any material decrease in man-power requirements if the Lancaster were introduced instead of the B. 3/42, particularly as the proportion of unskilled labour employed in the geodetic type of construction is higher than in the stressed skin type.

Switch of Austin and Short factories (except Short–Harland) from Stirling to Lancaster.

10. The proposal to switch this capacity has already been put forward to the War Cabinet by the Minister of Production. Although it is not a matter directly related to the replacement of the Warwick and the Wellington, it has been taken into account in this Report in view of its importance in the general picture of the heavy bomber programme. It is estimated that the change-over would mean the loss of about 300 bombers between mid-1943 and the end of 1944. In our opinion, this change-over should be put in hand at the earliest possible moment, even if it causes a temporary diminution in our bomb-dropping capacity on Germany. The Minister of Production is going to try to cover the loss by securing a special allotment of American heavy bombers for the purpose. But whether this can be done or not, the superior results obtained from the Lancaster, and the burdensome labour requirements for the Stirling, make the change eminently desirable, and it is hoped that it will be approved. The casualty rate of the Stirling combined with the large number of man-hours required for its construction make it only about one-third as good a machine as the Lancaster.

Switch of Halifax capacity to Lancasters.

11. This is another change-over which is, on the face of it, attractive. The loss would, however, be very considerable. The switch of all the Halifax firms would probably take from mid-1943 to mid-1945, and the loss over the two years might be as much as 1,000 bombers, with a possible further loss after the latter date. In any case, the jig and tool capacity of the country would be insufficient to permit changing the Halifax firms to Lancaster at the same time as changing the Stirling. Efforts are being made to regain the loss in performance which has developed in the Halifax, and it is likely that a substantial improvement in this respect can be effected by redesign and modification.

Requirements of Coastal Command and Bomber O.T.Us.

12. There will be a continuing requirement for a long time to come of Wellingtons for these two purposes, amounting to about 90 a month. Whatever scheme is adopted, therefore, it would seem advisable to retain on Wellingtons the Vickers Blackpool factory, which has a peak output of 100 a month. The position can be reviewed during 1943.

Recommendations.

13. The following recommendations are put forward for approval by the War Cabinet :—

(*a*) That the proposal to introduce the new Vickers four-engine bomber (the B. 3/42) at the Weybridge and Chester factories should be approved. Every effort should be made to accelerate its introduction.

(*b*) That the Vickers Blackpool factory should continue to manufacture Wellingtons, the position being reviewed, say, in six months.

(*c*) That steps should be taken to design a new aircraft (which would probably have six engines) as a replacement for the Lancaster and other non-geodetic types.

(*d*) That the improvement of the existing Lancaster should proceed in the normal way.

(*e*) That the change-over of Short's (except Short–Harland) and Austin's factories from Stirling to Lancaster should be approved in principle, and should be carried out as soon as possible.

(*f*) That the proposal to change over Halifax production to Lancaster should for the present be abandoned—efforts being concentrated on improving the performance of the Halifax.

APPENDIX.

	Re-designed Lancaster.	*B. 3/42.*
All-up weight	63,000 lbs.	60,000 lbs.
Maximum cruising speed at 23,000 feet ...	307 m.p.h.	325 m.p.h.
Economic cruising speed	220 m.p.h.	230 m.p.h.
Maximum bomb load	12,000 lbs.	8,000 lbs.
Range with maximum bomb load at most economical speed	820 miles	1,700 miles.
Range with 8,000 lbs. bomb load at maximum cruising speed	1,295 miles	1,300 miles.
Rate of climb at all-up weight at 23,000 feet	400 feet per minute	740 feet per minute.
Armour	Against ·303-in.	Against 20-mm.
Armament	2—·303-in. m.gs. forward 2—·303-in. m.gs. top 2—·303-in. m.gs. lower 4—·303-in. m.gs. rear	2—·303-in. m.gs. forward. 2—20-mm. guns aft. Plus 2—20-mm. Nacelle guns (to be introduced later, perhaps).

SECRET.

Copy No. 27

W.P.(R)(40)87.

WAR CABINET.

SUPPLY AND PRODUCTION.

SEVENTH REPORT BY THE AIR MINISTRY.

(Previous Report No. W.P(R)(40) 58).

The accompanying report on supply and production shows the position with regard to the supply of all the more important items of equipment of the Royal Air Force at the 29th February, 1940.

K.W.

Air Ministry, S.W.1.
8th March, 1940.

MONTHLY REPORT (No. 7) BY THE AIR MINISTRY
ON SUPPLY AND PRODUCTION.

Aircraft.

1. The output of aircraft in this country during the month of February, 1940, was 719 as compared with the planned output of 837, and, in addition, 58 aircraft were delivered from the United States. The deficiency on the planned programme was due to bad weather, which caused a great deal of sickness among operatives, interfered with their travelling, and rendered a number of aerodromes unusable for the flight testing and delivery of completed aircraft. Having regard to the very abnormal conditions, the output is creditable to the industry.

2. Additional orders were placed in this country during the month for 300 aircraft. Since the outbreak of war, 19,700 aircraft have been ordered in this country, 190 in Canada and 1,300 in the United States, at an estimated aggregate cost of £419 million.

3. The following are the more important measures approved during February to increase capacity for the production of aircraft:-

(i) The works of Cunliffe Owen Aircraft Ltd. near Southampton, which were established as a commercial venture for the manufacture of civil aircraft, will be extended and equipped by the Air Ministry for the production of Tornado (fighter) aircraft, at an estimated cost of £227,000.

(ii) The London and North Eastern Railway Company are undertaking the assembly of fuselages for Swordfish (torpedo spotter reconnaissance) aircraft in their workshops at York, which will be adapted and equipped for the purpose by the Air Ministry at a cost of approximately £15,000.

/(iii) ...

(iii) The new factory at Blackpool to be managed by Vickers-Armstrongs Ltd. for the assembly of Wellington aircraft manufactured by sub-contractors was described in the Fifth Report (W.P. (R) (40) 23, para. 3 (ii)). It is becoming increasingly necessary, in developing large sub-contracting schemes, to provide some balancing plant or machine tools, and the provision of £100,000 worth ofnplant for sub-contractors working in conjunction with the Blackpool factory has now been authorised, as a first instalment.

(iv) Airspeed Ltd., who are to manage the new factory at Christchurch for Oxford (trainer) production (W.P. (R) (40) 23, para. 3 (i)), are being provided with plant and machine tools costing approximately £12,500 for manufacture of the jigs and tools required for their greatly increased rate of output.

(v) Among schemes for the expansion of sub-contractors' capacity authorised during the month may be noted the decisions to provide plant and equipment within a total expenditure of £65,000 for the manufacture of spherical roller bearings by the Skefco Company at Welwyn, and to provide plant costing approximately £19,400 for the manufacture of high pressure joints by the British Ermeto Corporation at Maidenhead.

Engines.

4. The following are the more important measures approved during February for expanding the production of aero-engines and accessories to meet requirements of the aircraft programme:-

(i) Additional buildings and plant costing approximately £391,000 have been authorised to increase the production of carburettors for Bristol types of aero-engine by the Shadow factory at Oldham.

/(ii) ...

(ii) Plant costing approximately £21,000 is being provided for the A.C. Company to increase their production of sparking plugs.

(iii) The capacity of Messrs. Wyndham Hewitt, at Staines and Slough, for the production of controllable cooling gills for Bristol aero-engines, will be doubled, the firm providing the necessary additional floor space and services and the Department providing the additional plant required, estimated to cost approximately £22,000.

Equipment.

5. The position with regard to the supply of a number of types of aircraft instruments was reviewed during February, and approval was given to the provision of additional plant and machinery to enable production to be increased by the following firms:- M.R.C. Ltd., at Enfield (for automatic controls, £17,000); Mabie Todd & Co., Harlesden (for bombsights, £2,100); the Salford Electrical Instrument Company (for gunsights, £49,000; for engine speed indicators, £1,860; and for altimeters, £7,590).

Armament.

6. The supply of Browning .303" guns was reviewed and it was decided to provide additional buildings and plant at a cost of approximately £470,000 to increase, by 2,000 guns a month, the output of a sub-contracting organisation managed by B.S.A. Guns Ltd. This scheme is being planned so as to be capable of producing .5" guns if they are required instead of .303" guns at a later stage of the aircraft programme. Expenditure of £460,000 was also approved for the provision of additional capacity for the production of Browning gun barrels and spares by B.S.A. Guns Ltd. and their sub-contractors.

/7. ...

7. Having regard to the difficulty of providing sufficient capacity in this country for the production of 20 mm. Hispano Suiza cannon guns, the Canadian Supply Board are being asked to place an order for 3,000 guns with a view to the creation of a supply of up to 500 of these guns a month from the Ottawa Car Manufacturing Company, Canada. Only a limited amount of balancing plant is required by this firm, and no capital expenditure by the United Kingdom Government is involved.

8. During February, the Air Ministry agreed to provide buildings and plant costing approximately £598,000 for Parnall Aircraft Ltd., and plant costing approximately £175,000 for Daimler Ltd., to increase their production of Fraser-Nash types of gun turret. Machine tools costing approximately £14,000 are also being provided for Integral Auxiliary Gears, Ltd., who manufacture the oil pumps by which these turrets are operated.

Fuel.

9. Negotiations have been completed with Trinidad Leaseholds for the creation of capacity for 35 million tons of 100 octane fuel per annum in Trinidad, at a capital cost of £3 million.

Raw materials.

10. Light Alloys. Negotiations are in train with the object of diverting two 1,500 ton extrusion presses, one to France and one to this country, which are at present being manufactured, partly in England and partly in Belgium, under Russian contracts.

11. Additional plant costing approximately £70,000 is being provided for High Duty Alloys Ltd., who are to manufacture light alloy forgings and extrusions at Distington.

/12.

12. Steel. The present capacity of this country for the production of high grade steel tubes, made from electric furnace steel, must be at least doubled if the requirements of the aircraft programme are to be met. Proposals are under discussion with the Ministry of Supply and the firm concerned.

13. Supplies of Swedish electric furnace steel will be insufficient to meet requirements and British steel must be used to an increasing extent. During February, the provision of additional buildings and plant costing approximately £70,000 was approved to increase the output of electric furnace steel by the Clyde Alloy Steel Company.

14. Timber. A new factory is being provided and equipped at a cost of approximately £200,000 for the production of aircraft veneers and plywood by the Aeronautical Panel and Plywood Company at Lydney, Forest of Dean, and an investigation is being undertaken into the possibility of increasing veneer cutting capacity in Canada.

Total Capital Commitments.

15. The capital commitments incurred at the expense of Air Votes for the creation of productive capacity have been increased by £22 million to a total of £124 million.

Summary.

16. Aircraft.

(a) The output of aircraft in this country during February was 719 as compared with the planned output of 837; in addition, 58 aircraft were delivered from the United States. (Paragraph 1).

(b) Additional orders were placed in this country during February for 300 aircraft, making a total of 19,700 ordered since the outbreak of war. (Paragraph 2).

/(c).

(c) Further measures, of which examples are given, have been taken to increase productive capacity. (Paragraph 3).

17. Engines. Further steps have been taken to increase productive capacity, of which examples are given. (Paragraph 4).

18. Equipment. Further steps have been taken to increase capacity for the production of instruments. (Paragraph 5).

19. Armament. Additional capacity has been authorised for the production of Browning guns and Fraser Nash turrets in this country, and orders are being placed for cannon guns in Canada. (Paragraphs 6 - 8).

20. Fuel. Capacity for the production of 35 million tons of 100 octane fuel per annum has been authorised. (Paragraph 9).

21. Raw materials. Measures to increase the supply of light alloys, steel and timber are described. (Paragraphs 10 - 14).

22. Total Capital Commitments. Capital commitments under Air Votes now amount to £124 million. (Paragraph 15).

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despatched registered post 44A.
25/1. copy to overseas.

COPY. CIRCULATED BY S.B. (DEPT. ZA),

DATE: 27.1.40.

SECRET. HARROGATE,

S.B.125/S.8. YORKS.

25th January, 1940.

Gentlemen,

I am commanded by the Air Council to refer to your meeting on the 22nd November with the Air Member for Development and Production, and subsequent correspondence (your reference LCLM/EMP), regarding the production of high speed bomber aircraft to the specification 1/40. I am to inform you that the Council have decided to place with your firm an order for 50 of these aircraft, and this order will be confirmed by the issue of a contract containing the usual terms and conditions.

At the same time the Council are anxious that the production of Oxford aircraft by your firm should not be adversely affected by your undertaking this order, and I am to request that you will make special efforts to ensure that the programme of Oxford production by your firm enclosed with your letter of the 9th January will be fulfilled.

I am, Gentlemen,
Your obedient Servant,

(Sgd.) E. F. CLIFF

The De Havilland Aircraft Co., Ltd.,
Hatfield Aerodrome,
Herts.

soon as preliminary technical negotiations with the firm had been completed and that this would have to embrace, or be placed concurrently with, any order for prototypes.

44A.

ALL LETTERS SHOULD BE ADDRESSED TO THE COMPANY AND NOT TO INDIVIDUALS.

47A

THE
DE HAVILLAND
AIRCRAFT CO., LTD.

DIRECTORS:
A.S. BUTLER CHAIRMAN
G. DE HAVILLAND
C.C. WALKER
F.T. HEARLE
T.P. MILLS
W.E. NIXON
F.E.N. St.BARBE

HATFIELD AERODROME HERTS. ENGLAND

TELEPHONE: HATFIELD 2345 (14 LINES)
TELEGRAMS: HAVILLAND HATFIELD
CABLES: BENTLEY CODE

ASSOCIATED COMPANIES IN AUSTRALIA, CANADA, INDIA, SOUTH AFRICA AND NEW ZEALAND.

FNSTB/ELB.

The Under Secretary of State,
Air Ministry,
Department Z.A.,
HARROGATE.

29th January 1940.

Dear Sir,

44A.

We beg to acknowledge with thanks receipt of your letter dated January 25th, reference S.B.125/S.8., and we can give you our assurance that the design, development and production of 50 High-speed Bomber Aircraft to Specification 1/40 will not interfere with the programme of OXFORD production as enclosed with our letter of January 9th last.

Yours faithfully,

FOR THE DE HAVILLAND AIRCRAFT CO. LTD.,

DIRECTOR.

TO: 30 JAN 1940

FILED 30 JAN 1940 TO ON

S.B.125.

B19
758

DDRDT 29/1

TO CONTRACTORS TO THE AIR MINISTRY, DOMINION, COLONIAL AND FOREIGN GOVERNMENTS THROUGHOUT THE WORLD
PROPRIETORS OF THE DE HAVILLAND SCHOOL OF FLYING HATFIELD HERTS
ALL SALES ARE MADE SUBJECT ONLY TO THE COMPANY'S SPECIAL WARRANTY.

woodworkers there
the existing production programme,

(e) that an order for the whole quantity should be placed as
preliminary technical negotiations with the firm
should have to embrace,

6421

1208

481

69990/40/C.4.(c) 27 January, 1940

Gentlemen,

I am directed by the Secretary of State for Air to inform you that you are required to proceed with the supply of 50 Twin Engine Night Reconnaissance Bombing Aeroplanes fitted to take Merlin Engines, together with a range of spares in accordance with the requirements of the Director of Aeroplane Production.

In this connection you are requested to make special efforts to ensure that this order will not adversely affect Oxford production.

The jigging and tooling required for these aeroplanes are to be in accordance with such scale as may be approved by the Director of Aeroplane Production.

I am to add that this instruction to proceed is subject to the normal conditions of Air Ministry contracts and that the formal contract documents in connection with the supply of both aeroplanes and spares, including copies of the Specification B.1/40 and Appendix A. No. 1066 which will govern the construction and equipment of the aeroplanes, will be forwarded to you in due course.

I am, Gentlemen,
Your obedient Servant,

(Sd.) W. J. Jenkins

Messrs. de Havilland Aircraft Co. Ltd.,
Hatfield Aerodrome,

for Director of Aircraft Contracts.

Hatfield,

758

DDRDT 22/1

SECRET.

S.B.125.

SUBSTITUTE MINUTE SHEET.

~~A.D.R.D.T.~~ 1

De Havillands received by letter from P.A.S.(B) of 25th January (44A in S.B.125), information that an order for 50 high speed bombers to Specification 1/40 will be placed with them.

Can you now please press forward with the Specification to have it completed as early as possible?

D.D./R.D.T.

30.1.1940.

2.

DoR(A).

Para 1 noted thankyou. We are doing everything possible to get the Specification completed, but as you are aware there are still a few controversial points. We are having a Conference at De. Havillands next Monday at which I hope we shall reach a final conclusion. I think that we can complete the Specification immediately after Monday's Conference. I am equally anxious to get the Blackburn Specification completed but although it is a pure DTD Experiment I want to ensure that it meets the Staff Requirements. D.O.R. has been holding it up to De. Havilland until this was cleared, this to two or three days. I have asked DOR to expedite his comments and understand that he will send both to me in the next 48 hours. Once the DeH is approved the Blackburn can follow in a few days.

R.W. Lightfoot DoR(A)

1/2/40.

5a

DRAFT.

D. of C.

Attached are copies of Specification 1/40 for the De Havilland Reconnaissance Bomber which is the subject of your I.T.P. Reference 69990/40/C.4(c) dated the 27th January, 1940.

As it is of the greatest importance that these aircraft should be built quickly, certain variations from normal procedure have been agreed with the firm and should be covered in the contract document. The variations are as follows:-

1. Inspection.

The first 6 aircraft will be inspected by A.I.D. for workmanship only. The contractor will accept responsibility for the use of materials to the specification required by the design and that the dimensions of all parts conform to the requirements of the design.

Aircraft subsequent to the 6th will be subject to normal inspection control by A.I.D. during construction.

2. Flight Tests.

The contractor will take full responsibility for the first 15 aeroplanes during their flight tests up to the time of handing over at the conclusion of the firm's flight tests and for all alterations made during the course of the flight tests. The firm's certificate of safety for flight will be accepted as the basis of issue of form A.M.1090 by the A.I.D. on the completion of the flight tests. The firm will, however, work

the flight tests and a record will be kept by the firm of all alterations made on each of these aircraft during their flight tests.

Aircraft subsequent to the 15th will follow the normal procedure of the flight test period both in respect of Air Ministry liability during flight and of inspectional and technical control by A.I.D. and D.T.D. respectively.

The arrangements for the use of samples and photographs of sample parts instead of drawings accepted by us at our discussion with De Havillands on the 5th February is covered in the aircraft specification and need not be referred to in the contract.

Boulton Paul Prototype

12A

B.76301/40

High Speed Reconnaissance Bomber to Specification B1/40 (Mosquito). Preliminary Consideration of Design.

(Subsequent files RA 4001/41 PRU version
RA 4101/41 Fighter "
RA 4201/41 Turret ")

1a
27.1.40. Notes of discussion between representatives of De Havillands and the Airwothiness Department of the RAE on design problems arising from B1/40.

4a
5.2.40. Conference at Hatfield to discuss matters arising from the B1/40 specification. The firm made proposals for facilitating the development and the production of the type.

Drawings. Owing to the limited number of draughtsmen available, it is essential for drawing office work to be reduced to a minimum. The Air Ministry accepted the following procedure:

"(1) All machined fittings and principal metal fittings, forgings and castings etc., will be fully drawn.....

(2) Parts capable of being made without drawings will be developed in the Experimental Department, to the requirements of the design office. On completion and approval, additional sample parts will be made, which will be initialed or stamped by the design office."

Material Ordering. As soon as drawings are released from the design office for the prototype, the Experimental Department will order the full quantity of material for the full contract of 50 aircraft, plus 10% spares.

It was also agreed that AID would inspect the first six aeroplanes for workmanship only. Interchangeability of components will not be made in full on the first six aircraft, but as desirable on the seventh and subsequent.

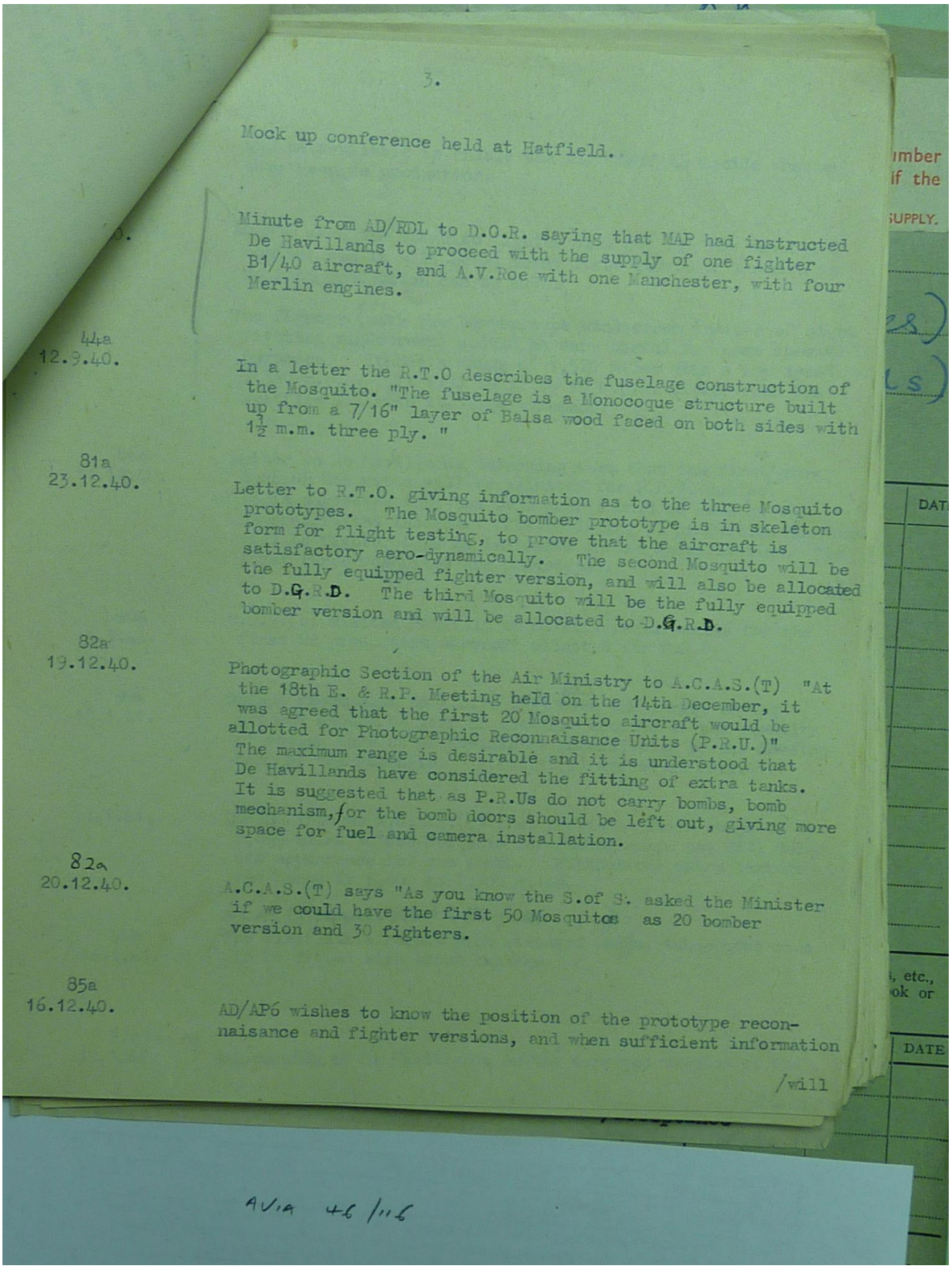
The firm suggested for their production procedure that the sample parts made in the Experimental Department shall be photographed by the Production Department, with sufficient views to show every part, with the part number and assembly number.

Flight Trials

Contractor will take responsibility for /10a
first take up to the time they are handed over

Mock-up For decision about mock-up see correspondence in 5.8.1944

AVIA 46/116



3.

Mock up conference held at Hatfield.

Minute from AD/RDL to D.O.R. saying that MAP had instructed De Havillands to proceed with the supply of one fighter B1/40 aircraft, and A.V.Roe with one Manchester, with four Merlin engines.

44a
12.9.40.

In a letter the R.T.O describes the fuselage construction of the Mosquito. "The fuselage is a Monocoque structure built up from a 7/16" layer of Balsa wood faced on both sides with 1½ m.m. three ply. "

81a
23.12.40.

Letter to R.T.O. giving information as to the three Mosquito prototypes. The Mosquito bomber prototype is in skeleton form for flight testing, to prove that the aircraft is satisfactory aero-dynamically. The second Mosquito will be the fully equipped fighter version, and will also be allocated to D.G.R.D. The third Mosquito will be the fully equipped bomber version and will be allocated to D.G.R.D.

82a
19.12.40.

Photographic Section of the Air Ministry to A.C.A.S.(T) "At the 18th E. & R.P. Meeting held on the 14th December, it was agreed that the first 20 Mosquito aircraft would be allotted for Photographic Reconnaisance Units (P.R.U.)" The maximum range is desirable and it is understood that De Havillands have considered the fitting of extra tanks. It is suggested that as P.R.Us do not carry bombs, bomb mechanism, for the bomb doors should be left out, giving more space for fuel and camera installation.

82a
20.12.40.

A.C.A.S.(T) says "As you know the S.of S. asked the Minister if we could have the first 50 Mosquitos as 20 bomber version and 30 fighters.

85a
16.12.40.

AD/AP6 wishes to know the position of the prototype reconnaisance and fighter versions, and when sufficient information

/will

AVIA 46/116

will be available to enable the Air Staff to decide whether they require production.

12.40. AD/RDL says the Mosquito fighter will not fly for about two months, and it will be at least three before a decision to go into production can be made.

The fighter (with the bomber type windscreen instead of night fighting windscreen) should be very useful for some special purposes. It has a range of 1,520 miles with a top speed of 360 m.p.h. It will be 12 to 15 m.p.h. slower than the Spitfire III with the same armament.

86a 31.12.40. Letter to De Havillands informing them that the first 20 production Mosquitos will be allotted for P.R.U. duties. It is suggested that the bomb gear should be deleted and cameras fitted instead. The following 27 production Mosquitos will be fighter type as indicated in the specification. The first three Mosquitos are prototypes.

90a 4.1.41. R.D.Q.(b) visited Hatfield to clarify requirements for the first 20 production aircraft allotted for P.R.U.

99a 18.1.41. DD/RDA recommends to A.C.A.S.(T) that the target towing project should be left in abeyance because of the quantity of design work at De Havillands necessitated by the development of the Mosquito. A.C.A.S.(T) agreed on 20.1.41.

12.1.41. DD/RDA informs A.C.A.S.(T) that provision for a range of 2,600 miles on the Mosquito for photographic use will delay its appearance for one month. Without the extra tankage the range is 1,600 to 1,700 miles.

94B 16.1.41. ACAS(T) agrees to take the first six aircraft with standard tanks, subsequent ones to be fitted with extra tankage.

97a 19.1.41. Discussion at De Havillands on the turreted version of the Mosquito

AVIA 46/116

Mosquito fighter. It appears that C.in C. Fighter Command was very anxious to have a turret with 4·303" guns. De Havillands are afraid the turret will have a severe effect on drag.

107a
1.41. The firm are informed through the R.T.O. that in view of the decision to make the first 20 Mosquitos the photographic type. the third Mosquito prototype shall be the fully equipped P.R.U. instead of bomber.

4.2.41. DD/RDA forwards minute to P.S. to the Minister on the progress of the Mosquito development.

" 1. This aeroplane was conceived by De Havillands as an un-armed Bomber Reconnaisance type, of high speed. The Air Staff were not enthusiastic, but accepted the type as it held promise and was of special interest because of wooden construction. The firm promised a prototype in nine months and completion of 50 aeroplanes in about twelve months.

" 2. Prototype design and construction has proceeded without interruption. The prototype flew in November, 1940. There have been difficulties in getting the airscrew engine combination to run well; these have now been overcome; the ailerons have been improved; the remaining difficulty is vibration coming from the tail end of the aircraft, the cause of which has not yet been traced. The firm are making every effort to get this right; we are collaborating with our own specialists.

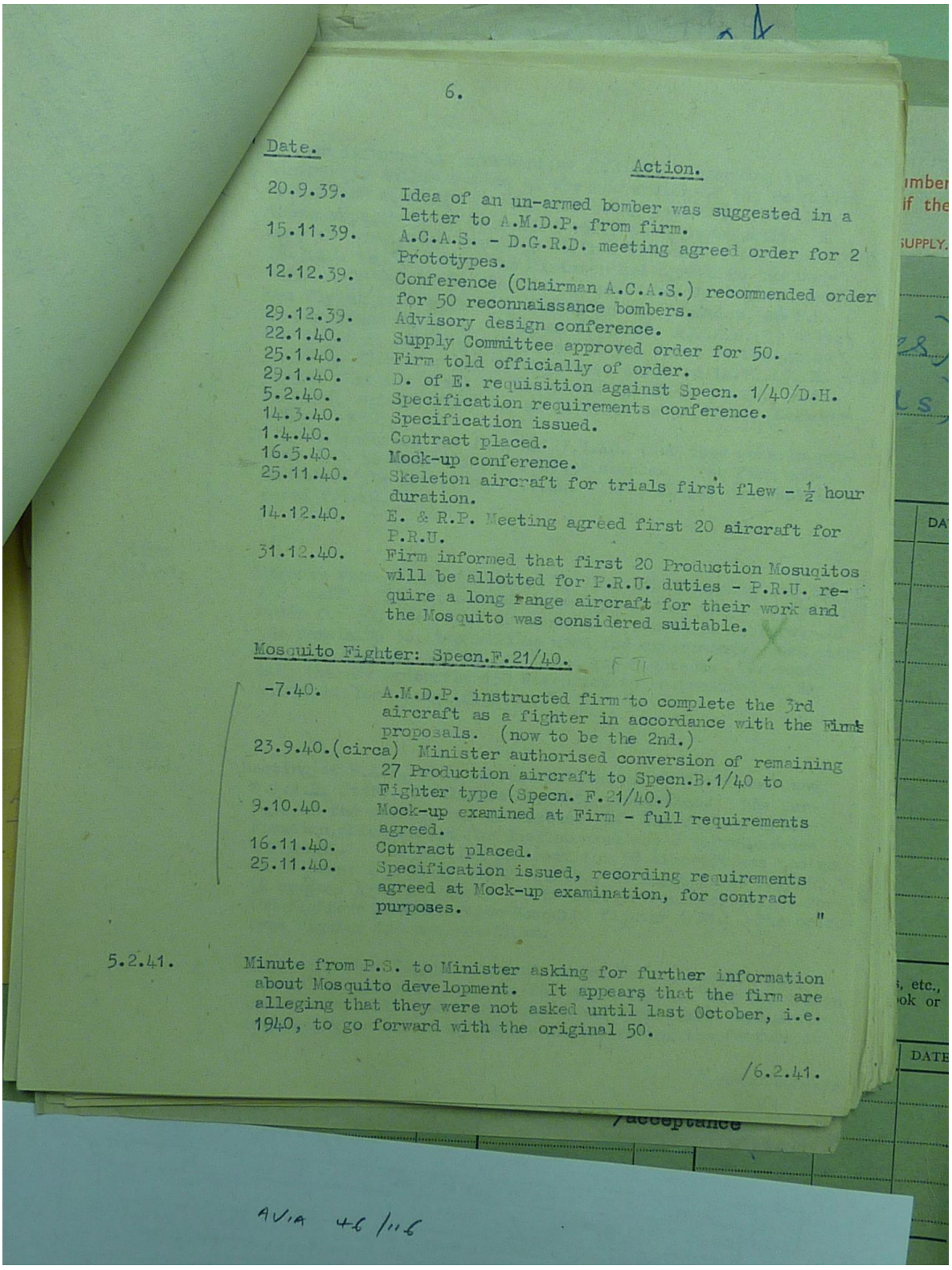
" 3. Slight delay resulted from the recent decision to use the first 20 aircraft for the Photographic Reconnaisance Unit. Extra long range is required for the work and additional fuel tanks have been fitted. The first aeroplane, so modified, is expected to be in flight at the end of March, 1941.

" 4. At a late stage in the design, the firm proposed the use of the type as a fighter. This was agreed and a prototype ordered. It entailed much redesign and therefore delay. The prototype fighter is expected to be flying in March, 1941.

" 5. Date sequence of the progress of the type is given on the attached sheet."

/.....

AVIA 46/116



6.

Date.	Action.
20.9.39.	Idea of an un-armed bomber was suggested in a letter to A.M.D.P. from firm.
15.11.39.	A.C.A.S. - D.G.R.D. meeting agreed order for 2 Prototypes.
12.12.39.	Conference (Chairman A.C.A.S.) recommended order for 50 reconnaissance bombers.
29.12.39.	Advisory design conference.
22.1.40.	Supply Committee approved order for 50.
25.1.40.	Firm told officially of order.
29.1.40.	D. of E. requisition against Specn. 1/40/D.H.
5.2.40.	Specification requirements conference.
14.3.40.	Specification issued.
1.4.40.	Contract placed.
16.5.40.	Mock-up conference.
25.11.40.	Skeleton aircraft for trials first flew - ½ hour duration.
14.12.40.	E. & R.P. Meeting agreed first 20 aircraft for P.R.U.
31.12.40.	Firm informed that first 20 Production Mosquitos will be allotted for P.R.U. duties - P.R.U. require a long range aircraft for their work and the Mosquito was considered suitable.

Mosquito Fighter: Specn.F.21/40.

-7.40.	A.M.D.P. instructed firm to complete the 3rd aircraft as a fighter in accordance with the Firm's proposals. (now to be the 2nd.)
23.9.40.(circa)	Minister authorised conversion of remaining 27 Production aircraft to Specn.B.1/40 to Fighter type (Specn. F.21/40.)
9.10.40.	Mock-up examined at Firm - full requirements agreed.
16.11.40.	Contract placed.
25.11.40.	Specification issued, recording requirements agreed at Mock-up examination, for contract purposes.

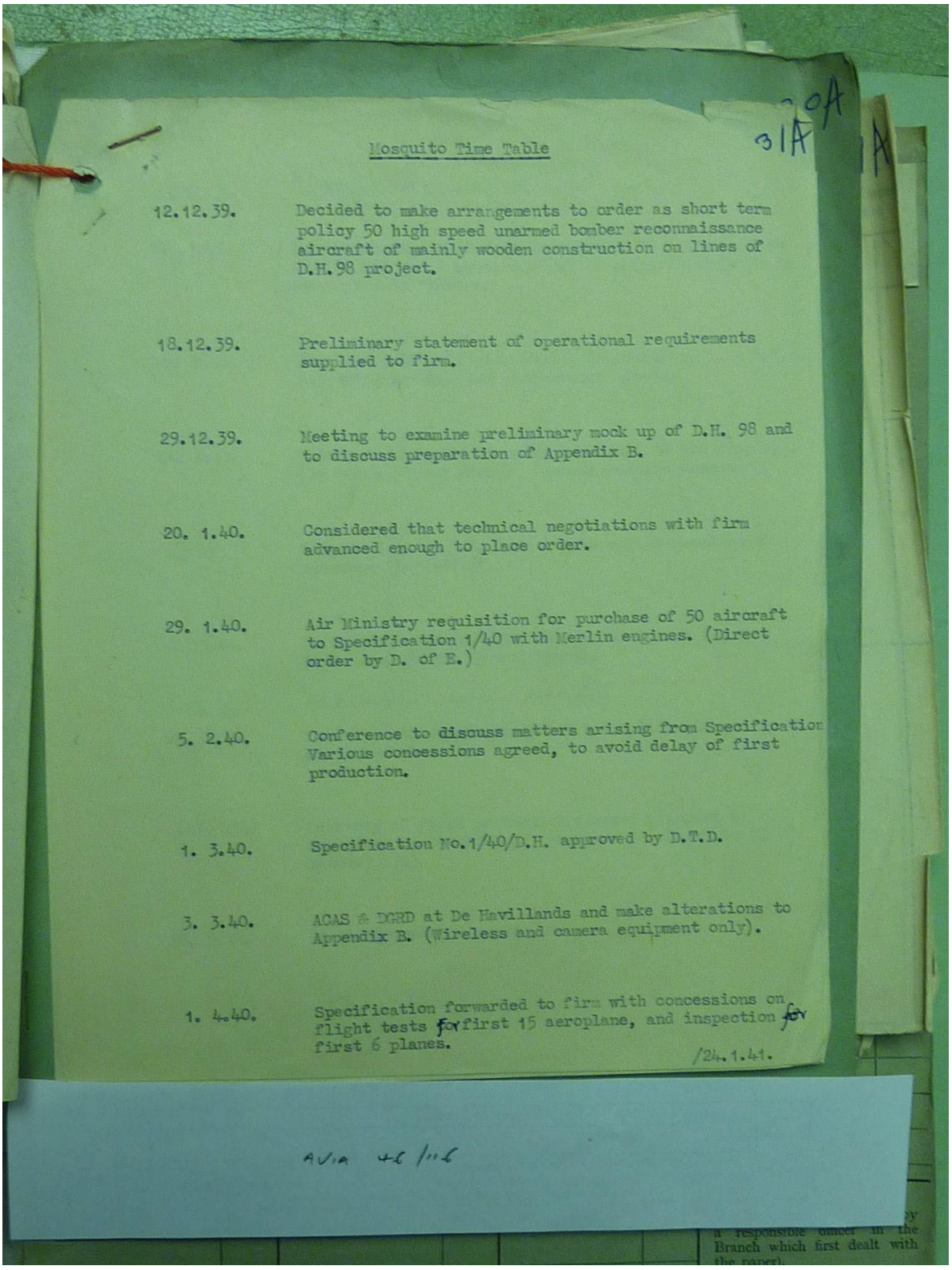
"

5.2.41. Minute from P.S. to Minister asking for further information about Mosquito development. It appears that the firm are alleging that they were not asked until last October, i.e. 1940, to go forward with the original 50.

/6.2.41.

/acceptance

AVIA 46/116



Mosquito Time Table

31A 9A

12.12.39. Decided to make arrangements to order as short term policy 50 high speed unarmed bomber reconnaissance aircraft of mainly wooden construction on lines of D.H.98 project.

18.12.39. Preliminary statement of operational requirements supplied to firm.

29.12.39. Meeting to examine preliminary mock up of D.H. 98 and to discuss preparation of Appendix B.

20. 1.40. Considered that technical negotiations with firm advanced enough to place order.

29. 1.40. Air Ministry requisition for purchase of 50 aircraft to Specification 1/40 with Merlin engines. (Direct order by D. of E.)

5. 2.40. Conference to discuss matters arising from Specification Various concessions agreed, to avoid delay of first production.

1. 3.40. Specification No.1/40/D.H. approved by D.T.D.

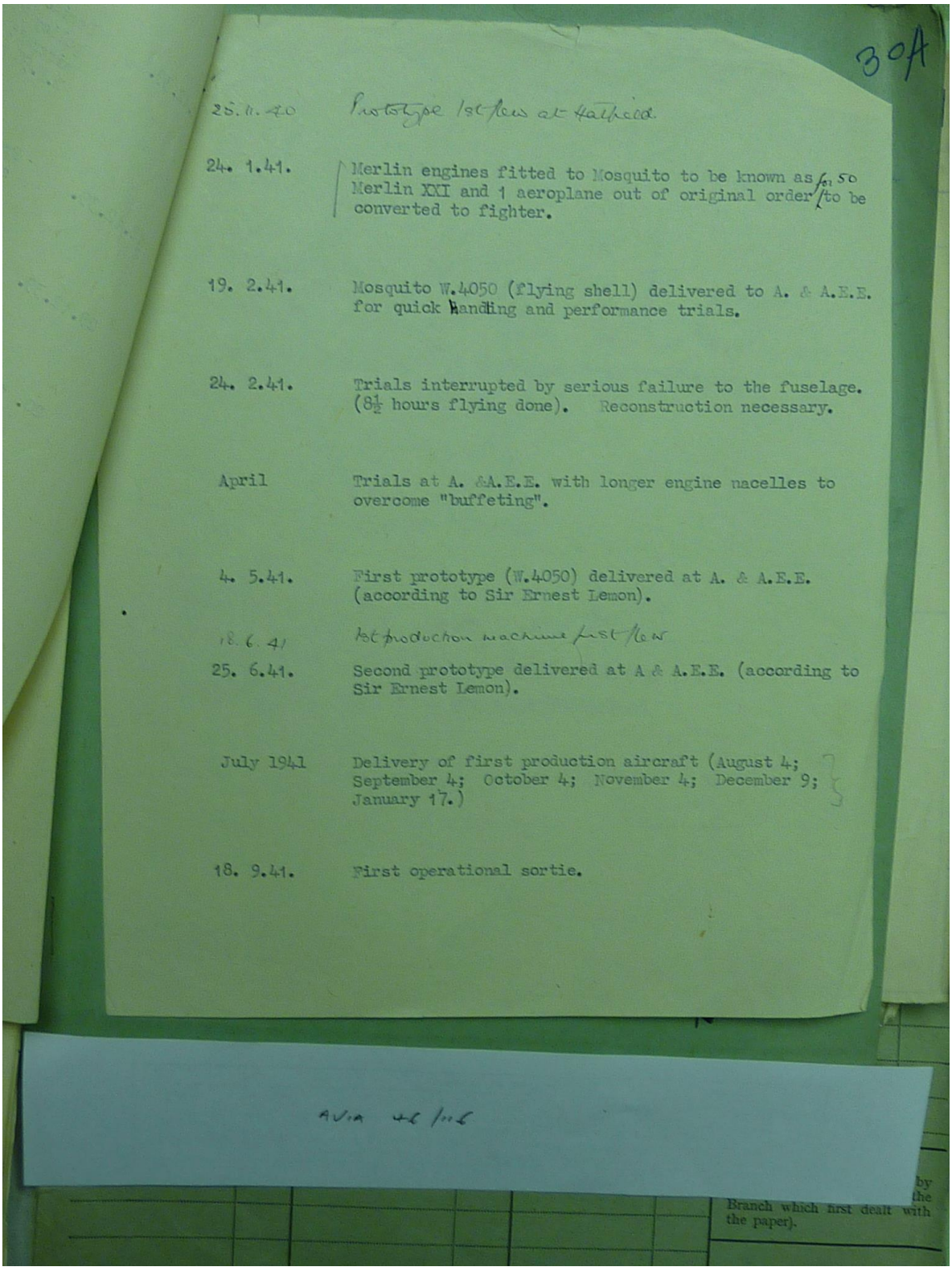
3. 3.40. ACAS & DGRD at De Havillands and make alterations to Appendix B. (Wireless and camera equipment only).

1. 4.40. Specification forwarded to firm with concessions on flight tests for first 15 aeroplane, and inspection for first 6 planes.

/24.1.41.

AVIA 46/106

a responsible officer in the Branch which first dealt with the paper).



30A

25.11.40 Prototype 1st flew at Hatfield

24. 1.41. Merlin engines fitted to Mosquito to be known as for 50 Merlin XXI and 1 aeroplane out of original order to be converted to fighter.

19. 2.41. Mosquito W.4050 (flying shell) delivered to A. & A.E.E. for quick handling and performance trials.

24. 2.41. Trials interrupted by serious failure to the fuselage. (8½ hours flying done). Reconstruction necessary.

April Trials at A. &A.E.E. with longer engine nacelles to overcome "buffeting".

4. 5.41. First prototype (W.4050) delivered at A. & A.E.E. (according to Sir Ernest Lemon).

18.6.41 1st production machine first flew

25. 6.41. Second prototype delivered at A & A.E.E. (according to Sir Ernest Lemon).

July 1941 Delivery of first production aircraft (August 4; September 4; October 4; November 4; December 9; January 17.)

18. 9.41. First operational sortie.

AVIA 46/106

by the Branch which first dealt with the paper).

24th May, 1943.

BRIEF NOTES ON PRE-DESIGN STAGE OF MOSQUITO DEVELOPMENT

(Extracted from Estimate File)

6th Sept. 1939

Estimates based on 1,000 lb. of bombs and 1,500 miles range.
Preliminary idea of size of machine with one Sabre to meet
400 m.p.h./16,000 ft./2000 h.p. (330 sq.ft. wing area)

14th Sept. and 18th Sept.

Comparison of speeds with 1 Sabre or 2 Merlins (330 sq.ft.)

18th Sept.

Size of machine to do 400 m.p.h. with 2 Merlins (Area = 440 sq.ft.
Span = 55.5 ft.)
Detailed weight estimate for (a) 2 Merlins and (b) 1 Sabre
(Span = 47 ft. Area = 330 sq.ft.)
Also scaled up aeroplane with 2 Merlins
(2 sizes:- 50.5 ft. and 54 ft. span)

19th Sept.

Further estimates for the above three sizes of aircraft with 2 Merlins
~~3 sizes of aircraft with 2 Merlins.~~

22nd Sept.

Investigation of the effect of wing loading on the three Merlin aircraft.

21st Sept.

2 Merlin 48 ft. span Area. 360 sq.ft. detailed examination.
Also 1 Sabre, and 2 Enlarged Daggers (E.112) in the same sized aeroplane.

4th October.

More on 2 Merlin aeroplane
2 Griffons in a machine 51.25 ft. span 410 sq.ft. area.
also Merlins in this larger size (Now most favoured)

16th October

Effect of adding defensive armament
2 guns on top, 1 underneath.

20th October

2 - 100 octane Daggers, also 2 - E.112 in above armed machine

(Somewhere about here Mr.Walker and Mr.Bishop went to Harrogate)

26th October

2 Griffons (a) armour for crew, tanks and engines
(b) armour for crew only and 2 guns rear turret.
(b) also with Merlins.

2nd November

(a) 2 Griffons 4 gun tail turret (G.A. with tail turret)
(b) 2 Merlins 2 " " "

also 4 cannon fighter version.
(Still 1000 lb. bombs for 1500 miles range, but provision for
1500 lb. bombs with shorter range)

2nd November

First work on radiator installation.

18th November

First contact with R.A.E. re. model tests.

22nd November

Meeting at Harrogate on the turret version
Mr.Murray, Mr.Bishop, Mr.Clarkson, Air Marshal Freeman,
Mr.Farren and Captain Liptrot. Freeman emphasised the P.R.U.
(Scepticism about estimates) duty and vetoed out the armament.

24th November

2 Merlins. No defence.
(A) Pilot, Navigator/Bomb Aimer, and W/T operator in rear fuselage
or four cannon version.
(B) Crew and size as now, alternative 4 cannons.

Detailed estimates for these two machines submitted about end of November 1939.

2nd December

Aeroplane (A) with Griffons.

Thereafter intensive detailed estimates proceeded on aeroplane (B) - the original Mosquito - until the end of December 1939 when it may be said that the Design requirement was finalized.

11th December 1941.

MOSQUITO PROJECT.

At the outbreak of war the Mosquito project commenced with discussions at the Ministry. The definite technical basis for the design of the aircraft was not finalised until December 1939. Broadly speaking, it was then to cover the design and production of 50 aircraft with 2 Merlin 20 engines, carrying 1000 lb. load of bombs with a performance comparable to contemporary fighters. Our figure for maximum speed was 386 m.p.h., although the Ministry had placed in various documents at the time the figure of 400 m.p.h. No armament was to be carried, on the assumption that its performance would enable evading tactics to be used.

It was considered that at the end of production of 50 aircraft it would be necessary to introduce a new model to keep abreast of fighter development. The idea, therefore, was to produce the 50 aircraft as rapidly as possible by some production and hand method. For this reason a plan was evolved necessitating the minimum of drawing office work and placing the maximum reliance upon patterns and sample parts. (Note: From our own point of view this policy has not been a success, and it is doubtful whether we should do it again, even for a correspondingly small order).

We submitted a programme completing the order for 50 aircraft by the end of July 1941.

In May 1940, further possibilities of the type were discussed with Sir Wilfrid Freeman, following my letter of May 8th giving three alternatives:

1. Unarmed Bomber.

2. Fighter/Bomber carrying forward armament, which could jettison its bombs and operate as a fighter.

3. Twin-engined fighter using all space available for forward armament.

This proposal was coupled with a suggestion that largerproduction orders should be given for the type, in view of the likelihood of it becoming a general purpose aircraft. This suggestion was turned down by the Air Staff on the grounds that they were very uncertain regarding the future of unarmed bombers, and they did not consider the alternatives satisfactory. The feeling of uneasiness regarding the position of the unarmed bomber increased until in July 1940 after some discussion it was decided to proceed with a long-range fighter conversion, and instructions were received to transfer the third aircraft to the Experimental Section to produce the prototype long-range fighter.

About this time a discussion commenced with the Ministry on a night fighter project to be delivered by Airspeeds. It soon became apparent that some variation of the Mosquito long-range fighter would suit this job better than the proposed single-engined Airspeed project. It was thought at this time that the Mosquito night fighter might require a nose wheel, and for a little while there was some confusion regarding the necessity of having two types or the combining of long-range fighter and night fighter. Eventually, the long-range fighter was dropped, and we went ahead with the night fighter based largely on the long-range fighter design.

Very shortly afterwards a decision was made to divert all the production after 20 bombers to the fighter project. Unfortunately, even the night fighter could not be adequately defined, and right through the remaining half of 1940 we were discussing with the Ministry the need for a turret and single and dual control. During this time the Battle

AVIA 46/116

of Britain was in progress, and night fighter pilots were continually changing their ideas in regard to detail requirements. The A.I. equipment was passing from an experimental basis to a practical basis and flying tactics were changed, with the result that the layout of a suitable type of aircraft could not be accurately determined. The final result of our negotiations on this matter was the development of the original single control fighter, two turret fighters with dual control and a dual-control fighter without turret.

After the prototype flew in November 1940 it was suddenly decided that there was no call for the unarmed bomber, and that the first 20 aircraft scheduled as bombers were to be modified for photographic reconnaissance uses. Although at first thought this appeared to be merely the taking off of equipment, it was found that more was involved, and considerable re-design of services such as hydraulics and electrical resulted from this change.

From the production point of view it should also be noted that we were forced by the Beaverbrook administration to attempt a very ambitious programme for the production of 50 bombers. All these design changes coming during this striving for the programme, coupled with the fact that we were told that we must on no account interfere with the production types running through our factory meant that sub-contracting help had to be enlisted to an uneconomical degree, resulting in duplication of jigs, all of which had to be modified as the subsequent design changes were made. Incidentally, it is important to note that at no time did we agree to the programme to deliver 50 aircraft before the end of 1940, and actually in my letter to Hennessy we pointed out that this was impossible. It is quite probable that had the design remained unchanged, we should have adhered to our original delivery programme of completing the batch before the end of July 1941. The additional changes, as well as affecting the jigs, also meant that waiting time was experienced both by sub-contractors and in our own factory.

During the first portion of 1941 it was decided to give further orders for this type, and on June 26th the position was as follows:-

1 Experimental prototype (unequipped)
1 Experimental night fighter
1 Prototype P.R.U.
2 Experimental turret fighters
19 Production P.R.U. aircraft
27 Production night fighters.

In addition, we had orders for 150 night fighters and 50 of a type not yet specified.

Shortly after this date we were asked to convert as rapidly as possible the last 10 P.R.U. production aircraft back to bombers.

The question of single control and dual control fighters has swung from one side to the other right through the period to the end of 1940, and to some extent is still indefinite.

We are now faced with large production orders, to be made in a number of different places. From the initiation of the project we had very inadequate records owing to the original basis on which we undertook the work. This in itself is bound to mean that production costs and jigging and tooling will be expensive.

30th January 1942.

MOSQUITO PROJECT.

The definite basis for this design was finalised in December 1939 and called for an unarmed aircraft to be fitted with two Merlin XX engines, carrying 1000 lbs. of bombs, and with a performance comparable with contemporary fighters.

The authorities advised us that only small-scale production could be envisaged because, on account of the rather special nature of this type, it would probably be necessary to follow it with a series of developments - keeping abreast of fighter performance. Production was therefore to be limited to 50 aircraft, and consequently a high proportion of hand methods was planned for manufacture. Drawing Office work was to be reduced to a minimum and the maximum reliance was to be placed on the use of patterns and sample parts.

On these plans, in January 1940, we submitted a programme to complete 50 aircraft by the end of July 1941.

In May 1940, as aerial warfare developed, the wider possibilities for the Mosquito began to impress us and we put forward proposals to develop a fighter-bomber and a long-range fighter in addition to the unarmed bomber version. Furthermore, we asked for larger orders so that big scale production could be planned. These proposals were not, however, accepted at that time.

In July, however, interest was shown in a long-range fighter conversion, and at the same time we were advised that there was some uneasiness with regard to the future of the unarmed bomber. In due course the interest in a long-range fighter switched to a night-fighter version, and it was then arranged that only 20 unarmed bombers should be built, the remaining 30 aircraft to be of a fighter type.

The precise requirements for a night-fighter aircraft were not then established and three alternative models were decided upon - the basic single-control arrangement, a dual-control type and a turret fighter.

The prototype built to the original specification flew in November 1940 - eleven months after the broad determination of the design requirements. Shortly afterwards we were instructed to convert all the 20 bombers to photographic reconnaissance aircraft.

We should mention that during the last half of 1940 the production of the Mosquito was carried on under considerable difficulties. Not only were there the above-mentioned uncertainties with regard to the future of the type, but in some quarters it was even considered that the project should be abandoned. In point of fact, in one issue of the M.A.P. programme the type was omitted, and this led to temporary difficulties in obtaining our supplies. We were urged to concentrate our efforts on Oxford production to a rapidly increasing programme.

In 1941 the possibilities of the Mosquito were increasingly realised, and in June the 50 aircraft were allocated as follows:-

1 Experimental prototype (completed)
1 Experimental night fighter (completed)
1 Prototype P.R.U. (completed)
2 Experimental Turret Fighters (being manufactured)
5 P.R.U. aircraft with standard tankage.
14 P.R.U. aircraft with long range tanks, including 2 with tropical equipment.
26 Night fighters.

Shortly afterwards the possibilities of using unarmed bombers were again considered and we were instructed to complete the last ten P.R.U. aircraft as bombers.

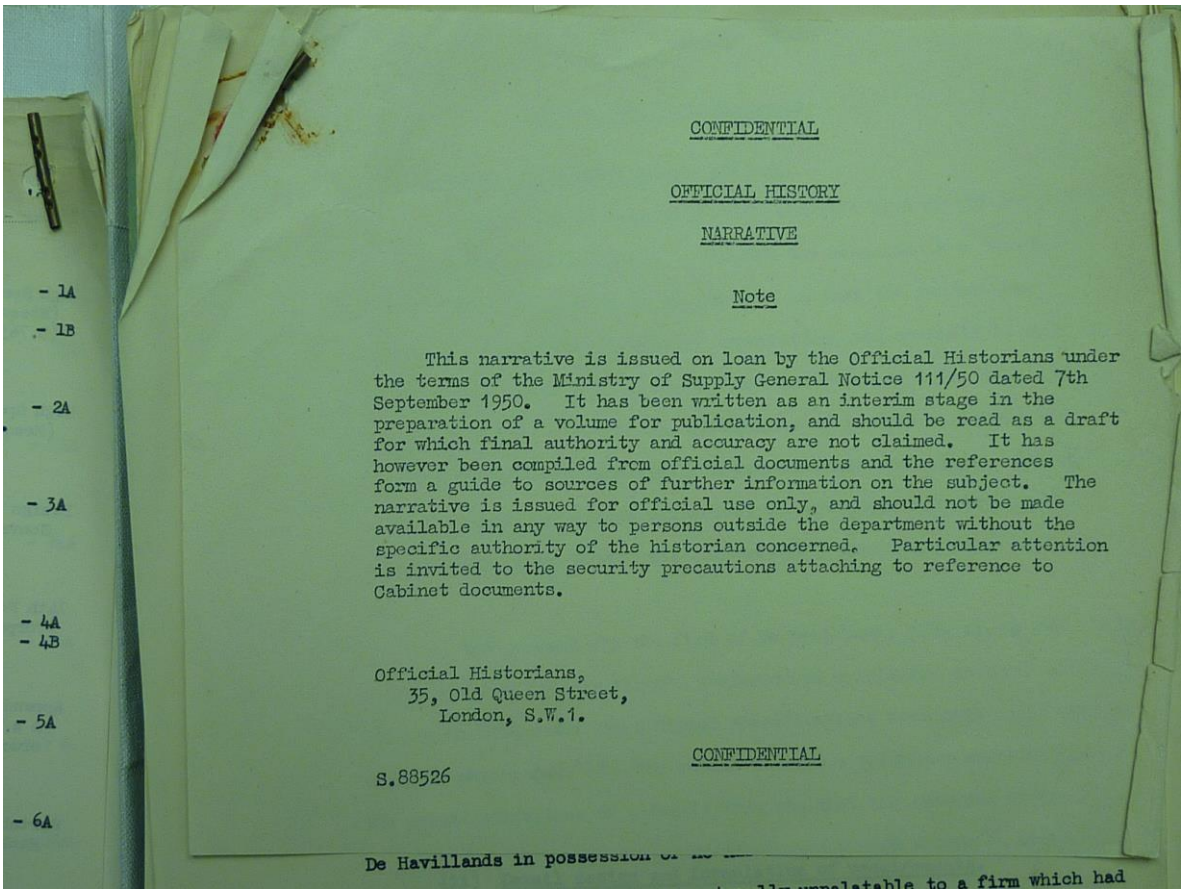
Contracts for 200 further aircraft were placed earlier in that year, and in the middle of July, we were instructed to plan for large quantity production, and the manufacture of two thousand aircraft was to be distributed between our headquarters factory, our shadow group and our associated company in Canada.

It will be seen that the development of the Mosquito was for a long time influenced by the original plan for smallscale production, and had we initiated more ambitious plans in May 1940 a great deal more progress would of course have been made by now. A very different procedure would have been adopted both in regard to production drawings policy and in the provisioning of jigs and tools and production equipment generally.

In any case we believe that the progress of this project has been good, and if compared with the parallel development of other types we feel sure that the position of the Mosquito will appear more than favourable.

The process of getting into production and at the same time developing a new type is always fraught with difficulties and troubles which have to be gradually overcome. We believe that the Mosquito is emerging from that stage and output figures should build up steadily from now on. It should be borne in mind that the development programme still continues, and at the present time we have the following projects in hand:-

Merlin 61 installation.
Pressure cabin.
A number of minor changes in armament and other equipment.



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- 1B
- 2A
- 3A
- 4A
- 4B
- 5A
- 6A

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OFFICIAL HISTORY

NARRATIVE

Note

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S.88526

De Havillands in possession of [illegible] to a firm which had

The De Havilland Mosquito

(i) Origin of unarmed bomber project.

1. Amongst the stories of British aircraft that of the Mosquito stands out for several reasons. Firstly the Mosquito is a "private venture" in the fullest sense of the word in that the project was completely independent of official inspiration, and secondly it has fulfilled with great success the operational roles of both front line fighter and bomber with all the differences of equipment, layout and requirements that two such widely separated functions imply. Thirdly, in spite of many unforeseen obstacles, the prototype and production aircraft were ready in what was comparatively speaking a remarkably short time.

2. The reasons why the firm of De Havilland, although on the list of Air Ministry "family firms", preferred to specialise on civil aircraft and not to tender for the official specifications have been dealt with in the main memorandum.(1) The result of such a voluntary abstention from the normal activities of a family firm was that the outbreak of war found De Havillands in possession of no Air Ministry work except an order for trainers. This situation was naturally unpalatable to a firm which had such high standards of design and which could point to such achievements as the Comet and the Albatross aircraft.

3. They proceeded therefore to design an aeroplane without any previous advice from the Air Ministry and to think out for themselves the whole tactical and strategic purposes to which the aircraft should be put. It was not surprising that the firm made a number of strategic and tactical assumptions which were not those of the Air Ministry. While the Air Ministry was still wholly devoted to the doctrine of night bombing by large, slow and heavy defended bombers, Sir Geoffrey de Havilland and his team conceived the idea of day bombing by fast unarmed aircraft. They calculated that if design and production were allowed to proceed quickly they would be in a position to produce a bomber which could outpace the

/then

(1) See Professor Postan's Memorandum "Aircraft Programmes Quality": See Ministry of Supply file 1/Hist/145, para.124.

then known German fighters. This would enable it to fly unarmed and would prevent its speed and performance being spoilt by turrets and other excrescences which would add to the weight and damage the clean aerodynamic lines of the aircraft. It was upon these two claims that the firm based their project for an undefended bomber -

(i) that they could design an aircraft capable of carrying a reasonably heavy bombload which would be at least as fast as the contemporary German fighter, and

(ii) that they could produce it in quantity before its relative superiority had been overtaken.

4. The Air Staff were unwilling to admit that the unarmed bomber was operationally desirable and the technical and production experts had grave doubts as to the firm's ability to achieve this performance and production promises. Thus the firm found a triple opposition arrayed against their project and they owe much to the two highly placed officers who were willing to take a heavy risk against expert advice. There is no doubt, in spite of the many changes of policy towards the Mosquito that the firm were able absolutely to vindicate their project of an unarmed bomber.

(ii) Detail design and formulation of requirements.

5. The original proposals for the De Havilland unarmed bomber were first sent to Sir Wilfrid Freeman in September 1939. The firm expounded their claims of performance and production as follows:-

(1) The methods of design and construction would be those used with the Comet and Albatross. The aircraft would be specially suited to high speeds because all surfaces would be smooth and free from rivets, overlapping plates and undulations.

(2) The form of wooden construction chosen would reduce to the minimum the time and man hours needed to design and construct jigs.

(3) Wooden construction would utilise labour and materials outside those used for production of other aircraft.

(4) The design staff had had much experience of producing very quickly aircraft types to meet specific and competitive needs.

(5) There would be a small use of embodiment loan items because of the simplicity of design and reliance upon performance for defence.

(6) A bomber with a high performance and capable of going into production within a year was an insurance against surprises emanating from the enemy's design resources.

/(7)

(7) Actual performance was estimated to be:
A speed of 405 m.p.h. at 20,000 ft. and a bomb load of 1,500 lb. at a range of 1,500 miles. The aircraft was to be powered with two Merlin engines and there would be a crew of two.

Such were the firm's proposals. At every turn they met opposition within the Air Ministry, although the broad idea that De Havilland's should design and build an aircraft of their own for the R.A.F. was thought to be a good one. Consequently discussions and correspondence regarding the kind of aircraft that the Air Staff wanted continued throughout the autumn, during which period the firm submitted several alternative schemes and provided more detailed information about their own project.

6. The Air Staff's fundamental objection to an unarmed bomber was repeatedly stated at a series of meetings in October, November and December and the A.O.C. in C. Bomber Command was equally insistent on the absolute necessity of rear defence.(1) However neither the Air Staff nor the C. in C. apparently had any objection to the experimental development of a high speed machine as a photographic reconnaissance and were quite prepared to accept a small number of aircraft to De Havilland's design provided it was fitted with adequate rear defence. Accordingly, although the firm were unwilling to spoil the logic of their project, they presented first of all a scheme for defensive armament similar to that of the Hampden i.e. 2 guns each in an upper and lower position in the middle of the fuselage, and then one which they considered more satisfactory, a tail turret with 4 guns. In each case they stated frankly that the loss of speed would be substantial and, to their mind would be fatal to the purpose of the aircraft whilst the extra work would add four months to the time taken to build the prototype. But in this latter form the design was acceptable to the Air Staff and at the 12th ACAS(T)/DGRD Liaison meeting on 15th November it was agreed that the firm should be given an order for 2 prototypes. The firm were accordingly told of this decision.(2) Simultaneously with this controversy about defensive armament there had been discussion in D.D.G.P. and D.T.D branches as to

/(i)

(1) 11th ACAS/DGRD Meeting, Conclusion 31, 1.11.39. See Ministry of Supply file 1/Hist/108 and
12th Meeting, Conclusion 16, 15.11.39. See Ministry of Supply file 1/Hist/108.
(2) File S.B.125. Encl.25A dated 20.11.39.

(i) the effect on the general production position of a production order and (ii) what reliance could be placed upon De Havilland's production and performance estimates. The firm had promised that their prototype could be flying in 9 months and that production would follow in about 18 months time.(1) D.D.G.P. had expressed himself sceptical as to the firm's ability to achieve this but agreed that production capacity for wooden aircraft would probably be available in 18 months time.(2) The performance estimates however were subjected to the usual severe criticism meted out to new designs. For several weeks the firm did not supply sufficient data for an adequate criticism to be made,(3) but eventually AD/RDT1's estimate was made and it compared very unfavourably with the firm's own estimate:

	Air Ministry	Firm
Max speed	350 m.p.h.	405 m.p.h.
All-up weight	19500 lbs.	15600 lbs.
Fuel	635 gallons	420 gallons

7. The effect of these detailed criticisms was salutory, because the firm were forced to revise their figures very thoroughly and to produce a new set which they and the Air Ministry knew were possible to achieve. The revised performance figures were:-

Max speed	386 m.p.h. at 20,000.
Cruising speed	315 m.p.h. at 15,000 ft.(4)

8. De Havilland's project for an unarmed bomber was not however universally opposed. Sir Wilfrid Freeman, A.M.D.P. and Sir Arthur Tedder, D.G.R.D. had from the first been attracted by the proposal. The Air Staff had assumed that given equal conditions of design and power the fighter would always be superior to the bomber.(5) The C. in C. Bomber Command had based his objections mostly on the grounds of tactics, i.e. that he required his fast bombers to penetrate singly heavily defended

/territory

(1) Ibid. Encl.12A dated 26.10.39.
(2) Ibid. Minute 20 dated 13.11.39.
(3) Ibid. Encl.14A dated 31.10.39, and Encl.2a dated 27.9.39.
(4) S.B.2750 Encl.5A dated 15.1.40.
(5) A.C.A.S/D.G.R.D. Meeting No.9. Conference to discuss Experimental Aircraft Programme. See Ministry of Supply file 1/Hist/108.

territory to reach selected targets. For reasons of morale, if nothing else, it was necessary for the aircraft to be able to defend itself. The criticism made by A.M.D.P. and D.G.R.D. of these arguments was that to sacrifice the extra speed for the sake of the armament would be likely to result in a bad compromise such as had occurred in the Blenheim which with its slow speed and inadequate defence was clearly obsolete.(1) But on the other hand, to maintain the relative ascendancy of the unarmed bomber, an improved version taking advantage of the latest engine development should appear each year. In spite of the fact that C. in C. Bomber Command remained unconvinced and repeated that he had no use for the unarmed bomber, the A.M.D.P. and the D.G.R.D. recommended it to the Air Staff for production in limited numbers as a gamble. Accordingly, a recommendation to order 50 De Havilland high speed bomber reconnaissance aircraft was made to the Aircraft Supply Council, the first 6 to be produced as development aircraft under relaxed production control instead of prototypes.(2) Approval was duly given on 22nd January, 1940,(3) and the firm were informed of the decision.(4)

(ii) Construction of prototype

9. As has been described above, no separate prototype order was given but certain concessions were to be granted in the manufacture of the first six aircraft. Normal development procedure in the specification stage was also abandoned. During the three months it was under discussion, the firm had done much to the design, so that by January when the specification was put in hand construction was nearly ready to begin. Already on December 29th, Air Ministry representatives had examined a preliminary mock-up.(5) As however the operational requirements had been the main subject of the early discussions at a high level drafts of these had been circulated and debated even earlier. The first outline

/requirements

(1) Meeting on 12.12.39. with C. in C. Bomber Command (S.B.125, enc.38a).
(2) SCM.41(40) dated 20.1.40. (SB.2750, enc.4a).
(3) 146th Meeting of Air Council Committee on Supply dated 22.1.40.
(4) Letter dated 25.1.40. (S.B.2750, enc.44a).
(5) S.B.2750 enc.6a.

requirements of the unarmed version had been discussed with the firm on 22.11.39. and the resulting draft was sent to them the next day.(1) These were naturally modified as a result of the final discussions leading up to the production order, and the approved requirements were at last sent to the firm on 17th February 1940.(2) A few weeks later the official specification, the B.1/40, was sent to the firm,(3) but by this time the first aircraft was well under construction.

10. The firm had promised on more than one occasion that their prototype would be flying in 9 months and this speedy construction was one of their main claims to receive an order. The firm were officially informed of the Air Council's decision to order their design on 25.1.40; the first prototype, a flying shell, first flew at Hatfield in November 1940. Thus the firm exceeded their estimate by about two months. This was in fact a very creditable achievement if it is remembered that throughout the summer of 1940 there was a universal dislocation to all experimental and development work. The prototype was delivered to the A. & A.E.E. in February 1941 where the following troubles were revealed in flight trials:-

1. Stability and control troubles
2. Buffeting of the tail
3. Bouncing of the aircraft on landing.

These troubles were cured - (1) by certain modifications proposed by the A. & A.E.E., (2) by lengthening the engine nacelles beyond the trailing edge, and (3) by substituting an oleo undercarriage leg instead of the original leg.

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(1) S.B.125.

(2) S.B.2750 enc.20a: summary:- The Air Staff require a high speed reconnaissance and bombing aircraft for use in the immediate future. The all-up weight should not exceed 20,000 lbs. as a bomber. Rapidity of manufacture, structural simplicity and low first cost are of the utmost importance. No defensive armament is required but a high speed and climb are therefore essential. Max. speed 400 mph. and cruising speed 345 mph (admitted by Air Staff to be a target only). Normal range 1200 miles; normal bomb load 1000 lbs; crew of 2; best possible pilot's view.

(3) On 1.4.40. (S.B.2750 enc.44b).

(iv) Mosquito fighter to Spec. F.21/40.

11. Even after the production order had been given for the unarmed bomber photographic reconnaissance design with the approval of the Air Council, considerable doubt as to its operational value remained in the minds of the Air Staff and C. in C. Bomber Command. The firm were aware of this doubt and as they had always envisaged that a really fast design would have a variety of uses, Sir Geoffrey de Havilland proposed to Sir Wilfrid Freeman in May 1940 that an alternative long range fighter should be built.(1) By July 1940 increasing uneasiness about the unarmed bomber caused interest to concentrated on the long range fighter version and in that month the Minister himself authorised the firm to construct the 3rd Mosquito aircraft as a fighter. This was subsequently changed to the 2nd aircraft. A few weeks later a specification was put in hand.(2) The draft specification was discussed at great length with the firm and it was estimated that such a fighter would have a speed of 367 mph with a short range of 640 miles and a speed of 364 mph with a long range of 980 miles.(3) The Air Staff however had great difficulty in deciding how the Mosquito fighter should be equipped. Should the fighter be primarily for day or night work? Should it be dual or single control? Should it be armed solely with fixed guns or partly with a 4 gun turret? It will be remembered that night fighting tactics and requirements were being modified nightly under the experience of the German night bombing attacks during the autumn of 1940 and in addition the appearance of A1 equipment and its possibilities for development had to be taken into consideration. Finally the prototype fighter specification No. F.21/40 was approved as a two seater, single control, fixed gun fighter.(4) There were to be 4 x 20 mm. and 4 x .303 m. forward firing guns and the second seat was to be occupied by an air observer/A1 operator. The controversy about the most desirable layout of fighter was however not settled as will appear in the next section.

/The

(1) See Note by Sir G. De Havilland dated 11.12.41. enclosed in letter to Professor Postan dated 28.5.43. See Ministry of Supply file 1/Hist/108.
(2) S.B.11419 enc.1a dated 23.9.40.
(3) Ibid.
(4) See S.B.11419.

The fighter prototype had originally been promised to fly in March 1941,(1) but the large amount of re-design necessary and the constant changes in requirements seriously delayed progress. In fact the fighter prototype did not fly until May 1941.(2) The 3rd prototype, which it was finally agreed after many changes, should be equipped as a photographic reconnaissance aircraft, flew soon after.(3)

(v) Production

12. It will be remembered that the De Havilland Mosquito was to be built of wood, the construction being a monoesque fuselage of a layer of Balsa wood 7/16" thick faced on both sides with 1½ mm. 3 ply wood. The firm's object in choosing wooden construction was purely to simplify production itself and to make use of materials and labour which were not required for the general aircraft programme. They claimed no special technical performance advantages over normal metal construction by the use of wood. The speed and performance which they predicted was due entirely to the design itself.(4) Production of a wooden airframe was considered easier for a number of reasons. The period of tooling up would be reduced and both the jigs and tools required would be much simpler than for an equivalent metal aircraft. In addition the firm endeavoured to simplify construction and assembly by employing as few Embodiment Loan items as possible and components, such as the under-carriage, employing a simple method of operation and manufacture.

13. The first production order was for 50 aircraft only, which the firm promised would be completed by July 1941.(5) In order to aid the development and production (the design was of course "ordered off the drawing board"). It was agreed that all parts which could be made without drawings should be developed in the Experimental department who would make sample parts for future use (this did not apply to machined fittings and the principal metal forgings and castings). In addition

/the

(1) Min. for Minister by DD/RDA dated 4.2.41. (B.76301/40).
(2) B.76301/40 enc.162a dated 1.5.41.
(3) Ibid.
(4) See notes of Professor Postan's Interview with Sir Geoffrey de Havilland dated 26.5.43. See Ministry of Supply file 1/Hist/108.
(5) See note by Sir G. de Havilland dated 11.12.41. enclosed in letter to Professor Postan dated 28.5.43. See Ministry of Supply file 1/Hist/108.

the Air Ministry agreed to allow the first six aircraft to be produced in the Experimental department to be inspected for workmanship only; interchangeability of components would also not be required at first.(1) The special production arrangements were suggested by the firm and accepted by the Air Ministry solely because it was desired to produce only 50 aircraft in the shortest possible time. In fact the methods of relaxed control and the mixture of production and hand methods were not successful. The firm themselves admitted as much. Production only began in July 1941 and remained a mere trickle for many months although the original order for 50 had been increased to 200 at the beginning of 1941. Originally the first 50 had been promised by July 1941 and the so-called Hennessy programme of 2nd October 1940 had put this date forward to the end of 1940. The firm however had never accepted this programme as possible.(2)

14. All the blame for the delay in production however cannot be laid at the door of the production methods. At least as important were the constant changes of design due to the evolution of the fighter requirements during late 1940 and 1941 and the failure of the Air Staff to decide

(a) whether they definitely did not require the unarmed bomber version and

(b) what proportion of total output they required to be built as fighters, bombers or photographic reconnaissance.

15. The changes in design due to the fluid state of fighter requirements has been referred to before and there was a very good reason for it. Tactics and ideas were changing all the time and it was only decided in early 1941 that the single control type was finally chosen. Even then several fighter variants remained the night fighter and the day fighter were quite distinct designs and the latter in addition had three alternative roles which required different items of equipment, i.e. the

/intruder

(1) File B.76301/40. Encl.4A dated 5.2.40.
(2) See note by Sir G. de Havilland dated 11.12.41. enclosed in letter to Professor Postan dated 28.5.43. See Ministry of Supply file 1/Hist/108.

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88

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W.P. (43) 373.

18*th August*, 1943.

WAR CABINET.

MAN-POWER FOR INDUSTRY.

MEMORANDUM BY THE LORD PRESIDENT OF THE COUNCIL.

I have considered, in consultation with the Minister of Labour and National Service, the Minister of Production and the Supply Ministers, the points raised at the meeting of the War Cabinet on the 16th August regarding the supply of labour for aircraft production and other vital supply programmes (W.M. (43) 115th Conclusions, Minute 7). We are agreed in submitting the following recommendations to the War Cabinet :—

1. The Minister of Labour is satisfied that, so long as he remains under an absolute obligation to ensure that the labour force working on aircraft production is increased by 115,000 during the period from the 1st April to the 31st December, 1943, and that any deficit in the total man-power supply does not fall on the M.A.P. programme, he must give an absolute and overriding preference to the labour demands of M.A.P. If, however, such an absolute preference is given to M.A.P. over the remaining months of 1943, there is a definite risk that other vital production will be jeopardised and that the balance of the supply programmes as a whole will be disturbed. We are, therefore, agreed that it is necessary to arrange that the labour requirements of certain vital parts of the other programmes shall receive the same preference as those of aircraft production. To secure this we propose the immediate adoption of the following arrangements, which will involve some modification of the absolute obligation now resting on the Minister of Labour (see paragraph 7 below).

2. Production which, though under the auspices of other Supply Departments, is part of the aircraft programme will be given the same preference for purposes of labour supply, as aircraft production itself. For the purpose of effecting the expansion of 115,000 in the labour force working for M.A.P., those parts of the "common service" and other programmes which are needed for the fulfilment of the aircraft programme will be regarded, for purposes of labour supply, as forming part of the M.A.P. programme.

This will apply to products such as ball bearings, tools, tyres, rubber and steel tubes required for aircraft production.

3. As regards other supply programmes, the Minister of Production will from time to time designate other urgent products or services which he is satisfied are vital to our war production and should be given a priority equal to that of the aircraft programme.

It is understood—

(*a*) that the products or services so designated will be few in number and relatively small in terms of labour required; and

(*b*) that the Departments concerned will not thereby, and to that extent, be relieved of their obligation to release (in the case of the Ministry of of Supply) the total numbers already approved by the War Cabinet; or to restrict (in the case of the Admiralty) their net demands for labour to the figures already approved by the War Cabinet. In planning their programmes in accordance with the previous decision of the War Cabinet, the Supply Departments allowed for the labour requirements of such new vital work as was then foreseen; but Departments may have to seek the approval of the War Cabinet for

additional man-power for new projects of the highest operational importance which were not contemplated at the time of the War Cabinet's decision, *e.g.*, the extension of the flexible bridge programme.

4. Where a product or service has been designated by the Minister of Production under paragraph 3 above, the particular firms and, where necessary, the particular parts of the production of those firms to which special preference is to be accorded will be identified and arrangements made, through the normal machinery of the Preferences Sub-Committee of the Labour Co-ordinating Committee, to secure that this production receives, where necessary for purposes of labour supply, equal preference with aircraft production.

5. The Minister of Production will report monthly to the War Cabinet the extent to which he has designated under paragraph 3 above products and services which are not directly related to aircraft production.

6. It is understood that nothing in the foregoing paragraphs will limit the process of ensuring that the release of labour from Ministry of Supply work is dovetailed into expansions of the M.A.P. labour force so far as is possible without dislocation of labour. Labour transferred from Ministry of Supply to M.A.P. work, whether in the same factory or by block transfers of work-people in the same district or by block transfers of orders, will be regarded as "released by the Ministry of Supply and absorbed by the Ministry of Aircraft Production."

7. These arrangements will not involve any change in the statistical distribution of our man-power supply, as settled by the War Cabinet on the 22nd July, or in the objectives of man-power policy then defined. They will, however, necessitate some modification of the absolute obligation which was then laid on the Minister of Labour to ensure that, whatever else happened, the labour force on aircraft production was increased by 115,000 by the end of 1943.

We therefore recommend that the first sentence in paragraph (14) of the War Cabinet Conclusions of the 22nd July should be modified so as to read :—

> "In the administrative arrangements made to give effect to this re-distribution of man-power every endeavour should be made to avoid a situation in which, if the supply up to the end of 1943 proved insufficient to meet all the requirements set out in (13) above, the deficit would fall on the Ministry of Aircraft Production."

J. A.

Offices of the War Cabinet, S.W. 1,
18*th August*, 1943.

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W.P. (40) 427.

October 27, 1940.

TO BE KEPT UNDER LOCK AND KEY.

It is requested that special care may be taken to ensure the secrecy of this document.

WAR CABINET.

SECOND REPORT ON THE MINISTRY OF AIRCRAFT PRODUCTION.

(Previous Report W.P. (40) 211.)

Memorandum by the Minister of Aircraft Production.

DURING the last three months a series of misfortunes has befallen this Ministry, as an inevitable consequence of the fact that its factories are a high-priority target for enemy bombing.

While many factories engaged on contracts for the Ministry have suffered through enemy bombing, there have been the following major disasters to main aircraft and engine works:—

August 14: *Castle Bromwich.*—Here the bombing had a limited effect on the production of Spitfires.

August 15: *Shorts, Rochester.*—As a result of this attack we have lost three months' output of Stirling bombers, and the plant, which has been abandoned.

September 4: *Vickers, Weybridge.*—We must expect a loss of one hundred and twenty-five Wellington bombers. The plant is disrupted, and almost evacuated.

September 24: *Supermarine, Southampton.*—We lost two out of the three plants at these Works. The final effect on output of the disaster will probably be a loss of six weeks' Spitfires.

September 25: *Bristol.*—This was another heavy blow. We lost the Rodney works, with complete stoppage of engine output for one week.* The effect on airframe production at the plant represents a loss of two or three weeks' output of Beauforts and Beaufighters.

October 3: *Hawker, Kingston.*—Here the attacks have not yet been reflected in production. The loss may be estimated provisionally at fifty Hurricanes.

October 4: *De Havillands.*—We lost just over a week's output of Oxford aircraft.

These disasters had a very considerable effect on production in September. We lost 300 machines, as compared with the August output.

But it must not be assumed that the bombing of factories was the sole explanation of the decline in output. A more serious factor was the loss of working time, due to the air raid warning system. Some factories lost half their working hours owing to time spent in the shelters.

In spite of these damaging influences, we have been able to sustain a dignified level of production.

* Normal production will be delayed for several weeks.

Here is our balance sheet:—

We have 780 more aircraft of the six principal operational types (Hurricane, Spitfire, Blenheim, Wellington, Whitley and Hampden) than we had on the 10th May.

On the 15th May, there were $88\frac{1}{4}$ bomber and fighter squadrons. On the 25th October there were $107\frac{1}{2}$ squadrons.

On the 15th May there were 884 machines available in those squadrons. There are now (the 25th October) 1,222.

We have in hand (the 26th October) in the Aircraft Storage Units, 911 aircraft of operational types "Ready,"* compared with 59 aircraft on the 15th May.

During the period the 15th May–24th October, there have been 2,731 casualties, in categories three and two, to Hurricanes and Spitfires alone.

The Training Command are entirely supplied with aircraft. They have all that they need for their purposes. Indeed, they have a surplus.

Twenty-nine non-operational aircraft, nearly all of training types, were ready for service in the Storage Units when the Churchill Government was formed. Now there are 730 of these same types.

Over this period of five months, engines on hand have been increased by 1,259 units, thus strengthening our reserves.

During these five months of violent life at home 1,164 aircraft have been shipped overseas, and these aircraft have carried with them 1,720 engines.

Deliveries of aircraft from the United States are disappointing in scale and limited in their value for purposes of combat.

The losses of American aircraft during transit to this country have been many.

There is a tendency among our people to rely more and more on American output of aircraft. That would be a mistake.

On the contrary, the American situation shows the need for increasing our productive effort here. This is the true lesson which it has for us.

A scheme of dispersal was launched last May in order to reduce, if possible, the damage to aircraft and allied production through enemy attack.

This scheme takes the form of splitting up the main factories in vulnerable areas into a number of separate premises, geographically convenient to one another.

The system of dispersal damages production, but it improves the prospect of security.

On the airframe and engine production side, 364 new premises have been acquired.

This immense dislocation has caused a certain amount of difficulty. It has aroused, naturally enough, a considerable measure of criticism among those who have been displaced. But it had to be done.

Many Government Departments have been asked to release premises. A most generous response has been accorded us by the Ministries.

In addition, instrument production has been dispersed in part. So, too, has radio manufacture.

It is not intended to convey the impression that the dispersal process has gone as far as may be necessary. In fact, many new schemes are in operation, and other projects are contemplated.

But it has been an immense task, and I must give high praise to my colleagues of the Dispersal Groups for the energy and imagination they have shown.

Yet these precautions and the further measures we are planning still leave us at the mercy of enemy attack, if there is any increase in the scale or intensity of his bombing operations.

The Aircraft Industry has borne its grievous blows with fortitude and equanimity, but it is conceivable that, if the attack is delivered more viciously, we will have more to suffer and a degree of endurance to display greater than all that has gone before.

B.

Ministry of Aircraft Production,
October 27, 1940.

* Ready and ready in four days.

Appendix B: Full published papers directly associated with this research

This research resulted in 8 published papers in peer-reviewed journals and conference. This appendix contains copies of the full papers as published in thier final fromat. This a list of the publication followed by the full copies in the same order.

1. Howsawi, E., Eager, D. & Bagia, R. *Understanding project success: The four-level project success framework*. *In:* IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 2011, 6-9 Dec. 2011. 620-624.

2. Howsawi, E., Eager, D., Bagia, R. & Niebecker, K. 2013. *Using video data in project management research*. AIPM National Conference 2013. Perth, Australia.

3. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). The four-level project success framework: application and assessment. *Organisational Project Management, 1*(1), 1-14.

4. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). Project Management During National Crisis: Concept Development. *International Review of Management and Business Research, 3*(1). 412-422

5. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). Success Strategies For Project Management During National Crises: Insights From The British Aviation Industry During World War Two. *International Review of Management and Business Research, 3*(1), 533-556.

6. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). The use of video data in project management research *Science Journal of Business and Management, 2*(1), 10-15. doi: 10.11648/j.sjbm.20140201.12

7. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). Delivering a Mega Construction Project Successfully During a National Crisis: Lessons Learned From The Aswan High Dam Construction Project. *International Review of Management and Business Research, 3*(2), 625-647.

8. Howsawi, E., Eager, D., Bagia, R., & Niebecker, K. (2014). A success model for project management during national crises. *International Review of Management and Business Research, 3*(2) 960-981.

Understanding Project Success: the Four-Level Project Success Framework

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It is acknowledged in project management literature that a project's success means different things to different people. This implies that the definition of success will be different for each project. However, success is a common goal for projects regardless of the specific definition for each project. This statement implies that there can be a common approach in planning for success and generalized framework that can guide the process of defining and planning the project success for different projects. This paper presents the underlying framework that directs the optimum success definition and planning process. Through a literature review and classification of success criteria, a four level success framework was developed, namely: context level; business level; product level; and project process level. This framework explains the relationship between levels and provides guidelines for decision process. The framework is generalized and can be applied to most projects.

Keywords - **Project success, success criteria, success framework, project management**

I. INTRODUCTION

There has been a great deal of research on project success and many works have been published. However, there is no consensus upon factors or criteria of success [1]. Researchers keep coming up with different sets of factors that contributed to project success, or criteria against which the success is measured. There are many reasons behind these differences, some of which are industry type and people involved in these projects [2]. The success criteria should be set at the very beginning of the project [3, 4] and because each project is unique by definition [5] each project should have its own set of criteria. It is therefore almost impossible to have one set of criteria to fit all projects [6-8]. Nevertheless, it is possible to construct an underlying framework that can help to guide the process of defining success for specific projects since all projects target success regardless of the specific definition for each project. The research in this field started with discovering success criteria. It then evolved to distributing these criteria into groups or dimensions. Then the systematic frameworks emerged to provide guidelines for success assessment and planning. However, these frameworks concentrate upon three groups of criteria which are: process related, product related and business related. However, at higher level there exists a group of criteria that have dominance over other groups; this is the context related criteria group. This paper argues that the contextual criteria are the highest influential group and need to be addressed first in the planning process. To support this argument the literature in project success criteria will be reviewed to highlight the missing level of criteria. Following this, the research problem will be formulated and the four-level success framework will be detailed. This four-level framework will be supported with discussion on several case studies.

II. LITERATURE REVIEW

Traditionally, project success has been measured against limited criteria namely: time, cost and quality; this is known as The Iron Triangle [9]. Even though it is "Iron", it has been criticized for being insufficient to fully define the project success criteria [1, 6, 10]. Simply completing a project on time, on budget and according to desired quality does not necessarily mean success. An example that reflects this limitation is the Sydney Opera House. It was several times over budget and several times overscheduled yet it is considered one of the greatest projects in Australia. Research keeps discovering more criteria to measure project success such as client satisfaction and end-user satisfaction [1].

Historically these criteria have been used to evaluate the project as a whole. This has led to contradicting judgments such as whether the Sydney Opera House was a successful or failed project? One profound idea to resolve this contradiction came from de Wit suggesting the distinction between project and project management [11]. This idea helps the decision maker to group the criteria which measure project results success on one side and the criteria which measure project management process success on the other side so a more realistic evaluation could be made. Since project results have many dimensions, further distinctions have emerged. Shenhar *et al.* introduced the business level as a distinct dimension or level of project success criteria. They suggest four distinct dimensions at which the project can be assessed. Thes dimensionas are: project efficiency, impact on the customer, business and direct success, and preparing for the future [12]. Even though Shenhar *et al* consider these dimensions as four distinct dimensions, the direct success and preparing for the future are both business dimensions with timeframe difference. The direct success dimension is related to short time while preparing for the future is related to long time. Later, Shenhar *et al.* incorporated these four dimensions into a multi-dimensional strategic framework for project success assessment containing 13 measures distributed between these four dimensions [2]. Different dimensions were identified by Milis, namely: a group of technical criteria; a group of criteria related to hype; a group of criteria related to the viewpoints of the parties involved in the project other than the project managers; and a group of criteria related to perceptions of the

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evaluation [10]. In a thought-provoking paper Judev and Muller [13] provided a detailed review of the concept of project success and the issues related to it in the past 40 years. Their findings support the emergence of a line of thought for grouping the success criteria into distinct groups and constructing frameworks to facilitate project success assessment and planning for success. Zhiye *et al.* [3] reviewed several influential studies and summarized the success criteria groups. Table I below summarizes the most influential dimensions of project success.

TABLE I
MOST INFLUENTIAL GROUPS OF PROJECT SUCCESS CRITERIA [3]

Authors	Success dimensions
Morris and Hough (1987)	• project functionality (meeting financial and technical requirements) • project management (meeting budget, schedule and specifications) • contractors' commercial performance • project termination (making reasonable and efficient decision on cancelling a project)
Pinto and Slevin (1988)	• technical validity • organizational validity • organizational effectiveness
Pinto and Prescottt (1990)	• budget and schedule • value (positive impact, merit, improved organizational effectiveness) • client satisfaction (in terms of product use, benefits to end users through increased efficiency or employee effectiveness)
Kerzner (1987); Freeman and Beale (1992)	• technical performance • efficiency of execution • managerial and organizational implications (customer satisfaction) • personal growth • manufacturability • business performance
Belassi and Tukel (1996)	• factors related to project • factors related to the project manager and team • factors related to the organization • factors related to the external environment
Shenhar *et al.* (1997)	• project efficiency • impact on customers • business and direct success • preparing for the future
Turner (1999)	• meet its stated business purpose • provide satisfactory benefits to the owner • satisfy the needs of owners, users, and stakeholders • meet its pre-stated objectives to produce the facility • have a deliverable that should be produced to specification, within budget, and on time • satisfy the needs of the project team and supporters • make a profit for the project team and supporters
Cleland and Ireland (2002)	• the degree to which technical project performance objectives were attained (e.g. time, cost, and scope) • the contribution that the project made to the strategic mission of the firm

Zhiye *et al.* [3] suggested a framework that shows the dependencies between success criteria. However, no detailed explanation of these dependencies was provided.

The literature on project success criteria evolved from limited criteria (Iron Triangle) to a wider variety of dimensions. Also, it progressed from a single level of judgment which judges the project as a whole to multiple levels of judgment such as project, product, and business levels. Moreover, it developed from segregated criteria to assess success to systematic frameworks more suitable for assessing and planning for success. However, all projects are bounded within their individual context and there must be an elaboration and assessment of project success at a contextual level. Also, since these levels or groups of criteria are related to each other, the sequence of their relationship and their effect upon each other should be investigated. These success measurement concepts appear to be absent in the literature.

III. RESEARCH PROBLEM

With all the effort in grouping success criteria to enhance understanding and assessment of project success, the literature review and experience support the hypothesis that there is an important dimension missing in the search for formulating the success measurement; it is the context, meaning the circumstances surrounding the project. A simple fact is that each project has its own contextual circumstances and the contextual circumstances have a crucial impact upon the project success. A project in an East Asian context is certainly different from one perspective or another to a project in a European context. Also, a project in peace time is different from one in war time. Also the research shows many groups of success criteria however, they are not equal in their impact upon each other. Certainly one group has greater impact over the other. Nevertheless, literature does not tell which group has upper hand over the other. These two observations make the basis for this research which tries to answer the following questions:

1) How do the contextual circumstances affect project success criteria?
2) What is the optimum sequence to follow in obtaining and setting success criteria during project initiation and planning?

IV. METHODOLOGY

This research is building upon the existing research in project success. At first stage, literature review is the methodology to be used. The observations and findings from the literature review will be classified with the aim to group them into distinct groups. The relationship between these groups will be analyzed. The second methodology to be used here is the case study. Several case studies will be done to examine the findings of the first stage.

The data for this research will be collected from published research in order to perform the classification and the analysis.

V.THE FOUR LEVELS FRAMEWORK

A. The Four Levels

In the literature of project success we find that there are a lot of success criteria. Regardless of different names that authors gave to these criteria, they belong to one of the following levels:

Project process level; this level contains all the criteria that deal with the actions taken to deliver the required deliverables. Examples from table 1 of such criteria are: meeting budget and schedule, and efficiency of execution.

Deliverables level; this level contains all the criteria that deal with the technical requirements. Examples from table 1 of such criteria are: Technical validity, manufacturability, and technical performance.

Business level; this level contains all the criteria that deal with the beneficiaries who will have some sort of benefit (or may sufferA from the deliverables of the project. Examples from table 1 of such criteria are: The contribution that the project made to the strategic mission of the firm, preparing for the future and satisfy the needs of owners, users, and stakeholders.

Context level; this level contains all the criteria that deal with the externalities that have effect upon the project and the project team or organization has no control upon them such as political situation, political regime and climate.

These are the four levels that have been found in the literature. They are called levels because when vertically linked the relationship between them get clearer.

B. The Aim of the Framework

Because projects differ widely, it is not practical to set criteria to measure success for all projects, rather, this framework is intended to guide the process of project success definition to facilitate the planning for success, judging and evaluating projects after completion.

C. The Framework Construct

The four levels that were described above are linked in a systematic framework to reveal the practical advantage of these four levels. Fig.1 depicts this framework model.

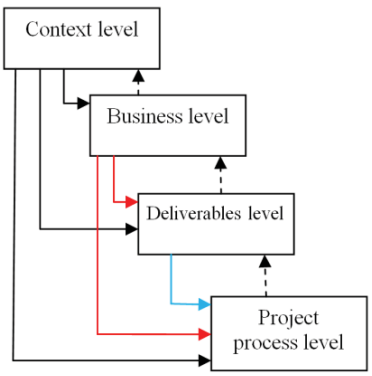

Fig.1. The four levels framework.

The following characteristics explain this framework:

1) The project can be assessed at each level separately as well as overall. The assessment of a certain level might be different from another. Consequently, different decisions might be made about the overall project or about certain level of the project.

2) The higher the level is the higher is its influence in success or failure of the project.

3) The impact from a lower level to a higher level is probable (dashed lines) but from a higher level to a lower level is certain (solid lines).

4) A criterion can exist at all levels at the same time however; the measures of such criterion can differ from one level to another. For example, if time is important, the measure at context level might be to get to the market sooner, at the business level to develop a faster decision strategy, at the product level to be manufacturable faster and at the project level to complete the project within the compressed schedule.

5) The assessment of a lower level is linked to a higher level. The change at a higher level alters the assessment of the lower one. The significance of the alteration depends upon the significance of the change at a higher level.

6) The assessment of a certain level will be subject to change during the life cycle of that level, but if the life cycle ended the assessment will remain regardless of the change at higher levels.

7) Each subordinate level can have criteria that might not have a relationship to the upper level.

8) If contradicting criteria exist, the one with link to a higher priority criterion at a higher level must be prioritized.

D. The Sequence of Setting the Success Criteria

Setting the success measuring criteria is a process that needs to be performed in a sequential manner in order to catch the implication of a certain level upon another. According to this framework, the upper level success criteria must be set first. Any business must be performed within a certain context, whether it is geographical region, political system, social environment or industry. So the contextual success criteria must be set prior to discussing those of the business level. Then any product must serve a certain business and in order to set the success criteria for this product, the business success criteria must be set first. Then any product is an outcome of a project and in order to set up the success criteria for the project, the product success criteria must be set first. This descending order allows catching the implications of the higher level criteria upon the lower one. It also helps with criteria prioritization.

VI. CASE STUDIES

A. Panther Tank vs. T-34 Tank

The case of the Soviet T-34 tank project compared with the Nazi Panther tank project during world war two supports the argument of the framework. The context is that Nazi Germany and the Soviet Union were fighting against each other in the eastern front. Each side wanted to deploy weapons faster than the other to achieve victory, so in this context the time is a top criterion. Both the Soviet and the Nazi businesses recognized the urgency nevertheless; the Nazi businesses could not alter their culture of engineering excellence to comply with the urgency imposed by the context of war while the Soviet could. The impact of the Nazi failure at business level led to a sophisticated product (Panther tank) which can't be produced as quickly as required while the Soviet success at business level led to a simpler product (T-34 tank) which can be produced faster in vast quantities . The Soviet project succeeded in reflecting the contextual success criteria upon lower levels while the Nazi failed to do so. The failure to produce required tank quantities is considered to be a significant reason for Nazi defeat in world war two [14-16].

B. De Havilland Mosquito

The de Havilland DH.98 Mosquito is a remarkable case of a successful project. The context of world war two imposed many demanding circumstances. Among the most important demanding circumstances are: the scarcity of material needed for aircraft manufacturing specially aluminum alloys, the lack of trained labor in metal manufacturing and the need for faster production of fighter aircraft. The de Havilland Company realized the context well. The company modified its business paradigm from civilian aircraft thinking to military aircraft. Moreover, it came up with an innovative approach to complying with the contextual circumstances. It intended to build a wooden aircraft instead of using metal. This shift in material use gave the project the advantage of the availability of professional wood labor and the availability of the wood itself. Consequently, the company was able to deliver the project in just 11 months and the Mosquito was the fastest fighter bomber during the war and the most versatile aircraft to see actions in world war two [17-19].

C. F-20 Tiger Shark

A case of multiple levels of success judgment is the F-20 Tiger Shark fighter aircraft. This aircraft was one of the best of its day in terms of capabilities and cost efficiency (success at product level) and its project fulfilled the budget, time and quality constraints (success at project process level). Nevertheless, at business level, this project was a loss and no single aircraft was sold. The analysis of the project attributed the failure mainly to an unexpected change which happened at the context level: it was a change in the government weapon export policy which lifted the export ban of more sophisticated aircraft. This change ruined the basis on which the project was set which was "less sophisticated aircraft for export". Eventually the project was terminated [20, 21].

VII. FURTHER EXPLANATION OF SUCCESS TIME DEPENDENCY

It is argued that success is time dependent [2, 10]. This is true to some extend however; further explanation will make this concept clearer. According to this framework, time passage has effect only at the context level. If no change happened at the context level during the life cycle of lower levels the judgment will remain the same and any change after the life cycle will not affect the judgment. The case of the P-51 mustang project is a good illustration. It was an awesome success at all levels until the end of world war two. After the war, the judgment at the project level did not change until today because there was no change at the context level during the project execution. At the product level, the aircraft was a successful fighter in 1945 and was rendered obsolete in the 1950s because there was a change at the context level; it was the introduction of jet fighters [22, 23]. Another case is the Boeing 747. Its project is a success at all levels regardless of time passage since its first introduction in 1970. No significant change took place at the context level in which it operates since then, no radical propulsion technology was introduced and no competitive alternative transport means was introduced. In the other hand, contextual changes such air travelling market expansion enforced the success of this air plane [24-26].

VIII. CONCLUSION

The result of this research complements the existing body of knowledge in the field of project management. It contributes to the body of knowledge by highlighting the effect of the context-related criteria on project success definition and planning. It also adds the idea of regrouping the project success criteria into a four-level sequential framework that can effectively guide the process of defining and planning for a project success. The four-level project success model is supported by several case studies. The case studies are drawn from defense and aviation industries however, the outcome of this research can be applicable to other industries and further case studies are needed to verify this applicability. Empirical proof of the four-level framework is beyond the scope of this paper.

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Using video data in project management research

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Abstract
In project management research, on site engagement is acknowledged as being good practice for gaining primary data and understanding the context of the projects being studied. However, it is not possible for researchers to be on site for every project they intend to research because projects can be difficult to access, or may be secret during the execution phase, or simply may have been completed a long time ago. Reading the project documents will provide a substantial amount of information, but there is always more to any project than written data alone, as project practitioners are well aware. Advances in technology since the beginning of the 20th century enable the filming of project works and perhaps the main benefit of that filming is to document the process for documentary production. Since the camera can capture a wealth of detail and rich complexity that it is impossible or very difficult to capture by other means, and since the eye and ear can acquire a great deal of information that it is practically impossible to write down simultaneously, can the use of such video data be beneficial in project management research? This paper reports the experience of the authors in using video data in such research. More than 250 hours of video data have been examined in researching British aviation projects during the period of the Second World War. The benefits of, and guidance for, using video data are presented, as well as cautions about what may affect the successful use of video data.

Keywords
Video data, project management research, World War 2, data acquisition

1. Introduction

A cornerstone of research is the data. The availability and quality of data are crucial in the success of any research. To acquire serviceable data, researchers deploy many methods and means such as conducting interviews and accessing written documents. These methods and means differ from one profession to another, and even within the same profession. Several factors affect the choice of a data acquisition method; for example interviews can be excellent sources of soft data, such as emotions and attitudes.

One of data source that has been used in research is the moving visual images of any kind. We refer to it in this article as video data (VD) because of the commonality of the term video nowadays. VD is a well-recognised data source in many disciplines such as psychology and anthropology. The use of VD in those disciplines aims to extract suitable data such as personnel profile. However, after conducted project management (PM) research for some time, we have not seen the use of VD in project management research therefore we may pioneer this approach with the following question:

Can the use of video data be beneficial in project management research?

We collected a variety of video clips related to aviation projects in the United Kingdom (UK) during World War 2 (WW2). The clips total length exceeds 250 hours. We examined this collection for possible beneficial use in PM research. This effort is part of ongoing research investigating project success during national crises, such as times of war and this aim justifies the amount of VD analysed. In this article, we report the experience we gained in the use of VD in PM research in the form of a classification scheme, practice guidance, and reporting the advantages and challenges that may affect the good use of VD in PM research.

PM discipline contains at least 3 linked pathways namely; research, body of knowledge and practice. The practice forms the basis for the research which feeds the body of knowledge which forms a solid ground for practice. This paper fits into the research pathway.

2. Data Sources in PM research

There are abundant data sources in the research world. The use of a specific source depends on the suitability of that source to the discipline and the research method. For example, historic documents are a suitable data source for researching historic events, while lab experiments are data sources suit science topics.

In PM discipline, several data sources are commonly used as shown in Table 1 . Surveys and questionnaires are predominant.

Table 1: Sources of data in PM research

Data source	Examples of literature that have used this source
Interviews	(Wells, 2012)
Surveys and questionnaires	(Turner & Zolin, 2012) (Ning, 2013) (Yang, 2012) (Ika, Diallo, & Thuillier, 2011) (Yong & Mustaffa, 2012)
Project documents	(Lenfle, 2011)
Research databases	(Davis, 2013)
Simulation and mathematical modelling	(Ford & Bhargav, 2006) (Mawby & Stupples, 2002)
Field observation	(Sullivan & Lines, 2012)
Literature analysis	(Müller & Jugdev, 2012) (Jugdev & Müller, 2005)
Mixture of above data sources	(Engwall, 2003) (Crawford & Helm, 2009)

3. Video data

The word “video” means “a recording of moving visual images made digitally or on videotape” (Oxford Dictionaries, 2013). It is derived from the Latin word (vide) which means to see. We mean by video here all types of moving visual images of any kind such as films and digital media. We define VD as “the information and messages that can be extracted from a certain video clip”. These messages and information can be direct, such as news reportage, or indirect, such as the emotions revealed by people gestures in the video clip. VD is found in a very wide array of collections and dealing with it as one segment is inefficient. To facilitate and make more efficient process of analysing VD, therefore, we need to classify the VD.

3.1 Classification of VD

“To classify” means “ to arrange (a group of people or things) in classes or categories according to shared qualities or characteristics” (Oxford Dictionaries, 2013). This implies that there are many classes to choose from. Moreover, there can be a combination of classification dimensions in one scheme.

Researchers and practitioners use different schemes for classification purposes; for example, medical practitioners may classify patients according to their age.

In the PM discipline, many dimensions are used for classifying projects such as industry type (e.g. construction and defence), or product novelty (e.g. radical and incremental).

VD is no exception, the language, the length of the clip and the time period of the clip are among possible classification dimensions. To help preparing VD for research purposes, we propose a classification scheme, shown in
that consists of three dimensions with two categories in each dimension. The dimensions were chosen because researchers need the information to be unbiased, true and original. The reporting type deals with information bias, the purpose of the recoding deals with information truthfulness and the originality dimension deals with information originality. It is worth noting that the categories in this classification are two ends of a spectrum and the clip can be anywhere in between, consequently, there might be some overlap between the types, but the researcher should categorise according to the overwhelming clip characteristics.

Table 2: VD classification scheme

The dimension	Description
Reporting type Analytical vs. informative	Concerning the type of information presented in the video clip. The analytical type presents content analysis of the video clip while the informative type presents straightforward information about the content.
The purpose Propaganda vs. documentation	Concerning the purpose behind recording the video clip. The propaganda type is a clip purposefully recorded for advertisement and propaganda, while the documentation type captures the event at face value without manipulation.
Originality Original vs. reproduction	Concerning how original is the recording? a clip that captures an actual event at the time of its occurrence is original, while a clip that contains a representation of the event through acting or reconstruction from various sources is reproduction.

Each video clip can hold a description of three categories as shown in

Figure 1. This scheme contains eight classification possibilities based on the binary combination of 2^3.

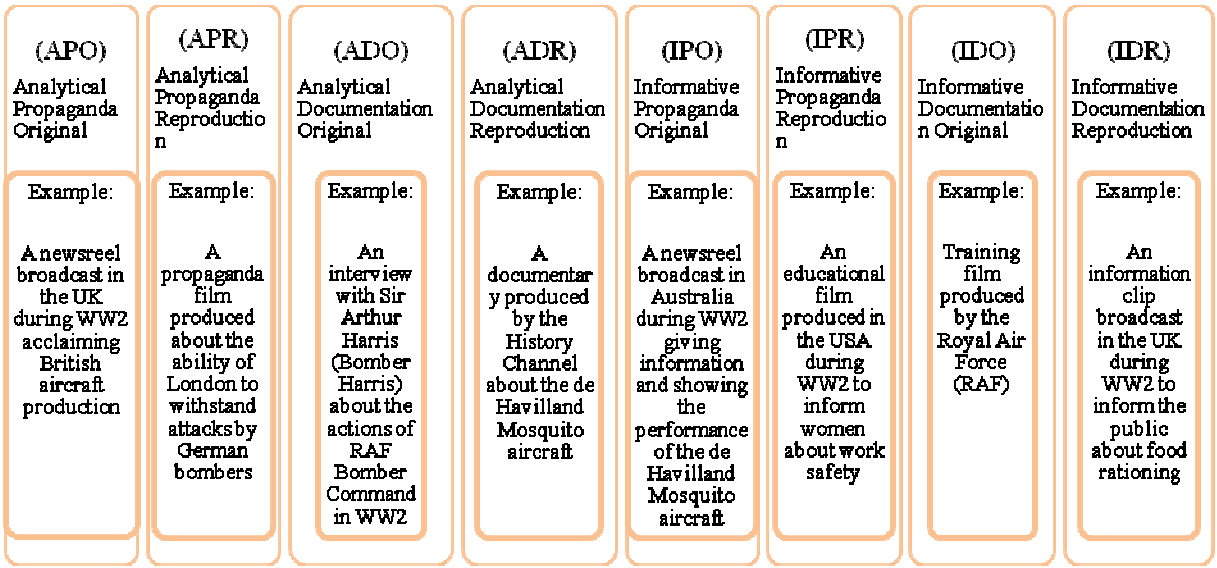

Figure 1: The eight classification possibilities

These categories have different characteristics from one another. The research objective determines suitable category to use. To align the details of these categories with relevant PM research, we will discuss this point in section 4.2 the practice guideline.

3.2 Features of VD

VD exists in the form of video recordings which usually contain sound and moving pictures, although sometimes they can be silent. Video clips retains following features:

- The richness of detail: video recording captures all the details exposed to the lens and the microphone. A human conscious mind cannot acquire these details simultaneously. Some events, such as accidents, happen quickly, their shocking nature distracts the observation process and they occur once and cannot be re-enacted. A video recording retains such events in rich detail.
- The ability to repeat the scene: in real world, there is no way to see an event again except by means of a recording. For example if a researcher is observing a phenomenon and misses some parts for any reason, such as the selective perception phenomenon effect, the only possible way

to see missed parts is in a video recording. Because of the richness of detail contained in VD and the inability of the human brain to acquire all these details simultaneously, the ability to repeat-view enables the performance of many data extraction rounds without losing high level data originality.

- Retaining a high level of data originality to allow re-examination without distortion: recording data in such forms as written documents usually carries the risk of distortion in one way or another. For example, if a researcher is taking notes from the field, these notes will be written in that researcher's style, while another researcher may interpret that style of writing in different way because everyone has their own distinctive way of writing. By contrast, there is no intervention by the researcher in the field when an original event is recorded as it is, so any researcher will see exactly the same clip. On this basis, the consensus of researchers who use the same original VD can be much stronger than if other forms of data, such written field notes, are used.
- Ease of use, storage and retrieval: VD is very easy to use nowadays thanks to the availability of video playback systems almost everywhere. The process of recording is much easier than ever before, given that the video recording function is available even in cheap mobile phones. With digital technology being the main technology for processing, VD can be stored in small electronic mediums such as USB flash memory. A full day's broadcast by a television channel can be stored in a cheap USB flash memory that can retain this data for many years and make it available instantly. Moreover, being stored electronically, VD can easily be transferred through electronic communication mediums such as the internet.

These are the most notable features of VD that we believe relevant and appealing to PM research.

4. Using VD in PM research

4.1 The significances of VD in PM research

VD clearly demonstrates its significance in our research; it helps the researcher gaining a deeper context understanding of the project that could not otherwise be gained than by being there. In 2010s we studied projects from the 1940s. Many of the projects' original documents were available, but from which there was no way to extract soft data such as the emotions and project team morale that may yield crucial insights into what makes projects successful during crises. VD provided us with soft data as if we were living the event. Also, tiny details, such as workplace arrangements, cannot be fully understood from written data, but with VD we could build a better mental image of the projects we researched.. Another significant point is that PM research is now being conducted internationally, researchers from one country study projects from another. There is need to enhance understanding between research teams about the project environment. VD enables this efficiently. Our research team contains members from Australia, Saudi Arabia and Germany. We studied cases from the UK that took place before the most senior among us was born, yet by using VD, we could build a detailed understanding about these cases and obtain significant findings.

Our experiment of using VD in PM research showed, for example, that it would have been impossible for a researcher from Saudi Arabia doing research in Australia to gain deep understanding of the British project context in the 1940s without using VD. It helped to convey all the contextual knowledge, as well as many project details, without the need to be a WW2 veteran.

4.2 Practice guidelines

Based on our experience with VD in PM research, we suggest the following guidelines for the effective use of VD in PM research.

- Develop a referencing scheme for your clips
  It is practical and efficient to have your data easily accessible. One way to achieve this is to develop a referencing scheme that contains all necessary information about the clip, such as an informative title and a summary about the clip's content. Worth noting is that instead of a page number, as used in paper documents, a video document is better referenced by a time marker. For example, you can refer to a point in the clip as "minute 4:30", or to a period of minutes such "3:30 to 6:20".
- Classify the clips according to the suggested classification scheme
  Classifying clips helps to guide the researcher to the best way of dealing with the data, what to expect from it and what to be aware of. The researcher needs to make an initial clip assessment to determine which of the eight types in this scheme best suits the clip. Each type of VD in the classification scheme will be discussed below.

Analytical Propaganda Original (APO): This type provides the opinion or analysis of someone other than the researcher in a propagandistic way. This diminishes the research originality because the researcher may be directed toward a certain conclusion. The original visual scenes may provide useful details, but the propagandistic nature of this type threatens the research objectivity. There is little to gain from this type to aid original PM research.

Analytical Propaganda Reproduction (APR): This type has the drawbacks of APO type, plus it lacks original scenes. This type should not be used in original PM research.

Analytical Documentation Original (ADO): This type provides the analysis of someone other than the researcher but the visual scenes originality and the documentation nature of this type can provide a good deal of information. The researcher should be aware of the possible narrator bias.

Analytical Documentation Reproduction (ADR): This type provides the analysis of someone other than the researcher plus the drawback of reproduction. This type has very little to benefit original PM research.

Informative Propaganda Original (IPO): This type provides true information in a propagandistic way with original scenes. If the researcher can eliminate the propaganda exaggeration, good details can be extracted for original PM research.

Informative Propaganda Reproduction (IPR): This type is less useful than IPO because of the reproduction. There is little for original PM research in this type. Only the narrated information can be used.

Informative Documentation Original (IDO): This type provides true information that documents the event with original scenes. This type is the best for original PM research. The threat to objectivity is minimal because no analysis is provided to the researcher, and the original event details are presented.

Informative Documentation Reproduction (IDR): This type carries the advantages of the IDO type but has one drawback, which is the reproduction. Nevertheless, a good deal of information can be extracted from the narration.

- Extract the data to suit your analysis method
  After classifying your clips, extract the data and prepare it to suit the analysis method you use for your research. VD can be used equally well with many analysis approaches; for example, for a qualitative analysis approach, build the themes and codes or answer the research questions as you go through your clips, and cross reference each segment from the VD to a suitable theme or question. For a quantitative approach, extract the required values from the clips then apply the numerical analysis your research requires.

These three points offer the basic guidelines from our own experience for using VD in PM research.

4.3 Advantages and drawbacks

The VD features mentioned above reflect its use in PM research. The richness of detail gives the PM researcher greater ability to extract information than any other mean. This feature demonstrated its importance when we investigated projects from the WW2 era. It is almost impossible to find an interviewee who can answer questions about workplace arrangements and project team moral during that time; however the rich details accompanying the video clips of those projects helped us to extract many details.

The ability to replay the scene and the ease of use, storage and retrieval gives the PM researcher the chance to conduct multiple rounds of analysis, with each round focusing on a single aspect. For example, in researching aviation projects from the 1940s, we made one round of analysis to focus on how the materials were managed in those projects. In another round we focused on the security issues of those projects. Without this feature, it would be more difficult to conduct multiple rounds of analysis.

Another advantage of using VD in PM research is that it reduces the impact of distance or time. For example, we are researchers in 21st century Australia, researching projects in 1940s UK thanks to the available VD from that era.

VD also deals with multiple human senses, which increases the capacity to acquire the knowledge. On the other hand the most important challenge to be faced in using VD in PM research is that video clips are not usually produced to address particular research questions, so to acquire quality details to answer one question, a researcher needs to view many hours of clips, which is very time-consuming. In addition, the interpretation of the VD can be subjective if the data is not numerical, or if it is ambiguous, so the researcher must be aware of this possibility and use suitable techniques, such as triangulation, to reduce this problem. The subjectivity reduction techniques are well detailed in the literature.

5 Conclusion

This article aims to report the experience we gained in using VD in PM research. Video clips are rich and beneficial sources of data but are not widely used in PM research. Using more than 250 hours of VD, we examined the use of such source of data in PM research. We found this source extremely useful. We presented the features of VD that made it useful and we developed a classification scheme to categorise video clips. Also we devised guidelines for using these clips in PM research. This attempt is an innovative effort. Nevertheless more research is needed to enhance the understanding and practices of using VD in PM research.

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Research Article

The four-level project success framework: application and assessment

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Abstract

Success is one of the ultimate goals of any project endeavour. Thus, clarifying the meaning of success is a vital step in achieving the desired success. In this study, the authors reviewed the project success literature and provided a framework for defining and evaluating project success. The framework consists of four levels that contain the possible criteria for assessing and evaluating success. The authors demonstrate the framework by case application. Further, experts in the field of project management conducted an external evaluation of the framework to assess its merits.

Keywords: Project Success, Success Factors, Four-Level Project Success Framework, Success Criteria

Introduction

Perhaps the most beloved word for any project practitioner is 'success'. However, the word's meaning is not universal; it can mean different things to different assessors (Andersen et al 2006; Davis 2013).Unspecified goals are not achievable; therefore, to achieve success, the exact meaning of the term should be specified upfront (Hamidovic & Krajnovic 2005; Thomas & Fernández 2008; Davis, 2013). This can be achieved in any particular project using the various tools available for defining success, such as the iron triangle. However, there is no agreement upon a single universal definition of success that fits all projects (McLeod et al 2012). Thus, defining success in the field of project management (PM) is a project-specific process. Because the world is changing continuously and each project is unique by definition, the need for methods and tools to define success may continue into the foreseeable future.

The aim of this study was to develop a framework for the process of success definition and evaluation. The first step was to review the literature and sum up the current situation in project success studies. Next, the framework was constructed and described. The authors then applied the framework to several cases. For evaluation purpose, the authors sent the framework to several experts and practitioners in the project management field. The experts' opinions are reported in this study along with recommendations for future development.

Literature review

The discipline of PM is relatively new so a clearer definition and understanding of project success took some time to develop (McLeod et al 2012). From the late 1950s up to the 1970s, project success was conceived as completing projects according to time, cost and quality; this is known as the iron or golden triangle (Jugdev & Müller 2005; Ika 2009). This triangle was and still is widely accepted but is criticised for being insufficient to fully define project success (Dvir et al 1998; Milis et al 2003; Ika 2009). Completing a project according to such criteria does not necessarily mean success (Turner & Zolin 2012). For example, the F-20 aircraft project was completed according to the iron triangle, yet it was a failure, and not a single aircraft was sold (Martin & Schmidt 1987). This triangle is very operational and could not assess the strategic dimensions of projects. Also, it lacks the ability to assess the soft dimensions of projects such as customer communication (Davis 2013). The project success concept has more criteria than that of the iron triangle.

De Wit (1988) enhanced the concept of project success by splitting it into two parts: project success (meaning the product), and PM success (meaning the managerial processes). He argued that product success should be assessed separately from the success of PM activities. Successful PM activities are not a guarantee for a successful product and a successful product is not necessarily the result of good PM activities. For example, the Sydney Opera House suffered huge cost and time overruns but it is a world renowned product (Ika 2009).

Further discussions of success include projects with a successful product and efficient PM activities, but no desired result. In the example of the F-20 there were good PM

processes and a fantastic aircraft. Thus success is achieved according to de Wit's (1988) proposal but the actual project assessment shows a failure. From the 1990s, there was further development of the concept of project success. Researchers argued that project success should be understood according to frameworks consisting of different levels or dimensions (Jugdev &Müller 2005). Each level or dimension has its own criteria. For example, Shenhar et al (1997) introduced business as a distinct dimension of project success in additionto the previous work of de Wit. They suggest four success dimensions, namely: **project efficiency (equivalent to PM activities); impact on the customer (equivalent to the product); business and direct success; and preparing for the future** (Shenhar et al 1997). Even though they consider these as four distinct dimensions, direct success and preparing for the future are business dimensions with a timeframe difference; short term and long term, respectively. Later, these four dimensions (containing 13 measures) formed a project success multidimensional strategic framework (Shenhar et al 2001). Assessing the F-20 project according to this framework shows that the project failed at the business dimension when it could not attract sales.

Baccarini (1999) introduced the logical framework method to define project success. He argued that four levels of project objectives should be used to define success. These levels are: goals, purpose, output and input. Baccarini's four levels are similar to Shenhar's four dimensions as shown in Table 1.

Table 1. Baccarini's four levels versus Shenhar's four dimensions

Baccarini (1999)	Shenhar et al (1997)	Similarity
Goal	Preparing for the future	Assessing long-term results
Purpose	Business and direct success	Assessing short-term results
Output	Impact on the customer	Assessing project deliverables
Input	Project efficiency	Assessing PM processes

Judev and Müller (2005) provided a detailed review of the project success concept covering a period of past 40 years. Their findings support the emergence of attitudes towards frameworks with distinct levels or dimensions at which project success is assessed and understood (Jugdev & Müller 2005). These attitudes continue today and they comply more effectively with the multidimensional nature of projects. Projects usually have multiple stakeholders with different points of view who perceive project success differently (Andersen et al 2006; Davis 2013).

Researchers also highlighted the influence of isolated factors on the perception of success. For example, cultural differences affect the perception of project success between teams in cross-national projects (Pereira et al 2008). In addition, the definition of success is sensitive to the time of assessment. Different perceptions, criteria and factors of success are required at different stages of the project lifecycle (Shenhar et al 2001; McLeod et al 2012). For example, during the planning phase a success criterion might be *addressing the needs of the right group of beneficiaries* while after the completion of the project this changes to *having the planned impact on the beneficiaries* (Do Ba & Tun Lin 2008). During the planning no impact can be measured and it is useless to address the needs after the completion.

Despite all attempts, there is no consensus on the definition of project success (Ika 2009; Han et al 2012). Many factors influence the definition process and every evaluator perceives success from a different point of view (Baccarini 1999; Turner & Zolin 2012; Kerzner 2013). Thus, there is a need for more tools to capture the various aspects of project success. These tools could possibly be the systematic success frameworks. More frameworks are needed as one framework does not fit all projects (Shenhar et al 2002).

The review of the literature showed that the definition of success evolved from a simple definition to systematic success frameworks. These frameworks contain the success criteria and factors at different levels or dimensions. However, these frameworks did not take into account the environment or the context surrounding the project. In fact, the impact of the context on projects is presented in literature (Balachandra & Friar 1997; Engwall 2003; Maaninen-Olsson & Müllern 2009). Many factors that affect project success (such as culture) lie outside the levels mentioned in the previous frameworks, namely, project, product and business. This highlights the need for introducing the context to the levels of success frameworks. By doing so, a wider spectrum of assessment and evaluation needs can be fulfilled.

The four-level project success framework

The literature review supports the proposition that there is an important dimension not explicitly mentioned in the process of formulating the concept of project success —that of context, meaning the circumstances surrounding the project. Each project or a set of closely related projects has its own contextual circumstances that have a significant impact upon the project's success. In addition, the literature contains many success criteria groups such as the project efficiency criteria group (Shenhar et al 2001). However, these groups of criteria do not impact equally on the overall project success and upon each other. Some groups may have a greater impact than others. The literature does not reveal which groups have the greater influence. Based on these observations, a new level, 'context', is added to the three existing levels described in the literature to formulate the four-level project success framework.

Projects differ widely (Shenhar et al 2002) so that claiming a universal set of criteria to measure success or to propose a single universal success definition for all projects might be problematic (McLeod 2012). Rather, the framework in this study is a proposal to guide the process of project success definition, to facilitate planning for success, and to aid in judging and evaluating projects after completion.

The four levels

In the project success literature, there are many success criteria. Regardless of the different names that authors use for these criteria, they can be allocated to one of the following levels:

- **Project process:** this level contains the criteria used to judge the actions taken to provide the required deliverables. Examples of such criteria are: meeting budget and schedule, and efficiency of execution.

- **Products and deliverables:** this level contains the criteria used to judge the technical requirements and qualities of the products or deliverables resulting from the project. Examples of such criteria are: technical validity, manufacturability and technical performance.
- **Business:** this level contains the criteria used to judge the benefits and returns (or losses) of the project to the stakeholders. Examples of such criteria are: the contribution of the project to the strategic mission of the firm, preparing for the future, and satisfying the needs of the users.
- **Context and externalities:** this level contains the criteria used to judge the project based on compliance with the contextual circumstances and externalities that affect it, such as the political situation, regime and climate. The project team or organization has little or no control over these externalities.

These four levels form the framework. They are called 'levels' because, when they are vertically linked, the relationship between them becomes clearer.

Framework construct and characteristics

The four levels described above are linked in a systematic framework to reveal their practical advantage. Figure 1 depicts this framework.

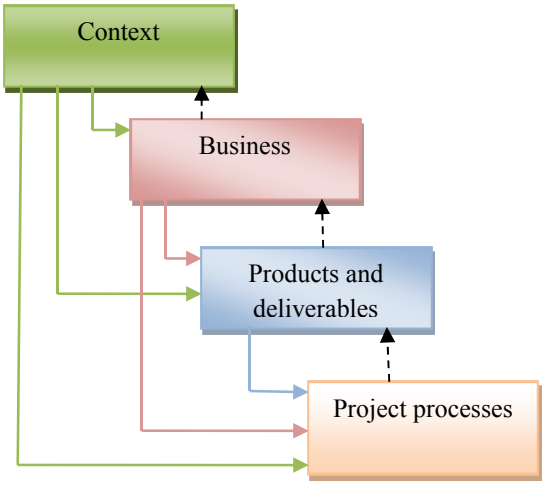

Figure 1. The four-level framework

The following characteristics describe this framework:

- The project can be assessed at each level separately as well as overall. The nature of assessment at one level might be different from that at another level. Consequently, different decisions might be made about the overall project or about certain levels of the project. For example, the Sydney Opera House was significantly over budget and behind schedule so it was a failure at the *project processes level*. However, it is considered one of Australia's greatest icons so it was a success at the *products and deliverables level*.
- The higher the level, the higher is its influence in the perceived success or failure of the project. For example, the success of the Sydney Opera House at the *product level* affected the overall perception of the project. Today, the fact that the project suffered

overruns is hardly remembered; the overwhelming majority of people talk about its beauty.

- The impact of a lower level on a higher level is probable (dashed lines) but that of a higher level on a lower level is certain (solid lines).The overruns of the Sydney Opera House could have destroyed the project but its outstanding success at the *product level* eliminated that probable impact.
- All levels can contain a particular criterion simultaneously; however, the measures of this criterion can differ from one level to another. For example, if time is important, the measure at *context level* might be (how short is the time taken to get the product to the market), at the *business level* might be (how quick is the decision-making strategy), at the *product level* might be (how quickly the product can be manufactured) and at the *project level* might be (is the project on schedule).
- The assessment criteria at a lower level are linked to those at a higher level. Any change at the higher level alters those at the lower level. The significance of any alteration at the lower level depends upon the significance of the change at a higher level. For example, 'compliance with government human resource policies' might be a criterion at the *context and externalities level*. Any change in these policies will require changes at lower levels. For instance, if policy changes at the *context level* in regards to women's empowerment or annual leave, changes must be made to gender balance in the recruitment process, or to work schedules, at the *project level*.
- The assessment of a certain level is time dependant and will be subject to change during the life cycle of that level; however, if the life cycle ends, the assessment will remain regardless of the change at higher levels. The case of the P-51 Mustang aircraft project is a good illustration. This project was an outstanding success at all levels until the end of World War II. From that war until today, judgement at *the project level* has not changed because there was no change at the context level during the project's execution. At the *product level*, the aircraft was a successful fighter in 1945 but was rendered obsolete in 1950 because there was a change at the *context level*—the introduction of jet fighters.
- Criteria at a lower level may not explicitly appear at higher levels. However, all the criteria at higher levels must be fulfilled through the criteria of at least one of the lower levels. For example, a project to produce a car might have 'emission level' as a criterion at *product level*; this criterion may not appear with the same title at the *project processes level* or the *business level* but it may appear at the *context level* as 'compliance with government emission regulations'.
- If contradicting criteria exist, the criterion with links to a criterion at a higher level must be prioritised. For example, if 'leading the competition' is a criterion at the *business level*, several criteria can exist at *product level*, such as 'cheap product' and 'high quality product'. These two criteria are contradictory to some extent. Toprioritise them, the *business level* criteria must be clarified first. If the criterion at *business level* was rewritten as 'leading the competition by being most affordable', it is clear that the 'cheaper product' criterion has higher priority than the 'high quality product' criterion at *product level*.

Setting the success criteria
The process of setting the success-measuring criteria needs to be performed sequentially in order to capture the impact of one level upon another. According to this framework, the upper level success criteria must be set first. Any business must be performed within a certain context, whether it is a geographical region, a political system, a social environment or an industry. Therefore, the contextual success criteria must be set prior to those at the business level. Any product must serve a certain business and, in order to set the success criteria for this product, the business success criteria must be set first. Any product is an outcome of a project and, in order to set the success criteria for the project, the product success criteria must be set first. This descending order allows the impacts of higher level criteria upon lower levels to be captured. It also aids criteria prioritisation. Moreover, having the criteria linked in this way helps to produce the specific success model for a particular project. Then by using a suitable weighting approach, an operationalized success model can be created for each single project.

The framework's applications
This framework can be applied to the process of defining success for and/or evaluating the success of a particular project. The following cases demonstrate the application of this framework to both tasks.

Application in project success definition
A project is by definition a unique endeavour. Therefore, the meaning of success for a particular project should have some sort of uniqueness. The following two examples demonstrate the application of the framework to the task of success definition.

<u>Project success definition in research about project management in the British aviation industry during World War II</u>
This example shows the use of the four-level project success framework to define, evaluate and understand project success in historical research about project management in the British aviation industry during World War II (Howsawi et al 2014). The analysis of the data related to that research shows that the context of the war contains at least six conditions as follows:

- Government control over business practices and the market
- Security threats
- Urgency to complete projects
- Disturbance of material supply
- Shortage of skilled manpower
- Changing requirements

The criteria at *context level* are derived from these contextual conditions. Failure to deal with any of the above conditions would mean certain failure to a project. Therefore, the success at the context level concerns projects that managed to deal with these contextual conditions successfully.

At the *business level*, a successful project is one that attracts enough production to keep the business running in the contextual conditions. At the *product level*, success is

achieved by satisfying client requirements given the conditions at the *context level*. At the *project level*, success is achieved by producing a satisfactory prototype given the contextual conditions. Therefore, a successful project can be defined as one that manages to deal with the contextual conditions and produces a product that attracts reasonable production orders. This definition can be customised to suit the specific research topic as follows: an aviation project that managed to deal with the circumstances of World War II in the United Kingdom (UK) and produced an aircraft that satisfied the government enough to issue a quantity production order.

This definition encapsulates the criteria of success at all levels in a subjective way. Then an objective or operationalisable indicator is needed to evaluate the project. The production figure can serve this purpose because during World War II no aircraft was authorised to be manufactured unless it satisfied British Government standards. The production quantity was also subject to government authorisation. Moreover, the continuous evaluation of aircraft could result in a halting of production if an aircraft was discovered to be flawed. Consequently, only aircraft with proven efficiency were ever produced in large quantities. For example, the Avro Manchester bomber went into production but when it proved unreliable, production was ceased after only 209 units had been produced.

This indicator illustrates the logic of the four-level project success framework. A project is more likely to reach mass production phase if it managed to deal with the contextual requirements. This was the case in many projects in the British aviation industry. The large production quantities were a good source of revenue to the manufacturing companies, so their businesses succeeded as a result of this revenue. Business success is likely if the business offers a satisfactory product to the customer. This was certainly the case in the UK because the circumstances of the time determined that only satisfactory products would pass into production. All the aircraft that were produced in large quantities — more than 500 units — were put to good use in the Royal Air Force. Given the circumstances of the time, project management processes were likely to produce a good product, within the budget and on time. During World War II in the UK, the circumstances were unforgiving and delays or overruns could cancel a project. For example, the Martin-Baker MB3 aircraft was a good aircraft during tests but it was considered outdated because of delays and late delivery. Eventually that aircraft never progressed to production.

The production figure can also indicate the following:

- Ease of production to satisfy the urgency. This means more units can be produced with less effort. For example, the de Havilland Mosquito aircraft could be produced using simple carpentry tools because it was made of wood. Also, it was constructed in modules, so these modules were produced in many small shops.
- Client satisfaction. The only requirement was to satisfy the British Government, since it was the sole customer and the only body that could authorise production.
- Good utilisation of manpower to overcome the skilled manpower shortage. Good utilisation of manpower means ability to produce more units of the product.

- Versatility to satisfy changing requirements since the same aircraft could serve different roles. Suitability for more roles means more units of the product are needed.
- Good utilisation of available material to overcome the disturbance of material supply. Good utilisation of material means ability to produce more units of the product.

This is an example of using the four-level success framework to create a customised definition of success.

Project success definition in research about the management of the Aswan High Dam construction project

This is another example of using the four-level project success framework in defining, evaluating and understanding project success within the context of the Aswan High Dam (AHD) project. Success here is defined as satisfying the following criteria:

- The product is delivered despite all the difficult and threatening circumstances surrounding the project
- The advantages of the project vastly outweigh the disadvantages
- The project provides economic benefits to the owner and good revenue to the contractors
- The project provides an excellent product to the specifications, within the specified time and budget.

Table 2 shows how this definition fits the AHD project.

Table 2. The definition of success to the AHD project

Level	Criterion	Success indicator
Context level	Delivering the desired product despite all the difficult and threatening circumstances surrounding the project	Completed or not? Despite all the complications of the 1960s crises, the project was completed
	The advantages of the project vastly outweigh the disadvantages	The opinion of the majority? The majority of experts consider the benefits of AHD to be far greater than the disadvantages
Business level	Providing economic benefits to the owner and good revenue to the contractors	Measures of economic benefit? On completion, the AHD provided more than 50% of national electrical power, and the company that built the dam is still in business today
Deliverables level	Providing an excellent product to specification	Technical specifications? The AHD is considered by many experts to be one of the finest engineering constructions in the world
Project process level	Providing an excellent product within the specified time and budget	Time? Cost? The project met the time frame of 10 years and the estimated cost of one billion dollars

Application in project success evaluation
Another use of this framework is to evaluate and analyse projects to reveal the multiple meanings of success in the project and to find the possible factors for success or failure. Here are some examples to show this application.

The case of the F-20 Tiger Shark fighter aircraft
In the early 1960s the Northrop Company privately designed and produced the F-5 Freedom Fighter aircraft as a low-cost, less-sophisticated fighter for export. The aircraft achieved great success in the export market and more than 2000 units were built. The company wanted to build upon this success and, in the early 1980s, started another privately financed project to produce the F-20 Tiger Shark. The company succeeded in producing the aircraft which was one of the best of its day in terms of capabilities and cost efficiency (success at *product level*) and its project fulfilled the budget, time and quality constraints (success at *project process level*). Nevertheless, at *business level*, this project was a loss and not a single aircraft was sold. An analysis of the project attributed the failure mainly to an unexpected change that happened at the *context level*; a change in the government weapon export policy. The government lifted the export ban of more sophisticated aircraft. This change ruined the basis on which the project was set, which was "less sophisticated aircraft for export". Eventually the project was terminated. The impact of the *context level* and the resulting failure at the *business level* (higher levels) influenced the fate of the project despite the success at *project* and *product levels* (lower levels).

The case of the de Havilland Mosquito aircraft project
The de Havilland DH.98 Mosquito aircraft project in the UK during World War II is an example of a remarkably successful project. The context of the war imposed many demanding restrictions. Among the most important demanding conditions were: the scarcity of material needed for aircraft manufacturing, especially aluminum alloys; the lack of trained labour in metal manufacturing; and the need for quick production. These conditions belong to the *context level* in the four-level project success framework. The de Havilland Company realised this and adopted the strategy of using innovative and radical ideas to comply with the contextual conditions and to exploit the core expertise of the company — speed. As a result of this strategy the company built a wooden aircraft instead of using metal. This shift in the material used provided several advantages at the *project level*:

- The ease of obtaining work authorisation from the government as the project would not consume precious and scarce material such as aluminium.
- The availability of professional wood labourers
- The availability of wood
- The simplicity in production as wood work was relatively easier than metal work

As a result, the company was able to deliver the aircraft in just 11 months after signing the contract.

Several innovative design features also helped the Mosquito to achieve success at the *product level*. Some of these features were:

- Speed: the Mosquito was the fastest aircraft in its class.
- Manufacturability: the aircraft was designed in modules so it could be produced in many small shops.
- Versatility: the Mosquito was labelled as "one aircraft for all purposes".

Overall, the project was a success at all levels. The Mosquito contributed significantly to the war effort and the company enjoyed huge revenue with more than 7000 aircraft produced.

Discussion

This study produced a four-level project success framework that was then applied to several cases. It was also sent to external experts for evaluation. To avoid the possibility of bias by the authors, the external experts were fully responsible for the evaluation.

Evaluation requests were sent to 91 experts. Seven agreed to take part in the process. These experts have experience in PM ranging from 5 to 35 years and all are certified project management professionals (PMPs). They are from the United States (US), India, Norway, Poland, the United Arab Emirates (UAE) and Germany. They have expertise in information technology (IT), telecommunication, construction and management consultation.

The evaluation request focused on two areas: the knowledge contribution of the framework and its possible future development. Regarding the knowledge contribution of the framework, the discussion with the experts concluded that:

- The framework helps significantly to achieve a customised success definition for any particular project. It expands the thinking about success beyond the triple constraints. It is adaptable and easy to modify to any particular situation. This feature is particularly important because, by definition, a project is a unique endeavour and the definition of success should consider this uniqueness.
- The framework articulates the context level, which is not well articulated in the existing literature. It shows the impact of the context level on project success. By considering and reviewing the environment and the wider context of a project the project is better understood and better stakeholder identification can be performed. Moreover, a more detailed risk coverage and assessment of the project can be undertaken as a result of the contextual awareness. The framework facilitates a better understanding of the bigger picture.
- The framework combines the levels of project success in a new way that adds to the existing literature. Previously, professionals have been aware of these levels particularly the first three and have used them in isolation, but the four levels have not been available for reference as a single group. The framework provides a systematic method by bringing together the various criteria that are in use in different circumstances and facilitates the addition of more criteria to create a more comprehensive set.

In terms of future development, the experts raised the following points:

- Change is often encountered in PM practice; consequently, the definition of success may change. For this reason, developing a strategy to respond to change and incorporating it into the framework will increase the usefulness of the framework in practice.
- The framework is not a standalone PM methodology; rather, it is a tool to supplement a PM methodology such as Projects in Controlled Environments, version 2 (PRINCE2). Even though the framework can be used separately, further details are required to include it in existing well-established methodologies. In addition, educational material should be developed to demonstrate how to use this framework with certain methodologies. This may increase the usefulness of the framework.
- Despite all projects being unique, there is a level of similarity between them in terms of success criteria. For this reason, the framework could be populated with common criteria at each level; then, the relationship between various criteria at different levels and the measurements of these criteria could be explained further. In this way, users could choose the common criteria from a menu rather than starting from scratch for every project, making the framework a time saving and effort-reducing tool.

These points regarding further development are thought provoking and worth consideration. However, they may be addressed in future research, as the scope of this paper is the presentation of the framework and its applications.

Conclusion

The concept of success is vital in the PM practice and research. This research contributes to the topic of project success by providing a four-level project success framework and, in particular, by highlighting the effect of a project's context on the definition of its success. The framework is generic and it is designed to provide a customised success definition for any particular project. Although the framework is new, it has been validated through several applications and external expert evaluations. The authors encourage other PM researchers and practitioners to apply the framework in order to develop it further.

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Project Management During National Crisis: Concept Development

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Abstract

National crises such as wars, economic crises and natural disasters are increasing in number and frequency worldwide. The context of a national crisis is unique and contains many abnormal challenges. Despite these challenges, projects are being commenced and executed during these events. Due to the abnormality of a national crisis context, the authors attempted, in this theoretical work, to propose the concept of project management during national crisis. Through literature synthesis and the content analysis of several data sets, the authors proposed a definition of the concept of crisis project management. This includes points of differences from peacetime project management and the common characteristics of a national crisis, with impact on project management processes. The authors discussed the results and provided some suggestions for further research.

Key Words: *Project management; national crisis; theoretical research; project context; crisis characteristics; content analysis.*

Introduction

Project management is the art of applying knowledge and skills to successfully deliver the required products or services. This art is affected by many factors that impact the outcome of a project. Among these factors is the project context, defined herein as the circumstances and conditions surrounding a project. The context has an important impact upon a project (Balachandra & Friar, 1997; Engwall, 2003) and (Maaninen-Olsson & Müllern, 2009).

A project context consists of many dimensions such as the geography, the industry type and the culture; each of which can be considered as a context. The impact of one context on a project may differ from the impact of another; consequently, each context may require different project management approaches to achieve success (Balachandra & Friar, 1997).For example, the recruitment processes in a defence project may differ from that in a construction project because national security is an important element in the

former, but not in the latter. In another example, a construction project manager must be physically unimpaired, while a project manager with some mobility limitations can manage a software project.

Because projects are unique by definition and each context has its own set of characteristics that disguises it from others, studying project management in a particular context can be an important path of investigation. Selected literature in this investigation is shown in Table 1. The context of a project is proved to be a vital factor in determining the fate of a project (Howsawi *et al.*, 2011)

Table 1: Examples of research with contextual focus

The research topic	The context
Studying the challenges of project management in public sector (Waddell, 2010)	Ownership type: Public vs. Private
The Cultural Barriers to the use of Western Project Management in Chinese enterprises (Wang & Liu, 2007)	Cultural: Western vs. Chinese
Critical managerial factors affecting defense projects (Dvir *et al.*, 2006)	Industry type: Defense
Analysis of factors critical to construction project success in Malaysia (Yong & Mustaffa, 2012) A study on project success factors in large construction projects in Vietnam (Nguyen *et al.*, 2004)	Industry type: Construction Geographical locations: Malaysia +Vietnam

Among the wide variety of possible project contexts, the context of a national crisis is unique and has significant effect on projects, and indeed, on all aspects of a nation's socioeconomic life. During a national crisis, most segments of the nation (if not all) are subjected to difficult circumstances that bring about many forced changes. For example, fundamental regulatory and institutional changes are approved as a result of the pressure of such crises. Project management then is supposed to be different in some regards from project management in peacetime. However, there is very little of such distinction in the literature of project management. There is an evident gap in knowledge and literature available about project management during times of crises (Hrůzová & Thornton, 2011). Based on that, this study is a conceptual research aimed to build the knowledge about project management during national crisis. The authors propose that "national crisis is a unique project context with particular characteristics that need different project management approach." To evaluate this proposition, the following three research question will be answered:

1. What is meant by national crisis and project management in such context?
2. Are there any differences between peacetime project management and project management during a national crisis?
3. What are the characteristics of a national crisis that impact project management?

The topic of this research is relevant and important because, when observing the situations worldwide, it is found that national crises are more prevalent in the 21st century than before; for example, wars between countries have been increasing since 1870 (Harrison & Wolf, 2011). The frequency of financial crises has doubled since the 1970s (Bordo *et al.*, 2001), and the frequency and severity of natural disasters is also rising (Degg, 1992);(Gurenko & Dumitru, 2009).

There are many contemporary examples of national crises worldwide, such as the wars in Iraq and Afghanistan, the aftermath of 2011 Japan's tsunami and the aftermath of 2005 Hurricane Katrina, and the 2008 global economic crisis. Against the odds, projects during these crises did not disappear, but continued to be executed in these contexts (Hrůzová & Thornton, 2011). Projects continued to be launched whether to respond to the crisis, to sustain businesses, or to reconstruct a devastated area. Deeper understanding is needed to enhance project management then.

Research Methodology

This article is a conceptual research piece, trying to constitute the concept of project management during national crisis. The research is a qualitative multi-method research. To answer the first and second research questions, a literature synthesis approach was used; and then to tackle the third research question, the content analysis method is used.

The Data Collection

The data of this study comes from different sources to ensure the rigor of the research through the triangulation of the data sources. Triangulation (having multiple independent sources of data) is known in the research world as one of the methods to offset biases and enhance the trustworthiness of the research (Shenton, 2004);(Turner & Turner, 2009),(Jonsen & Jehn, 2009). Both primary and secondary data is used in this study. The study consists of four data groups follows:

Secondary Data Group

The secondary data is primarily from the literature of project management and crisis management and other relevant literature because this topic is multi-disciplinary.

The Primary Data Groups

The primary data is related to several national crises worldwide. Some of these national crises are historic and others are contemporary. The data was collected though the following sources:

Archival Document

A sample of original documents from the World War II era was collected to investigate the project management context during this wartime period in the United Kingdom (UK). These documents were obtained from the National Archives; the UK Government's official archive, the Imperial War Museum in London and the Royal Air Force museum in London. More than 600 pages of documents were studied. These documents belong to the Ministry of Aircraft Production, Air Ministry, War Cabinet, Ministry of Supply and companies that delivered several projects during the war, such as de Havilland and Vickers. These documents are related to the industrial arrangements, product specifications, contracts, test reports, priority management, funding, staffing policies and practices during a period from 1938 to 1945.

Practitioner Group1

In 2011 a revolution took place in Egypt, and since then the country entered a state of a national crisis. The authors seized this good opportunity and visited the area in 2012 to investigate the project management context there. During that visit, 11 of contemporary project managers in Egypt were approached to discuss the research question of this study. All of those respondents managed projects before and during the period of a national crisis following the 2011 uprising; and they are well aware of the difference between project management during peacetime and during a national crisis time.

Practitioner Group 2

The authors also approached a group of project practitioners worldwide with an open-ended question survey. The practitioners were asked the same research questions mentioned above. Eleven experts responded to the survey, and all of them are certified project management professionals (PMP) with experience ranging from10to 35 years. Those experts are from Greece, Australia, United Arab Emirates, Brazil, Poland, USA and Malaysia.

The Data Analysis

The data of this research is mostly qualitative descriptive narratives, which contain the details woven between the lines. Two methods were used to answer the research questions, namely: literature synthesis and content analysis. Literature synthesis can be defined as combining a number of different pieces of information to build a conclusion. Content analysis is defined as "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton, 2002). Content analysis is a very suitable technique to be used with data described above (Elo & Kyngäs, 2008; Krippendorff, 2004).

Content analysis depends on reading through the data and finding quotes and statements of similar meanings, and then gathering them under one category called a *code* or a *theme*. Then, the relevance or the significance of these codes is described and conclusions are drawn from these codes. The validity of these conclusions is tested through several methods, such as case studies or statistical analysis.

In this study, the first and second research questions are answered through the literature synthesis. The third research question is answered using content analysis. The analysis aims to find statements and quotes that represent a feature or characteristics of the national crisis context, and place them under suitable title for that characteristic. Each group of data is analyzed separately, and then the categories that appear in all the four groups of data will constitute the results. Here are some examples from the analysis process. A respondent from practitioners group 1 said "we are facing the problems of thugs, which appeared after the revolution." A respondent from practitioners group 2 said "during a national crisis people die." In an archival document it is stated that "factories engaged on contracts for the Ministry have suffered through enemy bombing" (The-National-Archives, 1940). In an article it is stated, "Looting might also occur after natural disasters" (Kovács & Spens, 2007). All of these statements can be placed under the code "emergent threats and opportunities." Further discussion will be provided in the following sections.

The Results

The results of this research are divided into three sections as each section answers one research question.

The Concept of National Crisis

A crisis means "a time of intense difficulty or danger," (OxfordUniversity, 2012) or "a situation that has reached an extremely difficult or dangerous point; a time of great disagreement, uncertainty or suffering" (CambridgeUniversity, 2011). In the relevant literature, a crisis is an out of ordinary situation which creates new situation that cannot be dealt with using the existing or old rules. It contains urgency and has the capacity to make or break organization (Kuklan, 1986). Another definition of a crisis is "an unexpected event in an organization's life, which represents a significant threat to its high-priority values and demands a time-pressured response" (Loosemore, 1998). Also, it is defined as a situation faced by an individual, group or organization, which they are unable to cope with by the use of normal routine and procedures, and in which stress is created by sudden change (Booth, 1993).

Another author defines the crisis as an abnormal situation, which presents some extraordinary and high risks to the business (Shaluf *et al.*, 2001). The crisis is also described as a period of sudden change during which a totally new system is formed. In fact, the meaning of a crisis includes opportunity as well as risk, uncertainty, threat, conflict, accident, and instability (Öcal *et al.*, 2006). As can be seen, there are several attempts to define a crisis. Despite these attempts, similarities exist among all attempts such as urgency and threats. However, the generic or absolute definition needs to be customized to form a sound basis for investigation. If it is not tailored to particular context of study it will be problematic. The crisis can have specific meaning depending on the context it is associated with; for example, an economic crisis means a crisis in the economic system, an industrial crisis means a crisis in and industrial institution. This study is discussing the notion of national crisis. The word national means "relating to or characteristic of a nation; common to a whole nation" (Oxford University, 2012).

Also it means "relating to or typical of a whole country and its people"(Cambridge University, 2011). Thus, the term "national crisis" can be defined as "a situation or time at which a nation faces intense difficulty, uncertainty, danger or serious threat to people and national systems and organizations and a need for non-routine rules and procedures emerge accompanied with urgency." In Table 2 this definition is examined on several examples of national crises.

Table 2: The Definition and Examples of National Crises

	National crises examples					
Aspects of the definition	**WW2 in UK**	**9/11 USA**	**2004 tsunami Indonesia**	**2011 Japan tsunami**	**Iraq war 2003**	**Financial Crisis 2008 USA**
Difficulty, uncertainty, danger or serious threat to people and national systems and organizations	Convoys of goods were being attacked throughout the war	Terrorist attack threat continued for years to come	The capital of Aceh province was totally damaged	The tsunami caused a nuclear crisis in Fukushima power plant	Deaths exceeded 150,000 in the first three years of the crisis, according to the World Health Organization	The crisis triggered prolonged unemployment
Non-routine rules and procedures emerge	Rationing was introduced	The introduction of the USA Patriot Act 2001, which gave law enforcement officials sweeping new powers to conduct searches without warrants, monitor financial transactions and eavesdrop; and to detain and deport, in secret, individuals suspected of committing terrorist acts	Most of the local government members died in the crisis, so the central government took charge	Following the crisis most of the nuclear power plants were shut down causing a national power shortage so that power rationing was introduced. The government asked companies to reduce power consumption by 15%.Some companies moved their weekends to weekdays to smooth power demand	Many military operations were executed to restore order and to suppress gang and militias	The Federal Reserve dropped the interest rate to a record low of .25 %, which was averaging 6% before the crisis
Urgency	Urgent measures were needed and adopted to protect the convoys	Urgent measures were needed to counter the terrorism threatens USA Patriot Act 2001was prepared and voted on in one month despite being a major change to many US laws	Urgent measures were needed to avoid the spread of diseases	Urgent decommissioning of several nuclear reactors took place. Also urgent evacuation was needed due to the radioactive substance contamination in the area.	Urgent rebuild of security forces was introduced	Urgent bailout packages were needed and offered to support the economy; otherwise, it would collapse e.g. USA Emergency Economic Stabilization Act of 2008

Now the definition of a national crisis is set, but one step is still needed: linking it to the discipline of project management. Project management in general is defined as "the application of knowledge, skills and techniques to execute and deliver projects effectively and efficiently" (PMI, 2008). Herein, the definition of project management during national crisis is "the application of knowledge, skills and techniques to execute and deliver projects effectively and efficiently in a situation or time at which a nation faces intense difficulty, uncertainty, danger or serious threat to people and national systems and organizations and a need for non-routine rules and procedures emerge accompanied with urgency." This is the fundamental concept proposed by the authors. However, a legitimate question arises: Is there any difference between peacetime project management and project management during national crisis time?

Is there any difference?

A basic and straightforward answer to this question is *yes*. This answer is based on the premise that there are some features and characteristics emerging during a national crisis time and they have an impact upon the processes of project management and upon the common project success factors. The literature shows many of these different features. For example, the pressure of a national crisis brings people closer to each other and increases the attitude of collaboration between them (Rodríguez *et al.*, 2006; von Dawans *et al.*, 2012). Increased collaboration leads to increased project team effectiveness, which, in turn, increases the likelihood of success (Gemuenden & Lechler, 1997; Hoegl & Gemuenden, 2001); and(Yang *et al.*, 2011).
Also, the national crisis period is often associated with disruption of supply, either a shortage of materials required for projects or the inability to deliver them on time to the required area (Chang *et al.*, 2012). These shortages and disruptions destroy an important success factor, which is the availability of resources (Belassi & Tukel, 1996; Do Ba & Tun Lin, 2008). Consequently, these factors reduce the likelihood of success.
Moreover, a need for policy changes is associated with a national crisis period. For example, the crises of World War I and World War II enabled women to undertake jobs such as aircraft manufacturing, which were not open to women prior to such crises (Bloomfield & Bloomfield, 1997; Littlea & Griecob, 2011). This has a direct relationship to the availability of human resources, which is an important project success factor (Jo & Barry, 2008; Pinto & Slevin, 1987). Another example of a national crisis time is the aftermath of a natural disaster, such as an earthquake. Le Masurier *et al* (2006) investigated the reconstruction project after a natural disaster in New Zealand, and concluded that legislations prepared for routine peacetime projects are not effective enough for projects during a national crisis following a natural disaster. Those peacetime policies are not sufficient to cope with the urgency imposed by a national crisis situation(Le Masurier *et al.*, 2006). The Project Management Institute (PMI) has developed a Project Management Methodology for Post Disaster Reconstruction following the 2004 Indian Ocean tsunami which triggered national crises in several countries (Curlee & Sterling, 2008).
The war is an example of a national crisis. During such situations, an employee's continuance commitment (willingness to stay working for the organization) is negatively affected by the event of war (Messarra & Karkoulian, 2008). It is reported that commitment to the project is an important project success factor (Chua & Kog, 1999),(Nguyen, *et al.*, 2004), and the national crisis situation affects this commitment, consequently affecting the likelihood of project success.
A national crisis (particularly war) brings about new types of risks and threats that are unlikely to exist during peacetime, such as sabotage (Öcal, *et al.*, 2006). This may bring new types of stakeholders, such as the secret police.
The literature showed that project management in peacetime context is different from project management during national crisis time. Thus, what are the characteristics of a national crisis that impact project management?

The characteristics of a national crisis

This study presents five characteristics that constitute a national crisis and have an impact upon project management processes. Any single characteristic can exist in other contexts, but they collectively exist together in any national crisis. These characteristics are:

The urgency: time is described by many interviewees as the highest pressing factor during a national crisis. Things need to be done quickly; otherwise, the toll will be very high. An example to illustrate this can be found in WWII. During WWII in the UK, the circumstances were unforgiving and delays could cancel a project. For example, the Martin-Baker MB3 aircraft was a good aircraft during tests, but it was considered outdated because of few months of delay and late delivery. Consequently, it never progressed to mass production. The value of time during a national crisis may exceed the financial value to lives. In the aftermath of the Japan tsunami disaster in 2011, when urgent measures were issued to contain the Fukushima Daiichi nuclear disaster, as each hour of delay increased the risk of nuclear explosion which may kill thousands.

Government intervention: since a national crisis is a national event, the government is an influential stakeholder. Any national crisis includes government intervention, whether through legislative effort or various types of support or even direct involvement in particular projects. Rationing is a form of government intervention during a national crisis. During WWII, the British government controlled the raw material such as the aluminium. During the global financial crisis in 2008, several governments paid from taxpayer's money to private firms to prevent the economy from collapsing. For example, the US Government paid billions to auto manufacturers to avoid millions of layoffs.

Emerging threats and opportunities: almost all contexts have threats and opportunities, but there are particular threats and opportunities that emerge or gain high probability during a national crisis. The most serious threat that increases dramatically during a national crisis is the threat to lives. During wars or aftermath of natural disasters, people die in the hundreds or even thousands. Even during financial crises, which do not show a direct threat to lives, the reports showed dramatic increase in the suicide mortality rate during the financial crisis in East/Southeast Asia in1990s(Chang *et al.*, 2009) and in the 2008 global economic crisis (Chang *et al.*, 2013). On the other hand, one of the most important opportunities that increase during a national crisis is the tendency of people affected by the situation to collaborate.

Resources and supply disturbance: the national crisis is associated with disturbance in the supply chain or in the resource availability, either material or human resources. For example, natural disasters usually destroy the transportation and communication networks as what happened in the aftermath of the 2004 tsunami in Indonesia. Another example is in the UK during WWII. Because of the call of duty, the human resources were affected, as many experienced workers left their jobs in various industries to serve in the armed forces.

Uncertainty: crises are by nature uncontrollable and the series and consequences of events are least predictable; thus, a national crisis is defined by uncertainty. The requirements of certain work change rapidly and new realities can emerge suddenly. For example, during WWII no citizens in London was certain about the timing a bombing raid and the potential consequences of such a raid.
These are the major characteristics of a national crisis that can affect the project management. In the following section, the implications of these characteristics will be discussed.

Discussion

The first step in investigating any concept is to set the definition of that concept in such a way that it is distinguished from others. The definition of project management during a national crisis, which is proposed here, takes the popular definition of project management set by PMI and adds to it the national crisis definition compiled by the authors. By doing so, the resulting definition keeps the new concepts within the bigger umbrella of project management discipline. This leaves the door open for benefiting from the already well-established tools and techniques in the field of project management and modifying them if necessary to suit the new concept.
The concept of project management during a national crisis started to gain momentum in the literature under several titles of research, such as post-disaster project management and non-routine project management. However, a universal comprehensive definition is missing and this is the gap in which this paper contributes.
The concept is proposed for national crises in general. However, there is a need to investigate and classify the national crises further, as each type of national crises can have specific set of characteristics. A hint in this regard is that during national crises the death threat increases dramatically, however the death reason differs between different types of national crises. For example, during war people die because of bombs, while in economic crisis suicide is the main reason of increased deaths.
Presenting the concept of project management during a national crisis opens the debate if there are any differences between the new concept and the already existing concept of ordinary project management.

While this paper presented these differences, the implication of such differences and the characteristics of a national crisis is that they alter the assumptions of the project management processes; for example, due to the urgency accompanying a national crisis context, the time will almost always be the priority for project management during a national crisis. This change is significantly affecting any project feasibility study. Moreover, when drafting project procurement procedures for a national crisis situation, the idea of *doing things faster* should be highly prioritized. This also changes the approach of project planning from *planning ahead* to *planning on the go*. Likewise, this change in the planning approach is a result of the high uncertainty accompanying a national crisis.

The level of government intervention in a project is also an important factor that affects some aspects of the project management processes. For example, the government intervention in staffing process during peacetime is assumed to be limited to the general laws of employment in the country, while during a national crisis that level can increase to a point where the government decides who works where. This actually happened in several situations such as the aviation projects in UK during WWII when the government was attaching priority officers to projects. In addition, the British Government was appointing workers (by names) to different industries and companies. Another example is that during peacetime, raw materials are available in the market for those who can purchase them, while when rationing is introduced due to a national crisis, the quantities available for use are determined by the government not by the purchasing power. This level of intervention fundamentally affects the level of control a project manager (or a project owner) has over several aspects of the project.

One of the important characteristics of a national crisis is that new types of threats and opportunities gain higher probability. This has an impact on several project management processes. For example, the risk management plan is based on the type of the risks and their probability. This determines the action needed to deal with such risks. When new types of risks (such as sabotage) gain higher probability due to war situation, for example, a higher level of coordination with security authorities might be needed. Also, there are opportunities that emerge during a national crisis and they should be exploited very well in the project management processes. Among these opportunities is that people tend to be same-minded and think about common destiny. This makes it easier to direct and motivate them.

However, these emerging threats and opportunities need to be investigated further to develop a comprehensive set of these threats and opportunities. There is a need to associate each of them with particular types of national crises, in order to suggest the best practices to deal with such a threat or an opportunity during a particular type of national crises. A question that can guide this effort is: What are the best practices a project team can apply to deal with security issues in projects during wartime? Another suggested question is: What are the best practices a project team can adopt to exploit the prosocial attitude that emerges during and after a natural disaster?

Conclusion

This paper contributes to the project management literature by presenting the concept of project management during national crisis. The paper presents a definition of the concept and points of differences between this concept and ordinary project management. It also seeks to define the common characteristics of a national crises and their impact upon project management. While this research is a theoretical work aimed at building the concept of project management during a national crisis, empirical work is needed to solidify the concept and to develop operational measures, which can be used in real- life situations. This paper calls for more and deeper research into this theme because national crises are increasing. Both theorists and practitioners of project management need to develop their theories, assumptions, tools and techniques to better manage projects during a national crisis. The authors call other fellows to enhance the concept of project management during national crisis by addressing the definition proposed here, and presenting enhancements or even alternative definitions to increase the maturity of the concept.

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Success Strategies for Project Management During National Crises: Insights from the British Aviation Industry During World War Two

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Abstract

Success is a fundamental imperative in the field of project management. The authors contributed to the theme of success by exploring the strategies that assisted in the delivery of successful projects during national crises. The occurrence of these crises stimulates the emergence of different dynamics and constraints that affect every aspect of the socioeconomic system, including projects. The success strategies needed in such contexts are different from those employed during times of peace. This paper reported the results of an introspective study of 24 British aviation projects undertaken during World War Two. The authors revealed six effective strategies that support the delivery of successful projects during a national crisis period. The authors discussed the results and made Links to contemporary projects together with practical recommendations that will enhance the understanding of successful project delivery during national crises.

Key Words: *project success, national crises, project context, World War Two, content analysis, success strategy.*

Introduction

Successful projects are key elements for sustaining businesses and ensuring a nation's prosperity (PIPC, 2005). To understand how projects can be delivered successfully, researchers have studied in depth what makes projects successful. They have produced insightful articles such as de Wit (1988), Belassi & Tukel (1996), Shenhar et al. (1997), Chua & Kog (1999), Cooke-Davies (2002), Salleh (2009), and Han et al. (2012). Nevertheless, the success rate of projects remains low (Ika, Diallo, & Thuillier, 2011) and more research in the area of project success is still required.

The topic of project success can be studied from a number of different viewpoints; for example, the focus may be on human factors, the type of industry, or project management standards. In this study, the authors

addressed the notion of success from the context perspective, that is, the conditions and circumstances surrounding the project being studied.
The context of a project and the circumstances surrounding it are key factors that influence the outcome of the project (Balachandra & Friar, 1997; Engwall, 2003; Maaninen-Olsson & Müllern, 2009). The context can take many forms including the industry type, the culture, peacetime and national crisis contexts. Each context may have different effects upon a project; consequently, the strategies for project success may differ from one context to another (Balachandra & Friar, 1997).For example, the recruitment strategy may differ between a defense project and a construction project because secrecy is an important element in a defense project but not in a construction project. Also, a construction project manager must be physically capable, while a person with mobility limitations can manage a software project effectively.

Among the different project contexts, the context of a national crisis is unique and has very high impact upon the projects being implemented at that time (Howsawi, Eager, Bagia, & Niebecker, 2014a). During such a crisis, a large proportion of the nation (if not all) is subjected to difficult circumstances which bring about many changes in the socioeconomic system of a country. For example, abnormal institutional changes may be approved as a result of the pressure of a national crisis. The British Government control of raw material during the crisis of World War Two (WW2) is an example of an institutional change that affected projects (Backman & Fishman, 1941b). Given that national crisis is a unique context in which project management needs a different approach (Howsawi et al., 2014a), the authors therefore assert that the study of project success during national crises is an important research topic.
A careful look at situations worldwide shows that national crises continue to be prevalent. The frequency of financial crises has doubled since the 1970s (Bordo, Eichengreen, Klingebiel, Martinez-Peria, & Rose, 2001), and the frequency of natural disasters is also increasing (Degg, 1992; Gurenko & Dumitru, 2009).The number of wars has continued to increase since 1870 (Harrison & Wolf, 2011).

There are many national crises worldwide. The wars in Afghanistan and Iraq, the aftermath of Japan's tsunami, the aftermath Hurricane Katrina in the United States of America (US) and the global economic crisis are examples of recent crises. In the year 2011 alone, five incidents of civil unrest broke out in five Middle Eastern countries. The results of these crises are thousands of deaths, economic crises and regime changes.

Against the odds, projects do not stop during these times but continue to be issued and implemented in the crisis context (Howsawi et al., 2014a; Hrůzová & Thornton, 2011). These projects differ in their purpose; they may be in response to the crisis itself, or simply being implemented during the time of crisis. Nevertheless, all projects will be subject to the same demanding circumstances and all of them will need to discover how to succeed during such difficult times. Project teams need to adopt and practice certain strategies to elevate the likelihood of successful project delivery. However, given the abnormality of a crisis context, peacetime project strategies may not be suitable for delivering a successful project under such circumstances. This observation leads to the following broad research question:
What effective strategies should a project team adopt during national crises to increase the likelihood of successful project delivery?

This question will be narrowed and customized following the literature review and the definition of the case studies taken from British aviation projects during WW2 and used in this study.
Using the content analysis of original documents and a large collection of secondary data the authors revealed the strategies that have assisted in the success of several aviation projects in the context of a national crisis. They commented on the significance, generalizability and limitations of the findings.

Cases studied in this research: British aviation projects during the national crisis of WW2

The aviation industry in the United Kingdom (UK) in the 1930s was one of the most advanced in the world. Nevertheless, the inter-war period between World War One and World War Two witnessed slow progress

in this industry. With the signs of war looming on the horizon in the late 1930s, the industry started to shift towards preparation for war. An example of this preparation is the shadow factories plan which aimed to expand the manufacturing capacity of British factories, but this preparation was limited because the threat of war was at anticipation stage, and political effort was focused on the maintenance of peace.

With the outbreak of war in 1939, the country entered a state of national crisis. In this situation, the aviation industry was responsible for providing aircraft of all types to support the war effort, and in doing so, many aviation projects were issued. Some projects were an outstanding success, such as the construction of the de Havilland Mosquito and Avro Lancaster, and others were failures, such as the Hawker Tornado.

Twenty-four British aviation projects that were intended to produce aircraft for the war effort are included in this research. These projects were conducted during the war period and form the basis for understanding successful project management during national crises. Table 1 contains the names of all the aircraft projects in this study.

Table 1: the case studies from the British aviation industry during WW2

	Aircraft name		Aircraft name		Aircraft name
1	de Havilland Mosquito	9	Fairey Firefly	17	Bristol Brigand
2	Avro Lancaster	10	Hawker Tempest	18	Bristol Buckingham
3	Handley Page Halifax	11	Hawker Sea Fury	19	Westland Welkin
4	Bristol Beaufighter	12	Avro Lincoln	20	Supermarine Spiteful
5	Hawker Typhoon	13	Fairey Fulmar	21	Hawker Tornado
6	Fairey Barracuda	14	de Havilland Hornet	22	Vickers Windsor
7	Short Stirling	15	Avro Manchester	23	Miles M.20
8	Armstrong Whitworth Whitley	16	Blackburn Firebrand	24	Supermarine Type 322

The national crisis of WW2 in the UK and its impact upon aviation projects

In this study, the authors explored what enables projects to be delivered successfully during a national crisis. Because national crises can be of many types, the authors chose to focus on one type of national crisis, namely, war. Of the many examples of war worldwide, the authors selected WW2 as the particular example because it was a crisis that affected almost every nation on earth, with unprecedented outcomes. For example, the human casualties of that crisis exceeded 50 million (Harrington, 2002). This equates to one death every three seconds during nearly six years of conflict from 1939 to 1945, a statistic which illustrates the awful dimension of this crisis.

The impact of WW2 was international, but some nations and areas suffered more than others. The UK was among those countries that suffered the most. The authors chose it as the spatial scope of this research because it is a good example among the allied countries in WW2 for representing the difficulties of the war. The socioeconomic system in the UK was significantly affected during the war years for many reasons; for example, in the Battle of Britain in 1940, Nazi Germany bombed British strategic targets such as industrial facilities and infrastructure. In the Battle of the Atlantic, which continued from 1939 to 1945, maritime convoys to the UK were threatened and attacked by German naval vessels such as U-boats.
It was during this crisis that the characteristic of a national crisis as a context for project management mentioned by Howsawi et al. (Howsawi et al., 2014a) materialized and impacted aviation projects as follows:

- **Government intervention:** The British Government controlled many aspects of British life, such as business practices, material supply and employment, even in private firms (Backman & Fishman, 1941a; Murphy, 1942). The British Government supported the aviation industry during the war period more than any other industry.

- **Emerging threats and opportunities:** This took the form of bombing and sabotage and was a threat that disturbed work in several ways. It prevented workers from reaching their work site, or it destroyed the work site itself, or it killed or wounded workers. Aviation production facilities were among the key targets for the enemy, which meant that the work in these facilities was under constant threat. This continuous threat exerted huge psychological pressure on all the project team members. Furthermore, the destruction of a production facility by a bombing raid caused the work (either projects or production) to stop for a period, and all time was precious. Securing project sites from saboteurs and spies was also a great challenge that exceeded the capacity of normal business firms and required coordination with national security agencies.
- **Urgency:** Many projects needed to be delivered as quickly as possible because the changing situation might render a product obsolete if it was delayed. For example, the German forces advanced so rapidly that it took less than seven weeks for them to occupy France. This created a new tactical reality which significantly changed British weapons requirements. Aviation projects in particular needed to be completed quickly so that they were not obsolete even before entering production.
- **Resources and supply disturbance:** The UK is a group of islands dependent to a large degree on imports of raw material from overseas and continental Europe (Edgerton, 2011). With the fall of Europe into the hands of Nazi Germany and the sinking of convoys, there was a notable shortage of raw material, which seriously affected aviation projects. This disturbance in material supply affected the progress of aviation projects and forced the Government to control the use of important material, such as aluminum. As a result of the call of duty to serve in the armed forces, many experienced workers left their jobs in industry; in addition, the rapid development of new technologies, such as metal works, meant that trained personnel were in short supply (Weir, 2003).
- **Uncertainty:** During WW2, the citizens of the UK were uncertain as to when a bombing raid would occur and the potential consequences of that raid on the workforce and production facilities. In the aviation field, the designers of many projects were uncertain about final specifications, because the rapidly changing tactical situation made it difficult to set the final specification for aircraft design. This volatile situation imposed changes on both the specifications and the role of particular aircraft, which designers struggled to cope with.

All projects during that time were affected by the above-mentioned circumstances. Those projects which were well handled in these conditions succeeded, while those which were poorly handled failed.

Literature review

The topic of this study is an intersection between a number of themes within and outside the project management literature; namely, project success, crisis management and project context. The following literature review formulates the basis of this research.

Reviewing the concept of project success

Project management literature places great emphasis on the theme of project success. Indeed, the whole discipline of project management is about success. The discipline of modern project management started to take formal shape in the 1950s (Kwak, 2005) and from that beginning through to the 1970s, many studies addressed the concept and definition of project success. The initial definition of project success was to complete a project according to time, cost and quality specification (Atkinson, 1999), but the 1980s witnessed an evolution in the understanding of project success. The concept became more profound as complex frameworks to understand and evaluate project success replaced simple definitions of the three elements mentioned above (Jugdev & Müller, 2005). For example, a systematic framework to assess project success was introduced by Belassi and Tukel (Belassi & Tukel, 1996), and Shenhar et al. (2001) introduced a multidimensional framework that captured the different meanings of success to different stakeholders. Howsawi et al. (2011) introduced a four-level success framework which defines and assesses project success at four different levels to achieve an overall assessment.

Despite consensus on the intuitive meaning of project success, the term means different things to assessors (Han, Yusof, Ismail, & Aun, 2012; Ika et al., 2011). This fact shows clearly that any study should adopt and justify a particular definition of project success.

Context-focus project success factors and strategies

There are plenty of success factors and strategies detailed in many studies and articles in the project management literature. A careful look at these studies reveals that there is limited agreement between studies at the top of their respective lists of success factors and strategies. For example, a Vietnamese construction project research (Nguyen, Ogunlana, & Lan, 2004), an Indian construction project research (Iyer & Jha, 2006), and a research on multiple public and private projects in multiple industries (Mishra, Dangayach, & Mittal, 2011) agreed that the top success factor is the competency of the project manager. Contributing factors differ further down the list due to variations in the context of the specific study (Balachandra & Friar, 1997). However, whether the context is a geographical location such as Brunei (Salleh, 2009), an industrial sector such as defense (Dvir, Ben-David, Sadeh, & Shenhar, 2006), or a cultural medium such as Chilean culture vs. America culture (Pereira, Cerpa, Verner, Rivas, & Procaccino, 2008) it is critical to understand the context in which project success is being investigated to reach more realistic findings (Engwall, 2003; Maaninen-Olsson & Müllern, 2009).Because of this, it is necessary to define the context in which this study addresses the question of project success, namely, national crisis.

There is very little distinction between peacetime and a time of crisis as a context for project management in project success studies. This highlights the assumption that the results of those studies will be applicable to both contexts. Despite the difficulties that exist in a peacetime context, the changes, challenges and conditions of crisis time are very different; for example, delay or failure in peacetime is unlikely to result in military defeat, which may be a real risk in times of war crisis. Also, delays in a post-disaster project may lead to social breakdown in families and communities (Baroudi & Rapp, 2013).

The occurrence of a crisis such as war or the aftermath of a huge natural disaster is associated with sudden changes and the emergence of new realities (Kuklan, 1986). For example, war introduces institutional changes and restructures society into a new order (Modell & Haggerty, 1991). World War One and World War Two are crises that enabled women to undertake jobs such as aircraft manufacturing which were not widely open to women prior to these crises (Bloomfield & Bloomfield, 1997; Littlea & Griecob, 2011). Another example of the impact of war crisis is that an employee's commitment to an organization is affected by the event of war (Messarra & Karkoulian, 2008). Higher risk and safety issues, a greater need for change and shorter time for decision-making are characteristics of a crisis context (Karlin, 2007; Riley, 2006; Shaluf, Ahmadun, & Said, 2001). All projects will face the reality of the crisis irrespective of whether the project is a response to a crisis or whether it happened to be in the process of being implemented during the crisis period. Because of this fact, the context, particularly that of national crisis, should be considered carefully when investigating project success.

The notion of crisis

From a language point of view, a crisis means "a time of intense difficulty or danger" (OxfordUniversity, 2012) or "a situation that has reached an extremely difficult or dangerous point; a time of great disagreement, uncertainty or suffering" (CambridgeUniversity, 2011). In a more technical definition, a crisis is a situation faced by an individual, group or organization in which it is not possible to cope by the use of normal routine and procedures, and in which stress is created by sudden change (Booth, 1993). However, the definition of crisis has proved to be somewhat problematic and debate exists within the literature about the precise meaning of the term (Smith, 2005).

The crisis is described as a period of sudden change during which a totally new system is formed. In fact, the meaning of a crisis includes opportunity as well as risk, uncertainty, threat, conflict ,accident and

instability (Öcal, Oral, & Erdis, 2006). Crises occur across industries so the information on crises and their management contains many similarities; however, each industry responds to crises on the basis of its norms of practice (Hällgren & Wilson, 2008). A crisis can be abrupt or cumulative. An abrupt crisis is a result of internal or external disturbances. It is generally more specific and less predictable than a cumulative crisis, which can often be foreseen even though it might break suddenly (Hwang & Lichtenthal, 2000).

The crisis can have specific meaning depending on its context, as in the case of economic crisis and industrial crisis, for example. This study is concerned with national crises. A national crisis can be defined as "a situation or time at which a nation faces intense difficulty, uncertainty, danger or serious threat to people and national systems and organizations and a need for non-routine rules and procedures emerge accompanied with urgency" (Howsawi et al., 2014a). Following Smith's observation that the definition of the term is problematic, this study will adhere to the definition mentioned by Howsawi et al. (2014).
Because crises are in general unwanted events with serious consequences, there is a need to deal with their impact; thus, crisis management has evolved.

The project management literature and crisis management

The notion of crisis management in the project management field is not frequently encountered. An electronic search (October 2013) in the database of the *International Journal of Project Management* returned 36 articles containing the term "crisis management". This is possibly due to the newness of the term "crisis management" in the project management field. In the late1990s, research into crisis management within the project management field was described as being in its infancy (Loosemore, 1998). A decade or more later, it remains a poorly addressed topic within project management research (Chartier, Banville, & Landry, 2010; Geraldi, Lee-Kelley, & Kutsch, 2010) with only a few references addressing the various issues (Crawford, Langston, & Bajracharya, 2013). Nevertheless, some insights can be found there.
The literature on crisis management in project management can be classified into two categories: One concerns the search for the source and nature of crises, while the other seeks to find the right strategies and techniques to deal with such crises to increase the likelihood of success. Some articles contain the findings in one category, while others contain both types of finding.

Concerning the first category, Loosemore (1998) identified three ironies in crisis management in construction projects, as follows: At a time when effective communication is important, it is less likely to exist; at a time when mutual sensitivity between project members is important, it is less likely to exist; and at a time when collective responsibility and teamwork are important, they are less likely to exist (Loosemore, 1998). He stressed that crises create opportunities for increased cohesion, harmony and efficiency within project teams. Another study surveyed 120 construction companies and identified 28 factors that contribute to a project crisis, some of which are inadequate government human resource policies and sabotage (Öcal et al., 2006). Based on a comparison between routine and post-disaster projects, Le Masurier et al. (2006) pointed out that the legislation for routine projects is not sufficient to cope with the needs of projects such as post-disaster recovery projects. They call for revised legislation for such types of project (Le Masurier, Rotimi, & Wilkinson, 2006). The recent global crises in the 2000s, such as the global financial crisis 2008-09, led to a new view of crisis management in PM, namely project management during times of crises (Howsawi et al., 2014a; Hrůzová, 2011).

Table 2: Crisis origin classification typology (Piperca & Serghei, 2012)

Event predictability	Locus of generation		
	Internal environment	Immediate external environment	General external environment
More intense than predicted	Overrun	Setback	Swing
Predictable but unpredicted	Oversight	Knock on door	Revelation
Unpredictable	Showstopper	Mystery visitor	Shocker

This view is concerned with the impact of external circumstances that affect the broader domain of a nation rather than the limited sector of industry. A typology to classify unexpected events in projects was offered by Piperca and Serghei (Piperca & Serghei, 2012). Because crises by definition are results of unexpected events, this typology works as a classification of the origins of crises in projects and is a result of the intersection of two dimensions: Event predictability and the locus of generation, which fall into three types under each dimension. Table 2 represents this typology.

The other focus in the literature reports tactics, recommendations and strategies to increase the likelihood of success. Mallak et al. (1997) suggested some useful tools to prepare for crises. These tools are risk analysis, contingency plans, logic charts and table top exercises. They also offer several recommendations for successfully managing the crisis. They encourage establishing a crisis team before the crisis occurs, choosing a project manager indigenous to the place where the project is conducted and being mindful of the social and political consequences of the crisis (Mallak, Kurstedt, & Patzak, 1997). Loosemore (1998) suggested some practices to resolve the three ironies he discovered, such as paying particular attention to the financial aspects of a crisis and balancing control with flexibility in managerial strategies. Engwall and Svensson (2004) proposed the concept of cheetah teams for responding to the crisis (Engwall & Svensson, 2004). These teams are distinguished from other types of teams by being at the same time explicitly sanctioned, mission-specific, intended to dissolve when the mission is accomplished, staffed with full-time members, and not planned in advance. Hällgren and Wilson (2008) offered 15 remedies for projects in crises based on project-as-practiced observation. Their remedies include site teams to undertake overtime works and re-planning. Geraldi et al. (2010) proposed that successful crisis management is based on three pillars. These pillars are a responsive and functioning structure at the organizational level, good interpersonal relationships at the group level and competent people at the individual level (Geraldi et al., 2010). The practical application of these pillars can increase the likelihood of success. Post-disaster recovery projects are typical examples of projects in times of crisis. The analysis of successful project management in such times from three countries, China, Indonesia and Australia, show that the two common factors for successful project resourcing are the competence of the project team, and government response and intervention (Chang, Wilkinson, Potangaroa, & Seville, 2012). Baroudi and Rapp (2013) suggest that to successfully manage recovery projects, organizations should be able to staff their projects with capable competent teams, consider the many stakeholders involved and particularly for project manager to build strong stakeholder relationships as well as good social awareness.

All in all, the literature is characterized by having relatively few references scattered across several journals, some of which do not specialize in project management. Some authors offer insights into the concepts while others provide practical steps. Since the concept of crisis management is new in the project management field, there is a wide gap to fill in this respect. Continuing to derive lessons from practice will lead to the creation of a body of knowledge from which to choose in dealing with crises in the project management field.

The research problem statement and question

The above review shows that the topic of crisis management is covered in the project management literature in two ways. One is the description of the crisis and its root causes; the second is the search for methods and techniques to effectively deal with crises. Notably, the focus of the literature is on the internal crisis; that is, how to deal with the situation when things go wrong in a project, such as the occurrence of fire or hazardous leaks. The literature does not advise how to deal with external or contextual crises. External crises can include examples of national crises such as war and natural disaster. The need here is to present knowledge on how to improve the resistance of projects to this type of crisis. There is a need to find out what strategies to follow to reduce the vulnerability of major projects and to improve their resilience when they are challenged by a national crisis. This is the broad focus of this study. The particular focus of this study will be to investigate the topic as a UK-based spatial dimension and the period of WW2 as the

temporal dimension. The case studies will be drawn from the British aviation industry. Based on these dimensions the research question will be:
What are the effective strategies that project teams adopted in British aviation projects during the national crisis of WW2 to increase the likelihood of successful project delivery?
The importance of the topic of project success, the increasing frequency of crises (Buchanan & Denyer, 2013) and the impact of the national crisis context on projects increase the motivation to investigate the topic of success strategies in the context of national crises.

Research Design

The field of project management is a practice-driven discipline, in which the experience and knowledge gained from practice constitute acceptable knowledge. The management guru Peter Drucker has said that, "What constitutes knowledge in practice is largely defined by the ends, that is, by the practice" (Drucker, 1985). These words are the fundamental philosophy of knowledge creation in this study.

Definitions and concepts

For the sake of clarification and building common foundations, the authors set a number of definitions and concepts that they used in this research.

Success factor compared to project strategy

Many studies in the project success arena use the term "success factor". The definition of the word "factor" is "a circumstance, fact, or influence that contributes to a result" (OxfordUniversity, 2012). The literature of project management defines success factors as "those inputs to the management system that lead directly or indirectly to the success of the project" (Cooke-Davies, 2002). The term "project strategy" also appears in project management research. The definition of the term strategy is "a plan of action designed to achieve an overall aim" (OxfordUniversity, 2012). In the project management literature, the project strategy is defined as "a direction in a project that contributes to success of the project in its environment" (Artto, Kujala, Dietrich, & Martinsuo, 2008). Based on the definitions of both terms, the authors assert that the strategy is a driver for enhancing or diminishing a particular factor or factors.
Because many success factors are common to almost all projects (for example, the availability of resources), greater importance lies with the search for effective strategies that enhance the success factors in a given situation. These strategies change with changes in the project context.
Based on the above definitions and distinctions, the authors preferred to use the term "strategy" to describe the findings of this study, and within each strategy they pointed out the factors that were enhanced by using that strategy.

Micro and macro project success perspective

There are two complementary viewpoints of project success namely, the macro level viewpoint and the micro level viewpoint. The macro level viewpoint focuses on high level strategies that lead to success, while the micro level focuses on particular activities in relation to the project's success (Lim & Mohamed, 1999). For example, dependence on nearby sources of material is a macro level strategy for project success, while an effective procurement policy is a micro level success factor. The outcome of this research comprises macro level strategies that increase the likelihood of project success during national crisis as well as micro level success factors supported by such strategies.

What is meant by project success in this study

One of the widely accepted definitions of a project is that it is a temporary endeavour undertaken to create a unique product, service or result (PMI, 2008). This definition suggests the uniqueness of a project, and

indeed, the definitions of success mean different things to different assessors (Han et al., 2012; Ika et al., 2011). As a result claiming a universal set of criteria to measure success or to propose single universal success definition for all projects might be problematic (McLeod, 2012). Instead, using frameworks or models to define and assess particular project success is more dynamic and is the current trend (Jugdev & Müller, 2005).

The four-level project success framework (Howsawi, Eager, & Bagia, 2011) was chosen to define, evaluate and understand project success within the context of the British aviation industry during WW2. This framework consists of a context level, business level, product level and project level. As mentioned above, the characteristic of national crisis proposed by Howsawi et al.(Howsawi et al., 2014a) appeared in the context of WW2. Failure to deal with any of these characteristics would have meant certain failure for the project. Therefore, the first part of the success definition in this study concerns dealing effectively with the contextual characteristics. This is at the context level in the four-level project success framework.
At the business level, a successful project is one that will attract production to keep the business running in the given conditions of the context level. At the product level, success will satisfy client requirements given the conditions set at the context level. At the project level, success is the ability to produce the prototype given the conditions of the context.

The authors stated the definition of a successful project as: A project that deals with the contextual conditions and produces a product that attracts reasonable production orders. To customize this definition to better suit the situation of our study, the authors redefined it as: An aviation project that dealt effectively with the circumstances of WW2 in the UK and produced an aircraft that satisfied the Government sufficiently that they issued a quantity production order.
Given this definition, a justified indicator to evaluate the project was needed. The production figure serves this purpose as follows: During WW2 no aircraft was authorized to be manufactured unless it satisfied British Government standards; the production quantity was also subject to Government authorization. Moreover, the continuous evaluation of aircraft resulted in the cessation of production if an aircraft proved to be flawed, so only those with proven efficiency were produced in large quantity. For example, the Avro Manchester bomber went into production but, when it proved unreliable, production was ceased after only 209 units had been built.

This indicator complies with the logic of the four-level project success framework. A product is more likely to be produced in quantity if its project can deal effectively with the contextual circumstances. This was the case in many British aviation projects. All the projects that proceeded to the stage of mass production (more than 500 units, as shown in Table **3**) could deal with the difficult circumstances of the war.
The large quantities were a good source of revenue for the production companies, so their business succeeded as a result of this revenue. Business success based on mass production is likely to be achieved if a business offers a satisfactory product to the customer. This was certainly the case in the UK because the circumstances of the time determined that only satisfactory products would pass into production. Effective project management processes are likely to produce a good product within the budget and on time. During WW2 in the UK, the circumstances were unforgiving and delays or overruns could result in the cancellation of a project. For example, the Martin-Baker MB3 aircraft was a good aircraft during tests but it was cancelled because of delays and late delivery, and never progressed to production.

The production figure also reflects the following:

- Ease of production to satisfy the urgency. For example, the de Havilland Mosquito aircraft could be produced using simple carpentry tools because it was made of wood. Also, it was constructed in modules so these modules were produced in many small shops.
- Good utilization of workforce to satisfy the shortage in the skilled workforce. Benefiting from an alternative trained workforce means better production capacity.
- Versatility to satisfy changing requirements, since the same aircraft could serve different roles.

- Good utilization of available material to overcome the disturbance to material supply. For example, using local material reduced vulnerability to the material shortages that occurred as a result of the sinking of convoys from overseas.

Based on this approach to defining success, the projects analyzed in this study were assessed to extract the strategies that helped several projects to succeed, and also what caused other projects to fail.

The Research Approach

Generally speaking, there are two distinct research approaches with their own characteristics. These are the inductive and deductive approaches. However, these two approaches are not exclusive, and it is often advantageous to mix the two in certain research (Saunders, Lewis, & Thornhill, 2009). One of the most important benefits of combining the two approaches is that it allows understanding to be gained of the overall situation of the projects under scrutiny, as well as finding causal relationships between project success and the elements that caused that success. It also allows the researcher to benefit from both qualitative and quantitative data. Moreover, combining the two approaches allows the flexibility needed to address all stages of the research.

To answer the main research question the authors used the inductive–deductive approach shown in Figure **1**. The inductive approach was used at the beginning of the research and was based on an observation followed by a derivative question from the main research question to build the proposition. Then the deductive approach with content analysis techniques was used to extract the results that proved the proposition.

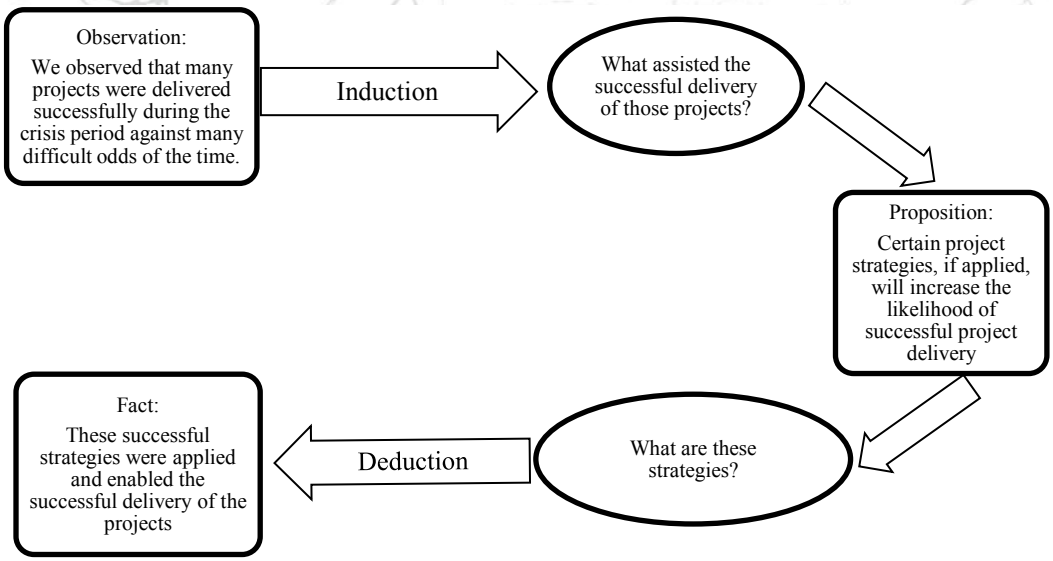

Figure 1: Inductive-deductive approach for this research

The Research Data

This research is a case study research. The authors used a portfolio of case studies consists of 24 WW2 British aviation projects, as shown in Table **3**. All these projects were intended to produce aircraft to serve in the Royal Air Force and other allied air forces to support the war effort. All projects were completed during the war period, although the production of an aircraft may have continued after the war period as a result of its success.

Table 3: WW2 British aviation projects used in this study

	The project name (aircraft name)	Manufacturer	Engine type	Number built	Class
1	de Havilland Mosquito	de Havilland Aircraft Company	Rolls-Royce Merlin	7,781	fighter
2	Avro Lancaster	A. V. Roe and Company (Avro)	Rolls-Royce Merlin	7,377	bomber
3	Handley Page Halifax	Handley Page Limited	Bristol Hercules	6,178	bomber
4	Bristol Beaufighter	Bristol Aeroplane Company	Bristol Hercules	5,928	fighter
5	Hawker Typhoon	Hawker Aircraft Limited	Napier Sabre	3,317	fighter
6	Fairey Barracuda	Fairey Aviation Company Limited	Rolls-Royce Merlin	2,607	fighter
7	Short Stirling	Short Brothers plc	Bristol Hercules	2,383	bomber
8	Armstrong Whitworth Whitley	Armstrong Whitworth Aircraft	Rolls-Royce Merlin	1,814	bomber
9	Fairey Firefly	Fairey Aviation Company Limited	Rolls-Royce Griffon	1,702	fighter
10	Hawker Tempest	Hawker Aircraft Limited	Napier Sabre	1,400	fighter
11	Hawker Sea Fury	Hawker Aircraft Limited	Bristol Centaurus	860	fighter
12	Avro Lincoln	A. V. Roe and Company (Avro)	Rolls-Royce Merlin	604	bomber
13	Fairey Fulmar	Fairey Aviation Company Limited	Rolls-Royce Merlin	600	fighter
14	de Havilland Hornet	de Havilland Aircraft Company	Rolls-Royce Merlin	383	fighter
15	Avro Manchester	A. V. Roe and Company (Avro)	Rolls-Royce Vulture	209	bomber
16	Blackburn Firebrand	Blackburn Aircraft Limited	Bristol Centaurus	193	fighter
17	Bristol Brigand	Bristol Aeroplane Company	Bristol Centaurus	147	fighter
18	Bristol Buckingham	Bristol Aeroplane Company	Bristol Centaurus	119	bomber
19	Westland Welkin	Westland Aircraft	Rolls-Royce Merlin	77	fighter
20	Supermarine Spiteful	Supermarine	Rolls-Royce Griffon	19	fighter
21	Hawker Tornado	Hawker Aircraft Limited	Rolls-Royce Vulture	4	fighter
22	Vickers Windsor	Vickers-Armstrongs Limited	Rolls-Royce Merlin	3	bomber
23	Miles M.20	Miles Aircraft Ltd	Rolls-Royce Merlin	2	fighter
24	Supermarine Type 322	Supermarine	Rolls-Royce Merlin	2	fighter

The data on these cases and in other aspects of this research were compiled from several sources to ensure the rigor of the research through the triangulation of data. The authors analyzed a sample of original documents obtained from The National Archives; The UK Government's official archive, the Imperial War Museum in London and the Royal Air Force Museum in London. More than 600 pages of documents were analyzed. These documents belong to the Ministry of Aircraft Production, Air Ministry, War Cabinet, Ministry of Supply and companies that managed several projects during the war, such as de Havilland and

Vickers. The documents are related to industrial arrangements, product specifications, contracts, test reports, priority management, funding, staffing policies and practices during the period from 1938 to 1945.
In addition to the documents, eight recorded interviews with WW2 industry veterans were used in the analysis. These recordings were obtained from the Imperial War Museum collection in London. The analysis also included a collection of approximately seven hours of media, including films, newsreels and documentaries produced and aired in the UK between 1938 and 1945.

Background information: a novel approach to understanding the context of WW2

To study any event or phenomenon, it is essential to understand its context; however, it is not always possible to take part in the event under scrutiny to understand its context. The required understanding must be achieved through other methods, such as intensive reading of previous research and historical publications about the phenomenon.
In the case of this research, the context of WW2 in the UK needs to be understood thoroughly to gain a detailed mental image of the war context and the British socioeconomic system, particularly concerning the aviation industry and how it performed during that period, especially in the delivery of projects. This mental image is necessary as background for the data collection and analysis process.
Since WW2 ended before any of the authors of this paper was born, an alternative technique was developed instead of live participation. After a period of research and trials, the authors found that, to gain deep understanding of the context, time spent in the following activities was very useful:

- Watching documentaries. This is an effective way to understand the context (Howsawi, Eager, Bagia, & Niebecker, 2014b). The authors spent more than 250 hours combined watching and understanding series of documentaries about every aspect of WW2.
- Visiting places that represent important information about the WW2. For this research specifically the authors visited the following locations:
    - Imperial War Museum London;
    - Royal Air Force museum archive London;
    - Churchill War Rooms; and
    - Britain at War Experience (permanent exhibition).
- Listening to BBC radio interviews and programs from the era. The authors listened to many hours of shows that were broadcast during that period

These activities, along with the traditional practice of reading literature and veterans' diaries, were added to archival documents and recorded interviews. Collectively, these resources provided a rich source of information that significantly helped the authors to gain a good conception of the context of WW2.

Data Analysis Procedure

Data analysis involves extracting meaningful results, conclusions and decisions from the data. Several techniques are used to analyze the data. Due to the nature of the data in this study, the authors chose content analysis as the main technique for data analysis.

The definition of content analysis

Content analysis is a technique that has a long history and is widely used in modern research. Scholars documented the first use of this technique in the 18th century (Hsieh & Shannon, 2005; Krippendorff, 2004).

The definition of content analysis evolved over time from a simple counting process (quantitative analysis of qualitative data) to a more comprehensive method of analyzing data (Hsieh & Shannon, 2005; Krippendorff, 2004).

One highly cited scholar who defined content analysis is Krippendorff. He was cited more than 13,000 times in Google Scholar as of February 2014. Krippendorff defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004). Another holistic definition came from Michael Quinn Patton in his book *Qualitative Research & Evaluation Methods* which has been cited in Google Scholar more than 30,000 times as of February 2014. Patton defines content analysis as "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton, 2002).
These definitions cover the characteristics of this technique. The technique is largely used for qualitative analysis backed by verbal, visual, or written data to describe a phenomenon and its dynamics. This technique can be applied well to subjects such as project management research (Wasiak, Hicks, Newnes, Loftus, Dong, & Burrow, 2011) and engineering education (Magenheim, Nelles, Rhode, Schaper, Schubert, & Stechert, 2010).

The framework of data analysis

The data for this research is mostly qualitative descriptive narrative which contains the details "woven between the lines". Content analysis is a very suitable technique to use with such data (Elo & Kyngäs, 2008; Krippendorff, 2004).

The execution of content analysis in a research project is based on the objective of that research. Some researchers aim to find trends in the data so that they may focus on counting the occurrence of certain themes. Others may aim to find answers to particular questions. In this case, the frequency is not the primary target but the valid and supported inference is more suitable. This highlights the fact that there is no simple single right way to do content analysis; instead, researchers should judge what is appropriate for their problem (Weber, 1990).

The data was coded into four main categories: 1. The *influential conditions*, 2. The *influential decisions*, 3. The *influential practices*, and 4. The *results*. The logic for choosing these categories is that the conditions (the context characteristics) induce a stakeholder to take decisions in response to these conditions. The applications of a stakeholder's decisions are practices. These practices produce results. Consequently, the results reflect on the conditions. Figure 2 represents the analysis framework designed for this study.

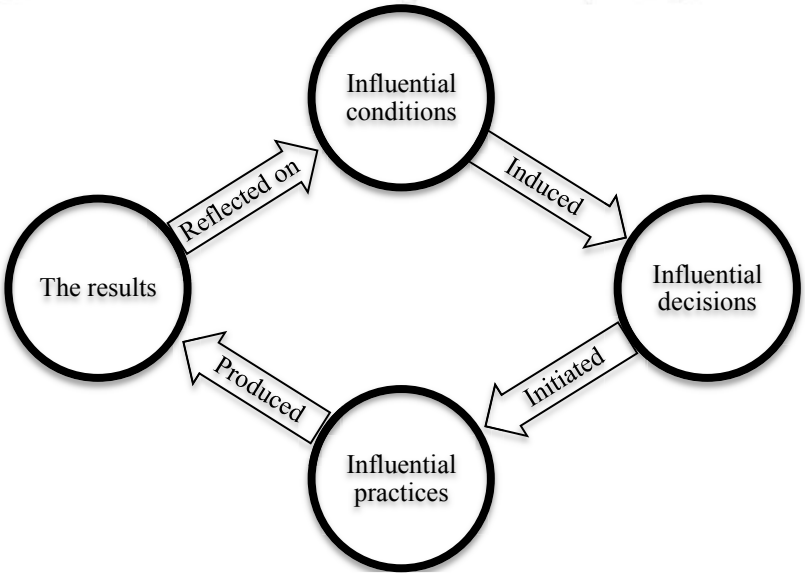

Figure 2: The analysis framework for this study

The influential conditions category contains the main themes or characteristics of the context of the phenomenon under analysis. The influential decisions category contains themes that represent the decisions that stakeholders take in response to the influential conditions. The influential practices category includes the practices that are applied in response to the decisions taken. The results category contains the results generated totally or partially through the practices applied. The success strategies resulting from this study are statements compiled based on the content of the *influential decisions* category and the *influential practices* category.

To give an example: In a collection of Government documents from 1940, reviewed in this study, the discussion about aircraft allotment for development works contains the statement "it is clearly impracticable to attempt to impose a limit on the number of aircraft…. Air staff and operational problems require high speed solutions which can only be obtained on the basis of a separate aircraft for each experiment" (The-National-Archives, 1940).

The phrase "require high speed solutions" represents the urgency and was coded in the condition category. The section that says "it is clearly impracticable to attempt to impose a limit on the number of aircraft" means allowing more aircraft for development work, and this statement was placed in the decision category, The section that says "a separate aircraft for each experiment" means the simultaneous development and testing of subsystems. This statement was placed in the practices category. Figure**3** illustrates the application of the analysis framework to the statement above.

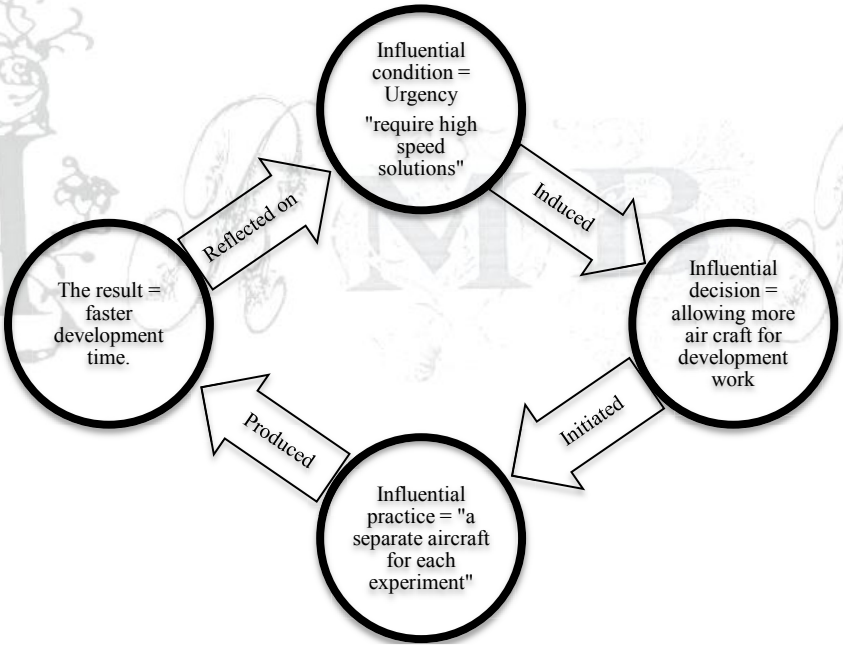

Figure3: The application of the analysis framework

The research trustworthiness approach

Reliability and validity are widely accepted quality measures in quantitative research. However, these concepts are not as clear in qualitative and mixed method research as they are in quantitative research (Golafshani, 2003). This study is largely a qualitative research, thus to deal with this issue of quality the authors adopted a trustworthiness model based on the work carried out by Shenton (2004) to establish equivalent qualitative measures of validity and reliability (Shenton, 2004). In Table **4**, the quality dimensions are defined and the actions to establish them are detailed.

Table 4: Trustworthiness model (Shenton, 2004)

Quality dimension	Definition of the dimension	Suggested action to establish the quality dimension
Credibility	Credibility (in preference to internal validity):Is about the representation adequacy of the constructions of the phenomenon under study	Triangulation of data sources
Transferability	Transferability(in preference to external validity/generalizability): Is concerned with the extent to which the findings of one study can be applied to other situations	Providing background data to establish context of study and providing examples of results application in different cases
Dependability	Dependability (in preference to reliability): Is concerned with the coherence of the internal process of the research, such as data collection and analysis	In-depth methodological description to allow study to be repeated
Confirmability	Confirmability (in preference to objectivity):Is concerned with the extent to which the findings of the research are supported by the data collected	In-depth methodological description to allow integrity of research results to be scrutinized

Results and Discussion

Summary of the Results

This study revealed six major strategies that proved effective in delivering successful projects during a time of crisis, based on the study of British aviation projects during WW2. Table **5** summarizes these strategies and nine generic common success factors supported by these strategies.

Table 5: Summary of the success strategies resulting from this study

Strategies	Factors
1. Obtaining Government support. A dedicated ministry for aircraft production. 2. Depending on nearby alternative material and workforce 3. Consolidating interagency collaboration 4. Applying a common platform strategy in new product development projects 5. Implementing the strategy of simultaneous development and testing of subsystems. 6. Incorporating versatility in the product design	1. Adequate material supply 2. Adequate work force 3. Reduced bureaucracy 4. Having priority and authority 5. Short time for assessment and rework 6. Adequate funding 7. Having appropriate expertise, knowledge and equipment as needed. 8. No communication or transportation loss 9. Having public support

The success model in Figure **4** below is a general influence diagram that illustrates the relationship between success strategies obtained from this study and the generic success factors from the project management literature.

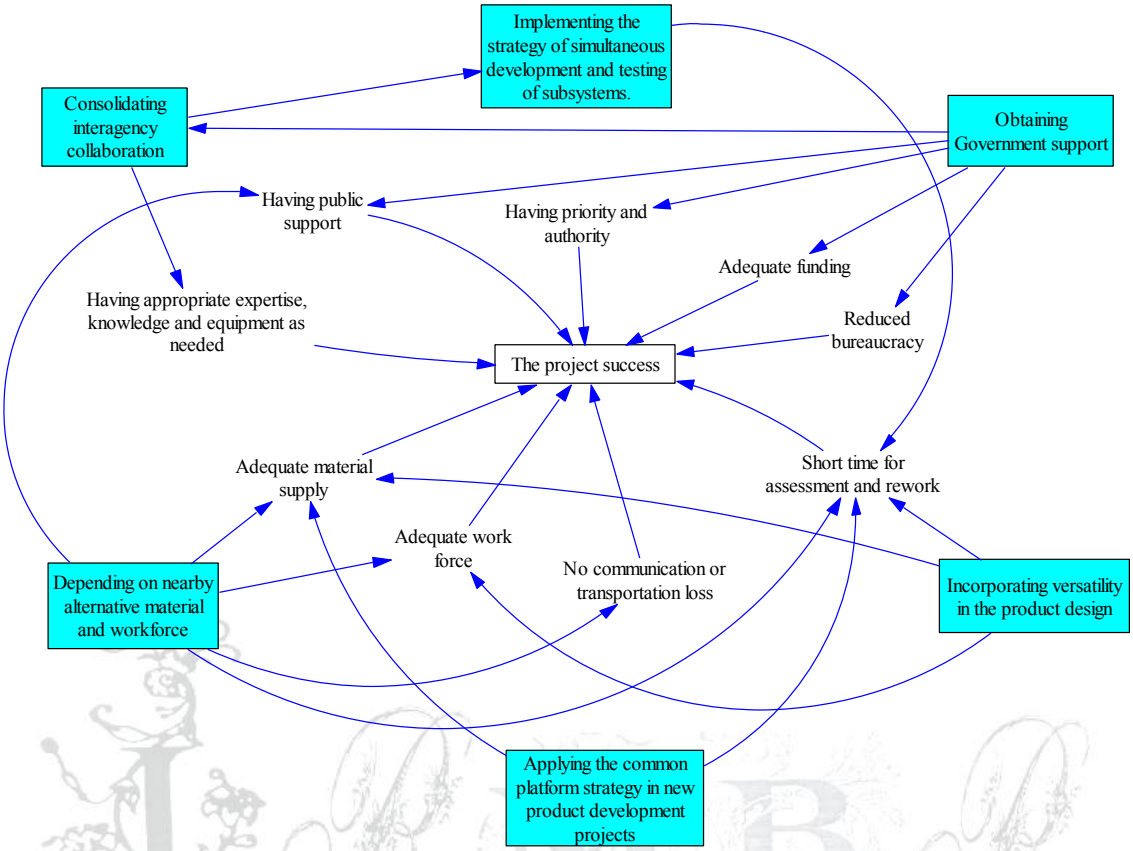

Figure 4: The success model

Discussion

Strategy No.1: Obtaining government support: A dedicated ministry for aircraft production.

During times of crisis, businesses face difficulties in obtaining the required resources, permissions to work, or special services. This was the case in the UK during WW2. Because the nation was at war, the Government imposed many restrictions on the British socioeconomic system. Government support in such a situation is an essential ingredient for success. The aviation industry enjoyed the privilege of having exclusive support at the highest governmental level. There was a dedicated powerful ministry to exclusively support aviation projects, an action which was somewhat similar to the cheetah teams proposed by (Engwall & Svensson, 2004). This ministry was called the Ministry of Aircraft Production. All other war-related projects came under the jurisdiction of another ministry called the Ministry of Production.

The impact of this support was that the obstacles hindering aircraft projects were discussed at Cabinet level. The reports of the War Cabinet reviewed in this study show that many discussions about aircraft projects took place. Decisions made by the War Cabinet were translated into priority for aircraft projects, which meant they were afforded extra resources. The Ministry of Aircraft Production was exclusive to the crisis period. It was created a few months after the outbreak of WW2 and before the Battle of Britain in July 1940. Three months after the war it was attached to another ministry. Then, eight months later it was abolished.
Other forms of government support were the security services the Government provided to projects. This was essential, because during national crises new types of threats emerge (such as sabotage) which exceed

the capacity of normal business firms to handle (Howsawi et al., 2014a). For example, national security agencies participated in deception plans and camouflage to disguise projects sites and production facilities against air raids.

Seeking a strong project supporter such as the government is not an exclusive strategy for times of crisis. However, it is very important to seek a supporter who can grant the project the required authorities, priorities and resources. Without the priority the aviation industry was granted during the early years of WW2, it might not have achieved all that it did.

An example that supports the effectiveness of this strategy is found in the case of the Aswan High Dam (AHD) construction project in Egypt in which took place during a series of Egyptian national crises in the 1960s. There are many differences between the AHD and the British aviation projects, such as the industry type, the geographical location, the culture, the era and the government regime. However, despite all these differences, one similarity is that an exclusive ministry called the Ministry of the High Dam was established exclusively to oversee all aspects of this project. This ministry was abolished after the successful completion of the project.

The Chilean miners rescue project in 2010 is also a representation of the effectiveness of this strategy. In that project, the country's president was appointed as the topmost responsible person in the rescue endeavor and the mining minister was on site 24 hours a day, seven days a week. All the required authorities and priorities were thus brought directly to the project, which strongly supported the success of that short-term, high-impact project (Crenshaw, 2010; Useem, Jordan, & Koljatic, 2011).

Strategy No. 2: Depending on nearby alternative material and workforce

One important condition that emerges during national crises is the disturbance of supplies and the shortage of skilled labor (Howsawi et al., 2014a). In addition, the risk of transportation loss increases dramatically; for example, a bombing raid can paralyze transportation for days.

This was a condition of considerable impact on the British aviation industry during WW2. Nevertheless, some projects overcame this condition and succeeded in producing some of the finest aircraft of the war period. One of these projects was the de Havilland Mosquito. One of the main strategies that contributed to this project's success was the use of available alternative material – wood instead of aluminum. The wood supply was plentiful because most projects had abandoned wood in favor of metal. In addition, wood was available in Britain (Edgerton, 2011), unlike aluminum, of which more than half was imported (Weir, 2003). By using wood, the project and the company also benefited from the availability of carpenters who worked in trades less essential to the war effort, such as furniture-making so those workers can be easily redirected to work in this aircraft production. This strategy reduced the impact of the shortage of skilled metal workers.

In managing projects during national crisis, reliance on sources of materials and workforce that require long distance transportation to the project site puts the whole project at risk of running out of resources due to transportation loss. Innovation is required to help projects to benefit from the available local resources to prevent these projects from running out of resources due to scarcity.

Strategy No. 3: Consolidating interagency collaboration

In the course of managing a project, there might be phases that require information, knowledge, or technologies that are not in-house; for example, the results of the research and development phase of a product component. In peacetime, companies usually retain their information, knowledge and technology – especially the secrets of their R&D – as a competitive advantage and may refuse to collaborate with rivals no matter what the immediate financial benefits might be.

In the UK during WW2, interagency collaboration was well-practiced, which helped to reduce the development time. This collaboration was ordered and enforced by the Government. In the document reviewed in this study, there were many Government orders to companies to share the results of their R&D or their facilities with other companies (peacetime rivals) to reduce development time. For example, one company might have advanced results in respect of the pressurized cabin while the other had a better airframe. In these circumstances, the Government would order the transfer of the cabin technology to the other company and arrange for reasonable compensation to the provider.
Failure to collaborate during national crises may lead to delays and overruns when they are least welcome. The consequences of delays during national crisis time exceed the financial losses to greater losses such as lives.

Recent examples that support this strategy are the reconstruction projects in Afghanistan following the 2001 war. The lack of sufficient interagency collaboration led to delays and overruns in reconstruction projects funded by the US (Sopko, 2012).

Strategy No. 4: Applying the common platform strategy in new product development projects: The conservative approach.

Greater uncertainty is one of the conditions of a national crisis (Howsawi et al., 2014a). There are plenty of sources for uncertainty in such a context, and there is a consequent need for uncertainty reduction strategies.
The aircraft industry during WW2 was in its early stages and the major components of aircraft were limited. These major components were at that time, the engine and airframe. It is much easier to modify, adapt or rework the airframe than the engine, so the engine has greater criticality in respect of the fate of an aircraft project.
In the UK during WW2, the project design team followed one of two approaches when a project to develop an aircraft was initiated:

1. To design an airframe around an existing and fully operationally tested engine. the authors call this the conservative approach; or
2. To design an airframe based on a perceived engine where the engine was at either the specification stage or the factory test stage, but was not in full operational use. The authors call this the pioneering approach.

All the projects in this research that succeeded in achieving more than 500 units of production were the result of projects that followed the conservative approach; that is, 13 out of 24 projects. On the other hand some of the unsuccessful aircraft which scored less than 250 units of production followed a pioneering approach, namely the Avro Manchester and Hawker Tornado projects. For example, the Avro Manchester failed because the Vulture engine was under development when the aircraft was designed. The same design was later modified to accommodate the Merlin engine, which was fully operational, and the result was the Avro Lancaster, which was one of the most successful bombers in British aviation history.
Following a conservative approach reduces the uncertainty that might result from using new, untried complex components in a new product development project. It is observed that the British aviation industry followed the conservative approach as a guiding rule. The Government document reviewed in this study showed many orders enforcing this approach.
Nevertheless, although the majority in the industry followed a conservative approach, this does not mean that there was no research or pioneering trials. Some works, such as R&D, are pioneering by nature. Also, following this approach does not contradict the uniqueness of a project because by definition the combination of proven vital components (the engine) with a new, less vital component (airframe) will result in new aircraft that perform unique sets of tasks.

Strategy No. 5: Implementing the strategy of simultaneous development and testing of subsystems

During national crisis time is considered to be among the top pressing factors (Howsawi et al., 2014a). Things need to be achieved quickly otherwise the rapidly changing circumstances may bring unwanted surprises. This was the case during WW2; the urgency to produce weapons was a pressing condition for British industries. To deal with this condition, the British aviation industry adopted a strategy of simultaneous development and testing of subsystems to reduce the overall development time. In applying this strategy, they developed and tested the subsystems of an intended aircraft on multiple experimental aircraft before assembling them all in the intended airframe. For example, a gun might be tested on an experimental airframe even before the intended airframe was finished, rather than waiting until the airframe was complete, then the gun would be mounted on the finished frame to test it.

This strategy by the British aviation industry during WW2 has now evolved into a more sophisticated technique called concurrent engineering which considerably reduces development time (Smith, 1997). Although this strategy works in crisis time as well as peacetime, the pressing urgency during crisis time makes this strategy essential for meeting time requirements and achieving project success.

Strategy No. 6: Incorporating versatility in product design

During times of crisis, a common problem is that requirements change rapidly, which requires many changes in specification during the development or application of the product. One strategy that helped some British aviation projects to neutralize the impact of changing requirements during WW2 was the versatility of the product. The de Havilland Mosquito and the Avro Lancaster, for example, were easy to modify to serve new roles. This feature gave them a very high rate of success at the product level of the four-level success framework. This feature considerably reduced the response time needed for changing requirements. For example, in the case of the de Havilland Mosquito, several changes to the aircraft specifications were requested after the contract was signed, yet the company managed to deliver the required quantity on time due to the versatility of the aircraft design.

Recommendations for Project Management Practice

The results of this research are intended to increase the likelihood of project success during national crises. Based on the strategies discussed above, the authors recommend the following:

1. The project management team should obtain government support, because the government is the strongest authority during national crisis. The intervention of the government is reported to be decisive in solving problems that face projects during crises such as resourcing bottlenecks (Chang, Wilkinson, Potangaroa, & Seville, 2010; Chang et al., 2012). Government support can grant the project required permissions, priorities and some special services such as security services when the environment is in chaos. This can mitigate the crisis making factors mentioned by Öcal et al. (2006) such as sabotage and government policies that act against the project.
2. Locally available resources should be prioritized in project resourcing because crises disrupt transportation (Chang et al., 2010; Natarajarathinam, Capar, & Narayanan, 2009). This recommendation mitigates the risk of transportation and communication loss. This can be a practical solution to the ironies mentioned by Loosemore (1998) “at a time when effective communication is important it is less likely” (Loosemore, 1998). Also substitutes should be highly considered to utilize the maximum available materials and workforce.
3. The project management team should establish an effective interagency collaboration system. This system should allow the required information, knowledge and technology to flow between projects as needed. By doing this, important lead time reduction can be achieved. As mentioned before, time is among the most pressing factors during national crises.

4. National crisis time is not a suitable time for trial and error, so the project team should follow a conservative approach in developing new product; in other words, they should follow incremental innovation, not radical innovation. Apart from R&D projects, the number of new untried components in a product should be minimized to reduce the uncertainty resulting from the combination of multiple untried components.
5. The project team should plan and schedule the project from the outset according to the strategy of simultaneous work. This is more complicated but saves much precious time. During national crises, saving time always wins the trade-off with extra effort.
6. The project team should be aware that the requirements of a product change rapidly during national crises, leaving the team with very limited time to react. The team should design the product from the outset with the idea of versatility in mind. A versatile product means the ability to fulfill new and emerging needs with minimum cost, time and effort.

The Research Contribution

Because the context of a project has a significant impact upon a project (Howsawi et al., 2011) and the peacetime context is different from the national crisis context, a different project management approach is needed to increase the likelihood of project success during a national crisis. This research expanded the literature of project management to that new arena; Project management during national crisis. This paper takes crisis management knowledge in the project management field beyond internal project crises to include external contextual crises, namely, national crises. In a broad sense, this paper solidified the concept of project management during a national crisis proposed by Howsawi et al. (2014a) by presenting six strategies proven to increase the likelihood of project success in such a context.

This study addressed a portfolio of projects from the British aviation industry during WW2 with a focus on the circumstances surrounding those projects. This work is particularly important because the world had never faced a crisis on the scale of WW2. The success lessons from that situation are likely to work in less intense circumstances. The results of this study are building blocks in understanding how to deliver projects successfully during national crises. The strategies presented by this study increase the immunity of projects to the impacts of national crises.

This study strengthened previous research findings related to project success during national crises. Previous studies provided strategies thought to increase the likelihood of project success during a national crisis; for example, Kwak et al. (2014) revealed that Federal Government support was a key factor for the success of the Hoover Dam project during the national crisis of the Great Depression in the 1930s in the US (Kwak, Walewski, Sleeper, & Sadatsafavi, 2014) The results of this study support the findings of other case studies such as that of the Hoover Dam. This mutual support between different studies makes the results more generalizable to the context of national crisis rather than individual project cases.
The increasing frequency and scale of national crises worldwide now makes the contribution of this study particularly important.

The Limitations of this Research

This study tackled a theme that is relatively rare in project management research, namely, project success during national crises. It took the approach of extracting the lessons from past successes and introducing them to present and future projects.
The research was limited to a macro view of project success during national crisis. This means that the results are top level strategies. The investigation of micro level details of success factors during national crises was not attempted in this research and this level of investigation is needed to enrich the knowledge about successful project delivery during national crises.
This study also addressed a set of cases from one industry (aviation) in one crisis (WW2). Despite referring to cases from other crises, more case studies are needed to reach an appropriate level of generalizability.

Moreover, the results were extracted from the data set available for this study. Other results might emerge from different sets of data. Meanwhile, the authors aim to produce a framework for success during national crises and are investigating other cases. Early results show a great deal of similarities between different cases despite differences in industry type, geographical location and socioeconomic system.
The strategies presented here might be applicable to other cases, although it is not necessary for all strategies to be applied simultaneously. Suitable strategies should be employed as needed for any given project.

Conclusion

Project success is an important topic that is being studied from many perspectives. This research has investigated the reasons behind the successful delivery of projects during national crises. Based on the 24 case studies of this research, six strategies were extracted and presented to increase the likelihood of project success. This paper contributes to the project management literature by solidifying the concept of project management during national crisis as well as supporting the findings of previous research. The results have limited generalizability because of the limitations of the case studies involved in this research. More diverse cases studies are needed to enhance generalizability. Nevertheless, this research represents a building block in the foundation for a sound body of knowledge to assist with the successful delivery of projects during national crises.

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The use of video data in project management research

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Abstract: In project management research, on site involvement is recognized as being effective practice for getting primary data, understanding the project tasks being examined and gaining context awareness. However, it is impossible for investigators to be present on site for every project they intend to investigate since project can be difficult to access, or may be undisclosed during the implementation stage, or may have been completed a long time ago. Reading the project reports and documents will provide a substantial amount of information, but there is always more to any project than written information alone; project practitioners are well aware of this fact. Advancements in technology since the beginning of the 20th century enable the film making of projects; possibly the main purpose of that film making is to produce documentaries. Based on the facts that the camera can capture a wealth of details and rich complexity that it is impossible or very difficult to capture by other means and the eye and ear can acquire a great deal of information that it is practically impossible to write simultaneously a question arises, can the use of video data be beneficial in project management research? This article reports the experience of the authors in employing video data in historic project management research. In researching British aviation projects during the period of the Second World War the authors uses the approach of content analysis to examine more than 250 hours of video data. A classification scheme of video data is presented in this paper. The advantages of and suggestions managing the usage of video are data also shown in this paper, in addition to caution concerning what may influence the effective usage of video data.

Keywords: Video Data, Project Management Research, World War 2, Data Acquisition

1. Introduction

A cornerstone of research is the data. The availability and quality of data are crucial in the success of any research. To acquire serviceable data, researchers deploy many methods and means such as conducting interviews and accessing written documents. These methods and means differ from one profession to another, and even within the same profession. Several factors affect the choice of a data acquisition method; for example interviews can be excellent sources of soft data, such as emotions and attitudes.

One of data source that has been used in research is the moving visual images of any kind. We refer to it in this article as video data (VD) because of the commonality of the term video nowadays. VD is a well-recognized data source in many disciplines such as psychology and anthropology. The use of VD in those disciplines aims to extract suitable data such as personnel profile. However, after conducted project management (PM) research for some time, we have not seen the use of VD in project management research therefore we may contribute to this gap by answering the following question:

Can the use of video data be beneficial in project management research?

PM discipline contains at least 3 linked pathways in close cycle. These pathways are the practice, the research and the body of knowledge. The beginning is from the practice which forms the basis for the research. The research then feeds the body of knowledge which forms a solid ground for practice. This paper fits into the research pathway.

2. Research Design and Methodology

First step in this study was the collection of the data. Because the research is about historic projects plenty of video data was available. We collected a variety of video clips related to several aviation projects in the United Kingdom (UK) during World War 2 (WWII). The clips total

length exceeds 250 hours. Because we did not produce the clips ourselves we were not sure how many hours we are going to examine. This is one of the reasons of having this long collection.

Second step follows data collection is the data analysis. It involves extracting meaningful results and conclusions. Several methods and techniques can be used to analyze the data. Due to the qualitative nature of data in this study content analysis was chosen to analyze the data.

Content analysis is a technique that has long history and is widely used in the modern research. Some scholar dated the first documented use of this technique to the 18th century [1, 2].

The definition of content analysis evolved overtime from mere word counting process (sometimes referred to as quantitative analysis of qualitative data) to more comprehensive method to analyze data [1, 2]..

One of the highly cited scholars who defined content analysis is Klaus Krippendorff. He was cited more than 12000 times in Google scholar as of October 2013. Dr. Krippendorff defines Content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" [2]. Another holistic definition came from Michael Quinn Patton in his book (Qualitative Research & Evaluation Methods) which has been cited in Google scholar more than 30000 times as of October 2013. Patton defines content analysis as "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" [3] p453.

These definitions cover the characteristics of this technique. The technique is largely used for qualitative analysis. It is not meant to produce statistical correlations or so; rather, it is used to make valid inferences that are baked with verbal, visual, or written data or to describe a phenomenon and its dynamics. This technique can be applied well to subjects such as PM research [4] and engineering education [5].

The execution of content analysis in a research project differs based on the objective of that research. There is no simple single right way to do content analysis, however the researchers should judge what is appropriate for their problem [6] p13.

In this study we extract main features of each clip and place that clip in suitable category. As the work progresses the categories and their features get clearer. A regular revision upon the previous stage is made. Modifications to the categories and their components are made if necessary. The whole process' comments and lessons are summarized in the results of this paper.

3. Data Sources in PM Research

There are abundant data sources in the research world. The use of a specific source depends on the suitability of that source to the discipline and the research method. For example, historic documents are a suitable data source for researching historic events, while lab experiments are data sources suit science topics.

In PM discipline, several data sources are commonly used as shown in Table 1.Surveys and questionnaires are predominant.

Table 1. *Sources of data in PM research*

Data source	Examples of literature that have used this source
Interviews	[7]
Surveys and questionnaires	[8-12]
Project documents	[13]
Research databases	[14]
Simulation and mathematical modelling	[15, 16]
Field observation	[17]
Literature analysis	[18, 19]
Mixture of above data sources	[20, 21]

4. Video Data

The word "video" means "a recording of moving visual images made digitally or on videotape" [22]. It is derived from the Latin word (vide) which means to see. We mean by video here all types of moving visual images of any kind such as films and digital media. We define VD as "the information and messages that can be extracted from a certain video clip". These messages and information can be direct, such as news reportage, or indirect, such as the emotions revealed by people gestures in the video clip. VD is found in a very wide array of collections and dealing with it as one segment is inefficient. To facilitate and make more efficient process of analysing VD, therefore, we need to classify the VD.

4.1. Classification of VD

"To classify" means " to arrange (a group of people or things) in classes or categories according to shared qualities or characteristics" [22]. This implies that there are many classes to choose from. Moreover, there can be a combination of classification dimensions in one scheme.

Researchers and practitioners use different schemes for classification purposes; for example, medical practitioners may classify patients according to their age.

In the PM discipline, many dimensions are used for classifying projects such as industry type (e.g. construction and defence), or product novelty (e.g. radical and incremental).

VD is no exception, the language, the length of the clip and the time period of the clip are among possible classification dimensions. To help preparing VD for research purposes, we propose a classification scheme, shown in Table 2 that consists of three dimensions with two categories in each dimension. The dimensions were chosen because researchers need the information to be unbiased, true and original. The reporting type deals with information bias, the purpose

of the recoding deals with information truthfulness and the originality dimension deals with information originality. It is worth noting that the categories in this classification are two ends of a spectrum and the clip can be anywhere in between, consequently, there might be some overlap between the types, but the researcher should categorise according to the overwhelming clip characteristics.

Table 2. *VD classification scheme*

The dimension	Description
Reporting type Analytical vs. informative	Concerning the type of information presented in the video clip. The analytical type presents content analysis of the video clip while the informative type presents straightforward information about the content.
The purpose Propaganda vs. documentation	Concerning the purpose behind recording the video clip. The propaganda type is a clip purposefully recorded for advertisement and propaganda, while the documentation type captures the event at face value without manipulation.
Originality Original vs. reproduction	Concerning how original is the recording? A clip that captures an actual event at the time of its occurrence is original, while a clip that contains a representation of the event through acting or reconstruction from various sources is reproduction.

Each video clip can hold a description of three categories as shown in Figure 1.This scheme contains eight classification possibilities based on the binary combination of 2^3.

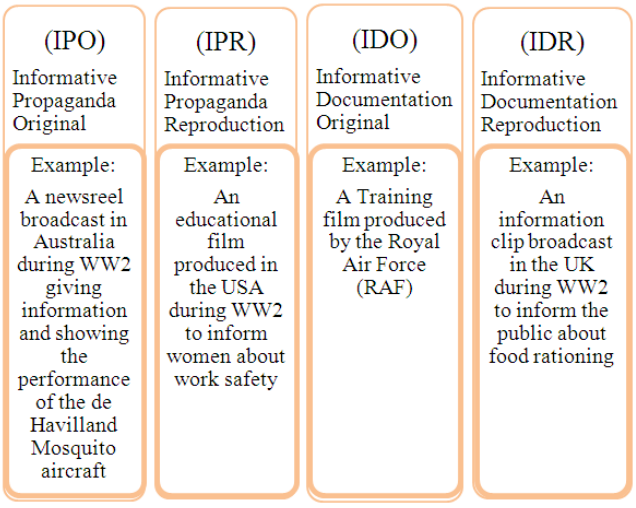

Figure 1-a. *The eight classification possibilities*

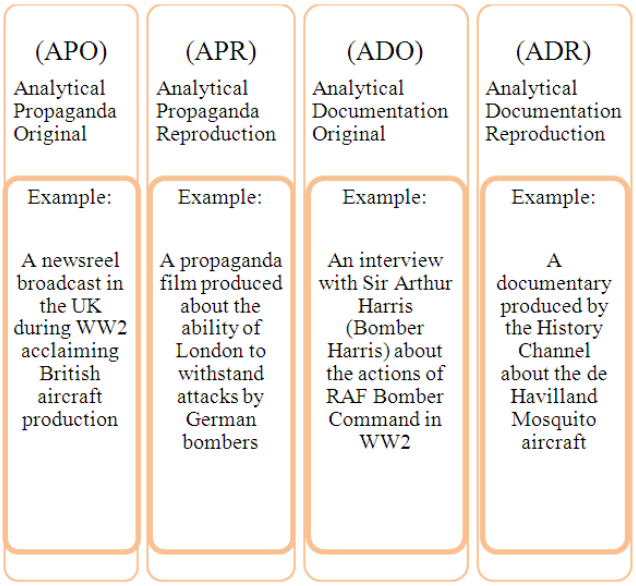

Figure 1-b. *The eight classification possibilities*

These categories have different characteristics from one another. The research objective determines suitable category to use. To align the details of these categories with relevant PM research, we will discuss this point in section 4.2 the practice guideline.

4.2. Features of VD

VD exists in the form of video recordings which usually contain sound and moving pictures, although sometimes they can be silent. Video clips retains following features:

1. The richness of detail: video recording captures all the details exposed to the lens and the microphone. A human conscious mind cannot acquire these details simultaneously. Some events, such as accidents, happen quickly, their shocking nature distracts the observation process and they occur once and cannot be re-enacted. A video recording retains such events in rich detail.
2. The ability to repeat the scene: in real world, there is no way to see an event again except by means of a recording. For example if a researcher is observing a phenomenon and misses some parts for any reason, such as the selective perception phenomenon effect, the only possible way to see missed parts is in a video recording. Because of the richness of detail contained in VD and the inability of the human brain to acquire all these details simultaneously, the ability to repeat-view enables the performance of many data extraction rounds without losing high level data originality.
3. Retaining a high level of data originality to allow re-examination without distortion: recording data in such forms as written documents usually carries the risk of distortion in one way or another. For example, if a researcher is taking notes from the field, these notes will be written in that researcher's style, while another researcher may interpret that style of writing in different way because everyone has their own distinctive way of writing. By contrast, there is no intervention by the researcher in the field when an original event is recorded as it is, so any researcher will see exactly the same clip. On this basis, the consensus of researchers who use the same original VD can be much stronger

than if other forms of data, such written field notes, are used.

4. Ease of use, storage and retrieval: VD is very easy to use nowadays thanks to the availability of video playback systems almost everywhere. The process of recording is much easier than ever before, given that the video recording function is available even in cheap mobile phones. With digital technology being the main technology for processing, VD can be stored in small electronic mediums such as USB flash memory. A full day's broadcast by a television channel can be stored in a cheap USB flash memory that can retain this data for many years and make it available instantly. Moreover, being stored electronically, VD can easily be transferred through electronic communication mediums such as the internet.

These are the most notable features of VD that we believe relevant and appealing to PM research.

5. Using VD in PM Research

5.1. The Significances of VD in PM Research

VD clearly demonstrates its significance in our research; it helps the researcher gaining a deeper context understanding of the project that could not otherwise be gained than by being there. In 2010s we studied projects from the 1940s. Many of the projects' original documents were available, but from which there was no way to extract soft data such as the emotions and project team morale that may yield crucial insights into what makes projects successful during crises. VD provided us with soft data as if we were living the event. Also, tiny details, such as workplace arrangements, cannot be fully understood from written data, but with VD we could build a better mental image of the projects we researched. Another significant point is that PM research is now being conducted internationally, researchers from one country study projects from another. There is need to enhance understanding between research teams about the project environment. VD enables this efficiently. Our research team contains members from Australia, Saudi Arabia and Germany. We studied cases from the UK that took place before the most senior among us was born, yet by using VD, we could build a detailed understanding about these cases and obtain significant findings.

Our experiment of using VD in PM research showed, for example, that it would have been impossible for a researcher from Saudi Arabia doing research in Australia to gain deep understanding of the British project context in the 1940s without using VD. It helped to convey all the contextual knowledge, as well as many project details, without the need to be a WW2 veteran.

5.2. Practice Guidelines

Based on our experience with VD in PM research, we suggest the following three-step guidelines for the effective use of VD in PM research.

First, develop a referencing scheme for your clips

It is practical and efficient to have your data easily accessible. One way to achieve this is to develop a referencing scheme that contains all necessary information about the clip, such as an informative title and a summary about the clip's content. Worth noting is that instead of a page number, as used in paper documents, a video document is better referenced by a time marker. For example, you can refer to a point in the clip as "minute 4:30", or to a period of minutes such "3:30 to 6:20".

Second, classify the clips according to the suggested classification scheme

Classifying clips helps to guide the researcher to the best way of dealing with the data, what to expect from it and what to be aware of. The researcher needs to make an initial clip assessment to determine which of the eight types in this scheme best suits the clip. Each type of VD in the classification scheme will be discussed below.

1. *Analytical Propaganda Original (APO):* This type provides the opinion or analysis of someone other than the researcher in a propagandistic way. This diminishes the research originality because the researcher may be directed toward a certain conclusion. The original visual scenes may provide useful details, but the propagandistic nature of this type threatens the research objectivity. There is little to gain from this type to aid original PM research.
2. *Analytical Propaganda Reproduction (APR):* This type has the drawbacks of APO type, plus it lacks original scenes. This type should not be used in original PM research.
3. *Analytical Documentation Original (ADO):* This type provides the analysis of someone other than the researcher but the visual scenes originality and the documentation nature of this type can provide a good deal of information. The researcher should be aware of the possible narrator bias.
4. *Analytical Documentation Reproduction (ADR):* This type provides the analysis of someone other than the researcher plus the drawback of reproduction. This type has very little to benefit original PM research.
5. *Informative Propaganda Original (IPO):* This type provides true information in a propagandistic way with original scenes. If the researcher can eliminate the propaganda exaggeration, good details can be extracted for original PM research.
6. *Informative Propaganda Reproduction (IPR):* This type is less useful than IPO because of the reproduction. There is little for original PM research in this type. Only the narrated information can be used.
7. *Informative Documentation Original (IDO):* This type provides true information that documents the event with original scenes. This type is the best for original PM research. The threat to objectivity is minimal because no analysis is provided to the researcher, and the original event details are presented.
8. *Informative Documentation Reproduction (IDR):* This

type carries the advantages of the IDO type but has one drawback, which is the reproduction. Nevertheless, a good deal of information can be extracted from the narration.

Third, extract the data to suit your analysis method

After classifying your clips, extract the data and prepare it to suit the analysis method you use for your research. VD can be used equally well with many analysis approaches; for example, for a qualitative analysis approach, build the themes and codes or answer the research questions as you go through your clips, and cross reference each segment from the VD to a suitable theme or question. For a quantitative approach, extract the required values from the clips then apply the numerical analysis your research requires.

These three points offer the basic guidelines from our own experience for using VD in PM research.

5.3. Advantages and Drawbacks

The VD features mentioned above reflect its use in PM research. The richness of detail gives the PM researcher greater ability to extract information than any other mean. This feature demonstrated its importance when we investigated projects from the WW2 era. It is almost impossible to find an interviewee who can answer questions about workplace arrangements and project team moral during that time; however the rich details accompanying the video clips of those projects helped us to extract many details.

The ability to replay the scene and the ease of use, storage and retrieval gives the PM researcher the chance to conduct multiple rounds of analysis, with each round focusing on a single aspect. For example, in researching aviation projects from the 1940s, we made one round of analysis to focus on how the materials were managed in those projects. In another round we focused on the security issues of those projects. Without this feature, it would be more difficult to conduct multiple rounds of analysis.

Another advantage of using VD in PM research is that it reduces the impact of distance or time. For example, we are researchers in 21st century Australia, researching projects in 1940s UK thanks to the available VD from that era.

VD also deals with multiple human senses, which increases the capacity to acquire the knowledge. On the other hand the most important challenge to be faced in using VD in PM research is that video clips are not usually produced to address particular research questions, so to acquire quality details to answer one question, a researcher needs to view many hours of clips, which is very time-consuming. In addition, the interpretation of the VD can be subjective if the data is not numerical, or if it is ambiguous, so the researcher must be aware of this possibility and use suitable techniques, such as triangulation, to reduce this problem. The subjectivity reduction techniques are well detailed in the literature.

6. Discussion and Conclusion

Video Data is a significant type of research data in many areas of research. It offers a quality resource for observational and investigational study. This study aimed to bring the benefits of VD to PM discipline.

This article contributes to the research pathway in PM field. Using the content analysis methodology more than 250 hours of video clips were analyzed and several results were proposed.

In this article we proposed a classification scheme for the VD. The importance of having this classification is that the user can choose the appropriate type of video clips for particular research need. This saves a lot of time for the researcher. Instead of searching all clips, the researcher needs to select only fewer clips required for the research. This also can be beneficial from cost point of view if the videos were not free. Less video clips mean less cost. Also this classification scheme is a step in the pathway to develop a comprehensive methodology for using the VD in the PM research. The door is open for further research and development as more dimensions might be included in the classification process so the scheme can evolve to more comprehensive form.

Also we mentioned four important features of the VD. These features are beneficial to research from different points of view. First, having rich details of an even and the ability to repeat watch it give the research the ability to perform multiple researches on the same event and link them together. This help to perform more profound research if the aim is to understand the relationship between different factors of the same event. Also, the ease of use can help the researcher greatly. Less effort will be needed to handle the data and this means faster and more efficient research projects.

In his article we report the experience we gained in using VD in PM research. Video clips are rich and beneficial sources of data but are not widely utilized in PM research. We presented the features of VD that made it useful. Also we developed a classification scheme to categorise video clips. Moreover, we devised guidelines as well as cautions for using these clips in PM research.

This attempt is an innovative effort. Nevertheless more research is needed to enhance the understanding and practices of using VD in PM research. We encourage other fellow researcher in the field of PM to employ and test VD in their research projects. If they report their experience, a better body of knowledge can be built about the use of VD in PM research.

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Delivering a Mega Construction Project Successfully During a National Crisis: Lessons Learned From The Aswan High Dam Construction Project

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Abstract

Project success is a key topic in project management research. This study contributes to this topic by presenting how projects succeed during difficult circumstances of national crises. The occurrence of a crisis leads to the emergence of new dynamics and constraints that affect projects. Success strategies pursued then are different from those employed during peacetime. This research takes the Aswan High Dam project in Egypt in the 1960s as a case study and reveals four strategies supporting ten success factors that helped that project to succeed during a period of national crises. Links to contemporary projects are presented, together with recommendations to enhance the understanding and likelihood of successful project delivery during a national crisis period.

Key Words: *Project Management, Project Success, National Crisis, Aswan High Dam, Project Context.*

Introduction

Delivering successful projects is a very important factor to support the growth of a nation (PIPC, 2005). There is a continuous stream of research that seeks to understand how to achieve this. The project management (PM) literature contains many insightful articles such as (de Wit, 1988) (Belassi & Tukel, 1996) (Shenhar, Levy, & Dvir, 1997) (Chua & Kog, 1999) (Cooke-Davies, 2002) (Salleh, 2009) and (Han, Yusof, Ismail, & Aun, 2012). However, the percentage of projects that reached the desired level of success is still unsatisfactory (Ika, Diallo, & Thuillier, 2011). There is a real need to continue researching the topic of project success.

The topic of project success can be addressed from a variety of viewpoints. For example, the effect of human factors on projects can be studied, or success can be investigated on the basis of the impact of

industry type on projects. The focus of this research is to study the topic with regard to the context of a project, that is, the circumstances surrounding the project in question.

It can be asserted that the context of a project and the circumstances surrounding it have significant impact upon the outcome of that project (Balachandra & Friar, 1997) (Engwall, 2003) (Maaninen-Olsson & Müllern, 2009). A project context can take many forms, such as geographical, industrial, peace-time and crisis contexts. The impact of one context on a project may differ from the impact of another context; consequently, each context may require different strategies to achieve success (Balachandra & Friar, 1997). For example, the recruitment strategy for a defense project may differ from that of a construction project because secrecy is an important element in the former but not in the latter.

One of the wide varieties of possible project contexts is the context of a national crisis. It is unique and has significant effect on projects, and indeed, on all aspects of a nation's socioeconomic life. During a national crisis, most segments of the nation (if not all) are subjected to difficult circumstances that bring about many forced changes. For example, fundamental regulatory and institutional changes are approved as a result of the pressure of such crises. The control of raw material by the government in the United Kingdom (UK) during the crisis of World War 2 (WW2) is an example of an institutional change affecting projects (Backman & Fishman, 1941). Based on these changes and other differences, project management during a national crisis is thought to be somehow different from peacetime project management (Howsawi, Eager, Bagia, & Niebecker, 2014b). Consequently, it can be proposed with confidence that project success during national crises is an important topic for research.

Observing the situations worldwide shows that national crises are more prevalent in the 21st century than in earlier centuries; for example, wars between countries have been increasing since 1870 (Harrison & Wolf, 2011). The frequency of financial crises has doubled since the 1970s (Bordo, Eichengreen, Klingebiel, Martinez-Peria, & Rose, 2001), and the frequency of natural disasters is also rising (Degg, 1992) (Gurenko & Dumitru, 2009).

There are currently many national crises worldwide, such as the wars in Iraq and Afghanistan, the aftermath of Japan's tsunami and the aftermath of Hurricane Katrina and the global economic crisis. Against the odds, projects during crises did not disappear but continued to be implemented in these contexts (Hrůzová & Thornton, 2011). Projects continued to be launched to respond to the crisis, to sustain businesses, or to reconstruct a devastated area. Project stakeholders clearly need to adopt and practice certain strategies to increase the likelihood of successful project delivery in such contexts; however, the abnormality of the crisis context raises doubt as to whether or not peacetime project strategies are suitable for the job. In this study, war is the example of interest as a national crisis. The case study is the successful construction of the Aswan High Dam (AHD) in Egypt during the national crises of the 1950s and 1960s. The following question is investigated:

What are the effective strategies that the project management team applied to the AHD project to assist in the successful delivery of that project?

The content analysis of several interviews with AHD project veterans, as well as contemporary Egyptian PM experts, and a large collection of secondary data revealed the strategies that assisted in the delivery of a highly successful project in the context of national crisis. Comments have made on the significance, generalizability and limitations of the findings.

The Aswan High Dam project (AHD)

Aswan High Dam is one of the largest dams in the world and it is the largest in Africa. It is 3820 meters long, 980 meters wide at the base, 40 meters wide at the top and 111 meters high. The dam can discharge

water at a rate of 11,000 cubic meters per second. Its reservoir, Lake Nasser, is 550 kilometers long and 35 kilometers wide at its widest point, and contains 162 billion cubic meters of water (Ibrahim, El-Belasy, & Abdel-Haleem, 2011). The dam is located in the Aswan province south of Egypt, where it traps and controls the flow into Egypt of the Nile River.

The dam was constructed throughout the 1960s, since which time it has contributed to the national growth of Egypt and provided many economic advantages. It has protected the country from several severe floods, and its massive reservoir provides water to the whole country during years of drought. Moreover, it provides electricity to the country, and at one time, the dam generated more than half of the country's electricity (Abu-Zeid & El-Shibini, 1997). Figure 1 shows the electrical output of the dam as a percentage of national output.

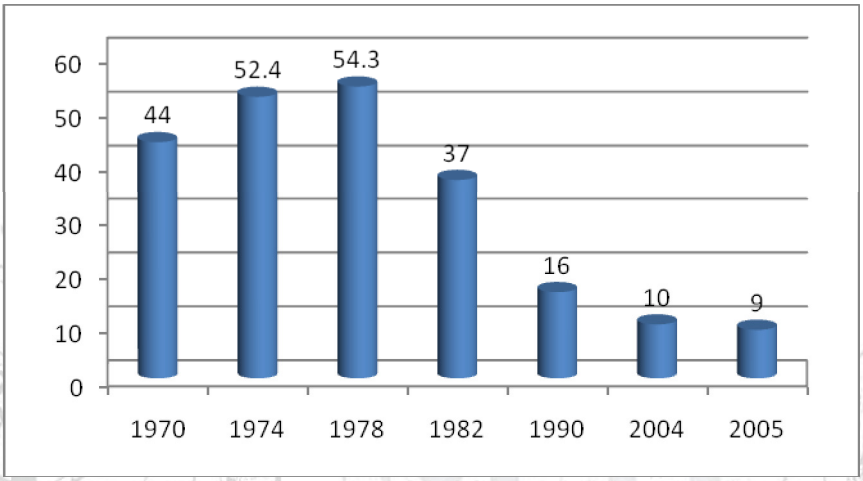

Figure 1: Percentage of Aswan High Dam contribution to national electricity generation (MoEE, 2005)

Nevertheless, the construction of this massive structure brought several disadvantages. Many people from the tribes around the dam area were moved from their homeland, and several archaeological sites were flooded in the creation of Lake Nasser. Other negative impacts of this project include water loss by evaporation and the degradation of downstream river courses (Abu-Zeid & El-Shibini, 1997). Overall, however, this project was a great construction achievement and the advantages outweighed the disadvantages (Zeid, 1989).

The construction of the dam was carried out by more than 30,000 Egyptian personnel aided by few hundred experts from the Soviet Union. The Soviet role was mainly in technical assistance and supervision of the project. The Egyptians carried out most of the managerial works, logistics and support services.

The dam was a very important and urgent solution to some accumulating Egyptian problems which, if delayed, would have catastrophic impacts. First, the 1952 revolution regime introduced huge economic reform to transform the country from an agricultural to an industrial society. This reform required sources of energy and the best option at that time for the Egyptian was the hydropower. Reform would not be possible without the cheap power the AHD provided and if the project was delayed the reform would be delayed. The second problem was that before the dam Egypt was dependant on the Nile River for drinking and agricultural water. When the river's follow decreases the country suffers from drought and when the flow exceeds the limit the country suffers from flood. In both cases there were deaths and economic losses. The solution to this problem was to control the river's flow through the AHD. Any delay in constructing this dam would mean extended vulnerability to the threat of flood and drought. The consequences of these

two problems were getting worse each year because of the rapid population growth. Throughout the 1960s the population increased by more than 2.5% annually or on average 0.75million people per year (Awad & Zohry, 2005); consequently the demand for food, water, electricity ,jobs and other services increased. This rate of population growth would be unsustainable without developing new agricultural lands, producing more energy and modernizing the economy to create jobs. The solution was the AHD.

Because of these problems and the problems emerging during the project, any delay would put the country at great risk.

National crises surrounding the AHD project

In 1952, a revolution led by army officers overthrew the royal regime in Egypt and the country entered a phase of turbulent political and socioeconomic turmoil. In 1954, an ambitious leader called Gamal Abdel Nasser seized power, and in 1956, Nasser nationalized the Suez Canal, a decision that triggered the Suez Canal crisis in which Egypt was attacked by Britain, France and Israel.

In 1962, the Egyptian army engaged in a war with Yemen. That crisis is known as the North Yemen civil war and continued until 1967.

In June 1967 Israel waged a surprise attack on Egypt and destroyed almost 90% of the Egyptian armed forces. This war is known as the Six-Day War. In response to this defeat, Egypt waged a war of attrition against Israel which continued until 1970.

The impact of the crises on AHD project

This series of national crises impacted the AHD project and made it vulnerable to high probability high impact risks. If any of these threats and risks materialized the fate of the project would be a failure. First, after the Suez Canal crisis in 1956 the Egyptian assets in UK, France and USA were frozen. This, alongside increased military expenditure because of the war, squeezed the Egyptian economy and affected its ability to finance mega projects such as the AHD. Then, while the Egyptian economy still suffers from the consequences of the 1956 war and the AHD project had already begun in 1960, another burden was placed on that economy by the North Yemen civil war. The expenditure caused by the Egyptian occupation forces in Yemen, which exceeded 70 thousand troops in addition to thousands of support personnel, exhausted a sizable portion of the Egyptian economy. This made it even more difficult for the Egyptian economy to support mega projects such as AHD. Then, after the destruction of 90% of the Egyptian armed forces in 1967 war, the rearmament effort and the dedication of the whole nation to the revenge war and the liberation of occupied land placed a huge burden on the Egyptian socioeconomic system. Indeed due to the war, Egypt lost its total income from the Suez Canal and also lost much of its income from tourism, petroleum production and foreign investment. This situation would prevent the country from supporting civilian projects such as AHD and consequently put the entire project at the risk of running out of resources. Also the project and its logistics were at risk of sabotage or bombing because the country was in a continuous state of war from the beginning of the project until its completion. For example, after the 1967 war Egypt possessed very little air defense and the Egyptian skies were almost open to an enemy air force which could reach the project site and destroy it. Moreover, the supplies of project equipment from overseas such as the electricity generators and turbines were under continuous threat of sabotage by the enemies and this needed abnormal measures in the management of supply.

However, despite this series of national crises and their threats and risks, the AHD project started officially in 1960 and was completed in 1968, with the official opening taking place in 1971.

Given the difficulties of the time, the size of the dam and the engineering success in this project, this case was chosen for investigating the strategies that led to its success despite the vulnerability and pressure of the national crises, and their risks and threats.

Literature review

This study addresses a topic which is an intersection between project success and crisis management in the field of project management. The following literature review will establish the foundation for this study.

Project success concept

Project success is a popular path of study in PM research. Since the emergence of PM as a discipline in the 1950s through to the 1970s (Carayannis, Kwak, & Anbari, 2005) the concept and definition of project success has been the focus of several studies. Project success was initially defined as the completion of a project according to cost, time and quality requirements (Atkinson, 1999). From the 1980s onwards, the understanding of project success became more profound, evolving from simple definitions to complex frameworks to understand and evaluate project success (Jugdev & Müller, 2005). Belassi and Tukel (1996), for example, created a systematic framework to assess project success. Shenhar et al. (2001) introduced a multidimensional framework that captured the different meanings of success to different stakeholders.

Howsawi et al. (2011) introduced a four-level success framework which defines and assesses project success at four different levels to achieve an overall assessment (Howsawi, Eager, & Bagia, 2011). Despite agreement on the basic meaning of project success, however, the term still has a range of meanings for different stakeholders (Han et al., 2012) (Ika et al., 2011). This fact highlights the need for providing specific project success definitions for this study.

Project success factors and strategies in context

Aggregate factors or strategies contributing to project success have been presented in the literature. A thorough examination of such studies reveals that they agree upon a limited number of factors at the top of their respective lists. For example, based on a study on large construction projects in Vietnam (Nguyen, Ogunlana, & Lan, 2004), a study from the Indian construction industry (Iyer & Jha, 2006), and a third study on multiple public and private firms in multiple industries (Mishra, Dangayach, & Mittal, 2011), the top factor for success is the competency of the project manager. Contributing factors differ further down the list due to variations in the context of the specific study (Balachandra & Friar, 1997). Whether the context is a geographical location such as Brunei (Salleh, 2009), an industrial sector such as defense (Dvir, Ben-David, Sadeh, & Shenhar, 2006), or a cultural medium such as Chilean culture vs. America culture (Pereira, Cerpa, Verner, Rivas, & Procaccino, 2008) it is critical to understand the context in which project success is being investigated to reach to more realistic findings (Engwall, 2003) (Maaninen-Olsson & Müllern, 2009). Because of this, it is necessary to define the context in which this study addresses the question of project success namely; national crisis.

There is very little distinction between peacetime and a time of crisis as a context for PM in project success studies. This highlights the assumption that the results of those studies will be applicable to both contexts. Despite the difficulties that exist in a peacetime context, the changes, challenges and conditions of crisis time are very different; for example, delay or failure in peacetime is unlikely to result in military defeat, which may be a real risk in times of crisis. Also delays in post-disaster project may lead to social breakdown in families and communities (Baroudi & Rapp, 2013).
The occurrence of a crisis, such as war, or the aftermath of a huge natural disaster, is associated with sudden changes and the emergence of new realities (Kuklan, 1986). For example, war introduces

institutional changes and restructures society into a new order (Modell & Haggerty, 1991). World War 1 and World War 2 are crises that enabled women to undertake jobs such as aircraft manufacturing which were not open to women prior to these crises (Bloomfield & Bloomfield, 1997) (Littlea & Griecob, 2011). Another example of the impact of war crisis is that an employee's commitment to an organization is affected by the event of war (Messarra & Karkoulian, 2008). Higher risk and safety issues, a greater need for change, and a shorter time for decision-making are characteristics of a crisis context (Karlin, 2007) (Riley, 2006) (Shaluf, Ahmadun, & Said, 2001). All projects will face the reality of the crisis irrespective of whether the project is a response to a crisis or happened to be in the process of being executed during the crisis period.

The Meaning of a Crisis

From language point of view a crisis means "a time of intense difficulty or danger" (OxfordUniversity, 2012) or "a situation that has reached an extremely difficult or dangerous point; a time of great disagreement, uncertainty or suffering" (CambridgeUniversity, 2011). In a more technical definition, a crisis is a situation faced by an individual, group or organization which they are unable to cope with by the use of normal routine and procedures and in which stress is created by sudden change (Booth, 1993). However, the definition of crisis has proved to be somewhat problematic and debate exists within the literature about the precise meaning of the term (Smith, 2005).

The crisis is described as a period of sudden change during which a new system is formed, In fact, the meaning of a crisis includes opportunity as well as risk, uncertainty, threat, conflict, accident, and instability (Öcal, Oral, & Erdis, 2006). Crises occur across industries so the information on crises and their management includes many similarities; however, each industry responds to crises based on its norms of practice (Hällgren & Wilson, 2008). A crisis can be abrupt or cumulative. An abrupt crisis is a result of internal or external disturbances. It is generally more specific and less predictable than a cumulative one. On the other hand, a cumulative crisis can be foreseen although it also breaks suddenly (Hwang & Lichtenthal, 2000).

The crisis can have specific meaning depending on the context it is associated with, for example, economic crisis and industrial crisis. This study is concerned with national crises. A national crisis can be defined as a situation or time at which the nation faces intense difficulty, uncertainty, danger or serious threat to people, and economy. As per Smith's observation that the definition of the term is problematic this study will adhere to the definition above.

Because crises are in general unwanted events with serious consequences there is a need to deal with their impact; thus, crisis management appears.

The Crisis Management in Pm Literature

The notion of crisis management in the PM field is not frequently encountered. For example an electronic search (as of October 2013) in the database of the *International Journal of Project Management* returned 36 articles containing the term "crisis management" as opposed to 571 articles containing the term "risk management". Perhaps this is due to the newness of the introduction of the term "crisis management" in the PM field. In the late1990s the research in crisis management within the PM field was described as being in its infancy. (Loosemore, 1998). A decade later it remains a poorly addressed topic within PM research (Chartier, Banville, & Landry, 2010) (Geraldi, Lee-Kelley, & Kutsch, 2010) with few references addressing it (Crawford, Langston, & Bajracharya, 2013). However some insights can be found there.

The literature on crisis management in PM can be classified into two directions one is searching for the sources and nature of crises while the other looks to find the right strategies and techniques to deal with

such crises to increase the likelihood of success. Some articles contain findings of one direction and others contain both types of findings.

Following first direction, Loosemore (1998) identified three ironies in crisis management in construction projects. These ironies are: at a time when effective communication is important it is less likely; at a time when mutual sensitivity between project members is important it is less likely; at a time when collective responsibility and teamwork are important they are less likely (Loosemore, 1998). He stressed that crises create opportunities for increased cohesion, harmony and efficiency within project teams. Another study surveyed 120 construction companies and came up with 28 factors contributing to a project crisis some of which are inadequate government policies of human resources and sabotages (Öcal et al., 2006). Based on a comparison between routine and post-disaster project, Le Masurier et al. (2006) pointed that the legislation for routine projects is not sufficient to cope with the needs of projects during crises namely; post disaster recovery projects. They call for revised legislation for such types of project (Le Masurier, Rotimi, & Wilkinson, 2006). The recent global crises in the 2000s such as the global financial crisis 2008-09, led to a new view of crisis management in PM which is PM during times of crises (Hrůzová, 2011). This view is concerned with the impact of the external circumstances that affect the broader portion of a nation rather than the limited sector of industry. A typology to classify unexpected events in projects was offered by (Piperca & Serghei, 2012). Because crises by definition are results of unexpected events, this typology works as a classification of the origins of crises in projects. This typology is a result of the intersection of two dimensions; event predictability and locus of generation with three types under each dimension. **Error! Reference source not found.** represents this typology.

Table 1: Crisis origin classification typology (Piperca & Serghei, 2012)

Event predictability	Locus of generation		
	Internal environment	Immediate external environment	General external environment
More intense than predicted	Overrun	Setback	Swing
Predictable but unpredicted	Oversight	Knock on door	Revelation
Unpredictable	Showstopper	Mystery visitor	Shocker

The other direction in the literature reports tactics, recommendations and strategies to increase the likelihood of success. Mallak et al (1997) suggested some useful tools in preparing for crises. These tools are risk analysis, contingency plans, logic charts and table top exercises. Also they offered some recommendations to successfully manage the crisis. They encourage; establishing a crisis team before the crisis occurs, choosing a project manager indigenous the place where the project is conducted and to be mindful of the social and political consequences of the crisis (Mallak, Kurstedt, & Patzak, 1997).

Loosemore (1998) suggested some practices to resolve the three ironies he discovered; for example, paying particular attention to the financial aspects of a crisis and balancing control with flexibility in managerial strategies (Loosemore, 1998). Engwall and Svensson (2004) proposed the concept of cheetah teams for responding to the crisis (Engwall & Svensson, 2004). These teams are distinguished from other types of teams by being at the same time explicitly sanctioned, mission-specific, intended to dissolve when the mission is accomplished, staffed with full-time members and not planned in advance. Hällgren and Wilson (2008) offered 15 remedies to projects in crises based on project-as-practiced observation (Hällgren & Wilson, 2008). Their remedies include site teams to undertake overtime works and re-planning. Geraldi et al. (2010) proposed that successful crisis management is based on three pillars. These pillars are; responsive and functioning structure at the organizational level, good interpersonal relationships at the group level and competent people at the individual level (Geraldi et al., 2010). Practical application of

these pillars can increase the likelihood of success. Post disaster recovery projects are typical examples of projects in crisis times. The analysis of successful PM in crises times from three countries, China , Indonesia and Australia, showed that the two common factors for successful project resourcing in times of crises are competence of project team and government response and intervention (Chang, Wilkinson, Potangaroa, & Seville, 2012). Baroudi and Rapp (2013) suggest that to successfully manage recovery projects, organizations should be able staff their projects with capable competent teams, consider the many stakeholders involved, and particularly for project manager to build strong stakeholder relationships as well as good social awareness (Baroudi & Rapp, 2013).

All in all, the literature is characterized by having relatively few references that are scattered in several journals some of which are not specialized in PM. Some authors offered insights into the concepts while others provided practical steps. Since the concept of crisis management is new in the PM field, it is too early to have a universal framework for such concept. However, continuing to derive lessons from practice will lead to the building of a body of knowledge from which to choose in dealing with crises in PM field.

The Point of interest

As mentioned before, crisis management in PM literature addresses two directions. One is to describe the crisis and its root causes. The other is the search for techniques and methods to manage these crises. However, the focus of the previous literature is on the internal crisis when things go wrong within a project such as fire and hazardous leaks; the literature does not tell how to deal with external or contextual crises such as wars and natural disasters. There is a keen need to present knowledge in how to improve the resistance of projects against national crises: what strategies to follow to reduce the vulnerability of major projects and to improve their resilience when a national crisis is challenging them. This is the real focus of the authors. The importance of the topic of project success, the increasing frequency of crises (Buchanan & Denyer, 2012) and the impact of such contexts on projects increase the motivation to investigate the topic of success strategies in the context of national crises. This motivation is also supported by the need to present practical knowledge in the area of project success: as (Geraldi et al., 2010) said “there is a lack of studies exploring the link between practices and success”.

Research Design

In a field that is practice-driven such as PM, what constitutes acceptable knowledge is what is derived from practice. In this regard the words of the management guru Peter Drucker are fundamental. He said “What constitutes knowledge in practice is largely defined by the ends, that is, by the practice” (Drucker, 1985). This is the base of knowledge creation in this study.

The challenge in researching the AHD project is that the project was executed in the 1960s, and it is now more than 40 years since its completion. This required careful research design to capture the important lessons from such a project. The authors needed to have good awareness about the AHD project and the circumstances surrounding it, so prior to commencing this research they spent a significant amount of time learning about the AHD through different sources such as newsreels from the 1960s and visits to locations in Egypt related to the AHD or the historic context of the 1960s in Egypt.

Concepts and Definitions

Success factor vs. project strategy

The term “success factor” is a popular term in PM literature. The word “factor” means “a circumstance, fact, or influence that contributes to a result” (OxfordUniversity, 2012). It is defined by PM scholars as

"those inputs to the management system that lead directly or indirectly to the success of the project" (Cooke-Davies, 2002). The term "project strategy" is also used in PM research. The term strategy is defined as "a plan of action designed to achieve an overall aim" (OxfordUniversity, 2012). The definition of the project strategy in the PM literature is "a direction in a project that contributes to success of the project in its environment" (Artto, Kujala, Dietrich, & Martinsuo, 2008).

The authors assert, on the basis of the definitions of both terms, that the strategy is the driver to enhance or diminish a particular factor or factors. Many success factors are generic; for example, "availability of resources" and "fast response time". Thus, great importance lies in the search for strategies that will enhance success factors in any given situation or context.

On the basis of previous definitions and distinctions, the authors use the term "strategy" to describe the main findings of this study, and within each strategy they point out the factors that were supported through the application of that strategy.

Macro vs. micro project success view

There are two complementary viewpoints of project success; namely, the macro level viewpoint and the micro level viewpoint. The macro level viewpoint focuses on high level strategies that lead to success, while the micro level focuses on particular activities in relation to the project's success (Lim & Mohamed, 1999). For example, dependence on nearby sources of material is a macro level strategy for project success, while an effective procurement policy is a micro level success factor. The outcome of this research comprises macro level strategies that increase the likelihood of project success during national crisis as well as the micro level success factors supported by such strategies.

Project success concept for this study

One of the widely accepted definitions of a project is that it is a temporary endeavor undertaken to create a unique product, service or result (PMI, 2008). Since this definition suggests the uniqueness of a project, the definitions of success may mean different things to different assessors (Han et al., 2012) (Ika et al., 2011) . As a result, it is not logical to have one definition or criterion of success to fit all projects. Instead, using frameworks or models for the definition and assessment of project success is more appropriate, because they are customizable to fit particular projects (Howsawi et al., 2011).

In this paper the four-level project success framework (Howsawi, Eager, Bagia, & Niebecker, 2014a) was chosen to define, evaluate and understand project success within the context of the AHD project because this framework is highly customizable. The four-level project success framework consists of a context level, a business level, a deliverables level and a project process level.

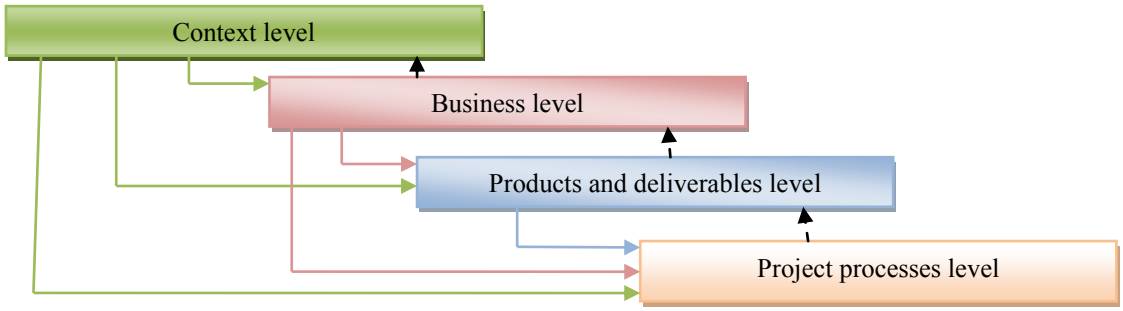

Figure 2: The four-level project success framework (Howsawi et al., 2014a)

In the four-level success framework the authors define the success at each level, and from all levels collectively they define the success of a project. Based on this, they define "success" here as satisfying the following criteria:

1. The product is delivered despite all the difficult and threatening circumstances surrounding the project
2. The advantages of the project vastly outweighed the disadvantages
3. The project provides economic benefits to the owner and good revenue to the contractors; and
4. The project provides an excellent product to the specification, within the specified time and budget.

Table **2** shows how this definition fits the AHD project.

Table 2: Fitting the definition of success to the AHD project

The level	The criteria	AHD
Context level	Delivering the desired product despite all the difficult and threatening circumstances surrounding the project	Despite all the complications of the 1960scrises, the project was completed
	The advantages of the project vastly outweigh the disadvantages	This is the judgement of many scholars concerning the AHD
Business level	Providing economic benefits to the owner and good revenue to the contractors	On completion, the AHD provided more than 50% of national electrical power, and the company which built the dam is still in business today
Deliverables level	Providing an excellent product to specification	The AHD is considered by many experts to be one of the finest engineering constructions in the world
Project process level	Providing an excellent product within the specified time and budget	The project met the time frame of 10 years and the estimated cost of one billion dollars

The Research approach

Generally speaking there are two distinct research approaches with their own characteristics. These approaches are the inductive and the deductive. However, saying that there are two approaches does not mean they cannot be mixed in a certain research; indeed it is often advantageous to do so (Saunders, Lewis, & Thornhill, 2009). One of the most important features of combining the two approaches is that it allows for gaining understanding of the overall situation of the projects under scrutiny as well as finding causal relationships between project success and the elements that caused that success. Also it allows the researcher to benefit from both qualitative and quantitative data. Moreover, combining the two approaches allows the flexibility needed for the vague part of the research and the more structured approach for the clearer part.

In order to answer the main research question the authors used an inductive–deductive approach as shown in Figure 3. The inductive approach was used at the beginning of the research and it was based on an observation followed by a derivative question from the main research question to build the proposition.

Then the deductive approach with content analysis techniques was used to extract the results that proved the proposition.

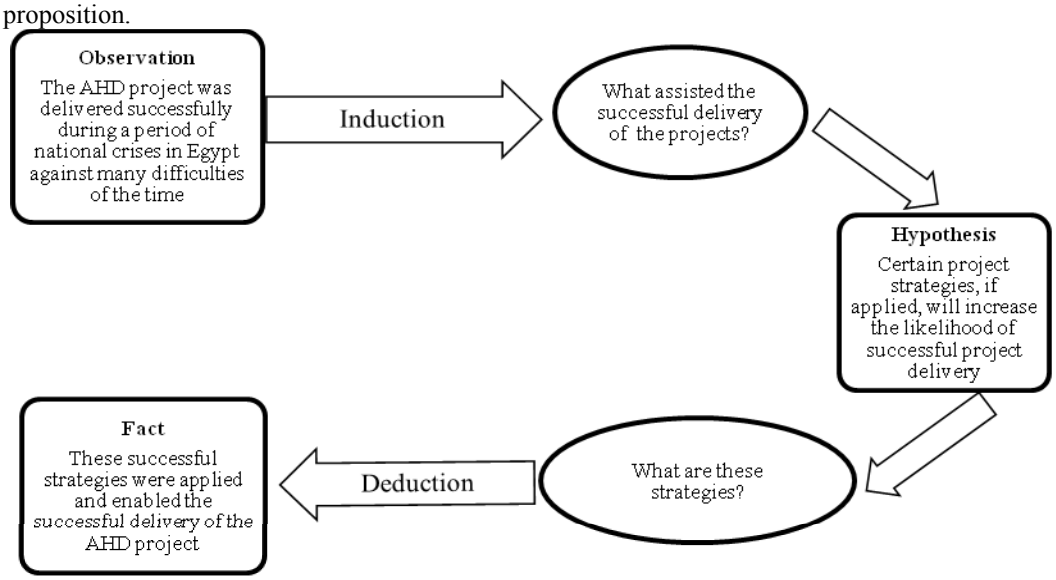

Figure 3: Inductive-deductive approach for this research

Research Data

In this study, the authors collected primary and secondary data from various sources to ensure the rigor of the research through the triangulation of the data sources. The authors were able conduct interviews with high profile engineers who held key roles in the AHD project as well as contemporary Egyptian expert project managers. These interviews were very rich and supplemented the small number of original documents available. The data of this study was collected according to the methods described below.

Veteran Interviews

The authors conducted personal interviews with high profile veteran engineers who worked in the AHD project from its early phase (since 1958) through to completion. With the help of a small local association in Egypt, the authors could identify 30 veterans. However, due to the health conditions of those old veterans and other obstacles the authors were able to interview three veterans. After the AHD project one became a high-ranking government official (a minister) while the other two continued their professional career until retirement.

Recorded interviews

The authors collected several recorded interviews with workers on the AHD project. These interviews were recorded over a period of time by different people. Ten of those interviews were found and used. All of those workers were doing ordinary labor duties such as digging, operating machines and driving trucks.

Expert interviews

The authors visited Egypt in 2012 during a time of national crisis after the 2011 revolution. Many characteristics of the national crisis context were apparent such as security issues and loss of transportation. This situation gave the expert interviewed the chance to make a good reflection on the current state of projects in Egypt and to link it to the AHD project. Eleven of the contemporary project managers in Egypt were contacted. Those interviewees fulfilled the following selection criteria: having experience in project

management, living and understanding the context and recent history of Egypt and being knowledgeable about AHD. Also all of them managed projects during the period of national crisis following the 2011 uprising and instability in Egypt. In this way, the interviewees were able to make informed comparisons between managing projects during peacetime and crisis time, while referring to the AHD project to tell what is required for success during crisis time.

The two sets of interviews (veterans and expert) consisted of open-ended questions to allow the interviewees to express their thoughts freely. The authors asked four core questions as follows:

- Do you think that the AHD project was a successful project during difficult time in Egypt and why?
- Can you elaborate on the difficulties that threatened that projects and how they threatened the project?
- What helped that project to achieve success despite these difficulties?
- How do you think the lessons learned from AHD project success can be applied to achieve the success in other projects in similar situations?

Other follow-up and clarification questions were asked throughout the interviews. The logic of the sequence of these questions was that the first question was to establish the common ground about the assessment of the project then second question was to elaborate the circumstances surrounding the project which were the national crises. After having common assessment of the project and knowledge about the project context, the third question was to discuss the strategies that led to success in the given context. The fourth question was about the reflection and the application of the results in other projects in similar situations.

Beside such sources, the authors conducted an extensive literature review about the AHD and investigated a wide array of data sources which do not have direct relationship to AHD but are necessary to understand the historical context in which the project was executed.

Data Analysis

In the research world the process that follows data collection is data analysis. It involves extracting meaningful results, conclusions and decision from the data. It is done through many techniques and procedures. Some of these techniques work with quantitative data while others work with qualitative data. Examples of these techniques include regression analysis and correlation analysis in the quantitative domain, content analysis and discourse analysis in the qualitative domain. Due to the nature of the data in this study content analysis was chosen to analyze the data.

What is content analysis?

Content analysis is a technique that has long history and is widely used in the modern research. A scholar documented the first use of this technique to the 18th century (Hsieh & Shannon, 2005) (Krippendorff, 2004).
The definition of content analysis evolved over time from a simple counting process (quantitative analysis of qualitative data) to more a comprehensive method to analyze data (Hsieh & Shannon, 2005) (Krippendorff, 2004).

One of the highly cited scholars to define content analysis is Krippendorff. He was cited more than 12,000 times in Google scholar as of October 2013. Krippendorff defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004). Another holistic definition came from Michael Quinn Patton in his book *Qualitative research & evaluation methods* which has been cited in Google scholar more than 30,000 times

as of October 2013. Patton defines content analysis as "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton, 2002).

These definitions cover the characteristics of this technique. The technique is largely used for qualitative data in verbal, visual, or written format to describe a phenomenon and its dynamics. This technique can be applied well to subjects such as PM research (Wasiak, Hicks, Newnes, Loftus, Dong, & Burrow, 2011) and engineering education (Magenheim, Nelles, Rhode, Schaper, Schubert, & Stechert, 2010).

The data analysis framework

The data for this research is mostly qualitative descriptive narrative which contains the details woven between the lines. Content analysis is a very suitable technique to be used with such data (Elo & Kyngäs, 2008; Krippendorff, 2004).

The execution of content analysis in a research project is based on the objective of that research. Some researchers aim to find trends in the data so that they may focus in counting the occurrence of certain themes. Others may aim to find answers to particular questions: in this case the frequency is not the primary target but the valid and supported inference is more suitable. This highlights the fact that there is no simple single right way to do content analysis; however, the researchers should judge what is appropriate for their problem (Weber, 1990).

In this study the data was analyzed in multiple rounds. The aim of first round was to explore the nature of the whole data and the possible categories to be identified from such data. Four main categories resulted from first round of analysis namely; 1. the *influential conditions*; 2. the *influential decisions*; 3. the *influential practices*; and 4. the *results*. The logic for choosing these categories is that the conditions (the context characteristics) induce a stakeholder to take decisions in response to these conditions. The applications of a stakeholder's decisions are practices; these practices produce results, and the results reflect on the conditions. Figure 4 illustrate the analytical framework designed for this study.

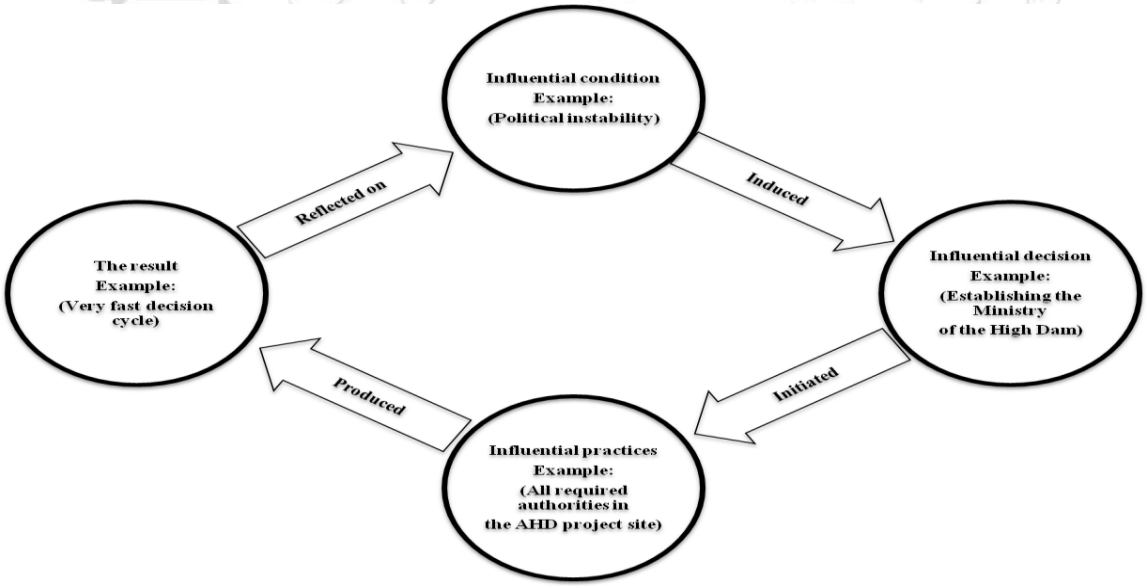

Figure 4: The analytical framework of this study

The following rounds of analysis aim to allocate the relevant content into each category.

The *influential conditions* category contains the main codes or characteristics of the context of the phenomenon being analyzed. The *influential decisions* category contains the code that represents the decisions taken by stakeholders in response to the influential conditions. The *influential practices* category includes the practices that are applied in response to the decisions taken. The *results* category contains the results generated totally or partially through the practices applied.

The success strategies resulting from this study are statements compiled based on the content of the *influential decisions* category and the *influential practices* category.

The application of the analysis framework is illustrated in Figure 4. For example, an interviewee described the onsite supervision of the Minister of High Dam as an important practice in the success of the AHD project. From other documents, it is discovered that the Ministry of High Dam was established exclusively to supervise this project. Also from another source, information about the political instability during the 1960s in Egypt was revealed, and finally, there was information that the success of the AHD supported the government. The authors established the relationship between these disparate pieces of information by placing "political instability" under the category of influential conditions. The government, which is the owner of the AHD project, responded to this instability with a decision to establish an exclusive ministry called "Ministry of High Dam" operated by a powerful minister who reported directly to the President of Egypt. This ministry brought all the required support and authorities including the minister himself, to the AHD project site. The result was a very fast decision cycle which enabled corrective action to be taken on the spot as problems occurred. This result contributed to the success of the project and this success supported the government in bringing political stability in the country.

Research trustworthiness

Reliability and validity concepts are not as clear in qualitative and mixed method research as they are in quantitative research (Golafshani, 2003). To deal with this issue in this qualitative research, the authors adopted a trustworthiness model based on the work carried out by Shenton (2004) to establish equivalent qualitative approaches to validity and reliability (Shenton, 2004). In
Table **3**, the quality dimensions are defined and the actions to establish them are detailed.

Table 3: Trustworthiness model (Shenton, 2004)

Quality dimension	Definition of the dimension	Suggested action to establish the quality dimension
Credibility	Credibility (in preference to internal validity): is about the representation adequacy of the constructions of the phenomenon under study	Triangulation of data sources
Transferability	Transferability(in preference to external validity/generalizability): is concerned with the extent to which the findings of one study can be applied to other situations	Providing background data to establish context of study and providing examples of results application in different cases
Dependability	Dependability (in preference to reliability): is concerned with the coherence of the internal process of the research, such as data collection and analysis	In-depth methodological description to allow study to be repeated
Confirmability	Confirmability (in preference to objectivity):is concerned with the extent to which the findings of the research are supported by the data collected	In-depth methodological description to allow integrity of research results to be scrutinized

Results and Discussions

This study revealed the four main strategies that were applied in the AHD project which in turn supported ten factors that led to the success of the project.
Table **4** summarizes the strategies and factors identified by this study.

Table 4: Summary of the strategies identified by this study and the success factors they supported

Strategies	Factors
1. Consolidating national interest in AHD project 2. Obtaining government support for AHD project 3. Co-locating all personnel and equipment to the AHD project site 4. Depending on nearby sources of material and workforce	1. Adequate material supply 2. Adequate work force 3. Reduced bureaucracy 4. Having priority and authority 5. Short time for assessment, decision and action 6. Having public support 7. Adequate funding 8. High morale in project team 9. Availability of appropriate expertise, knowledge and equipment as needed 10. No communication or transportation loss

The model in Figure 5 is a general influence diagram that represents the relationship between success strategies and factors in the AHD project.

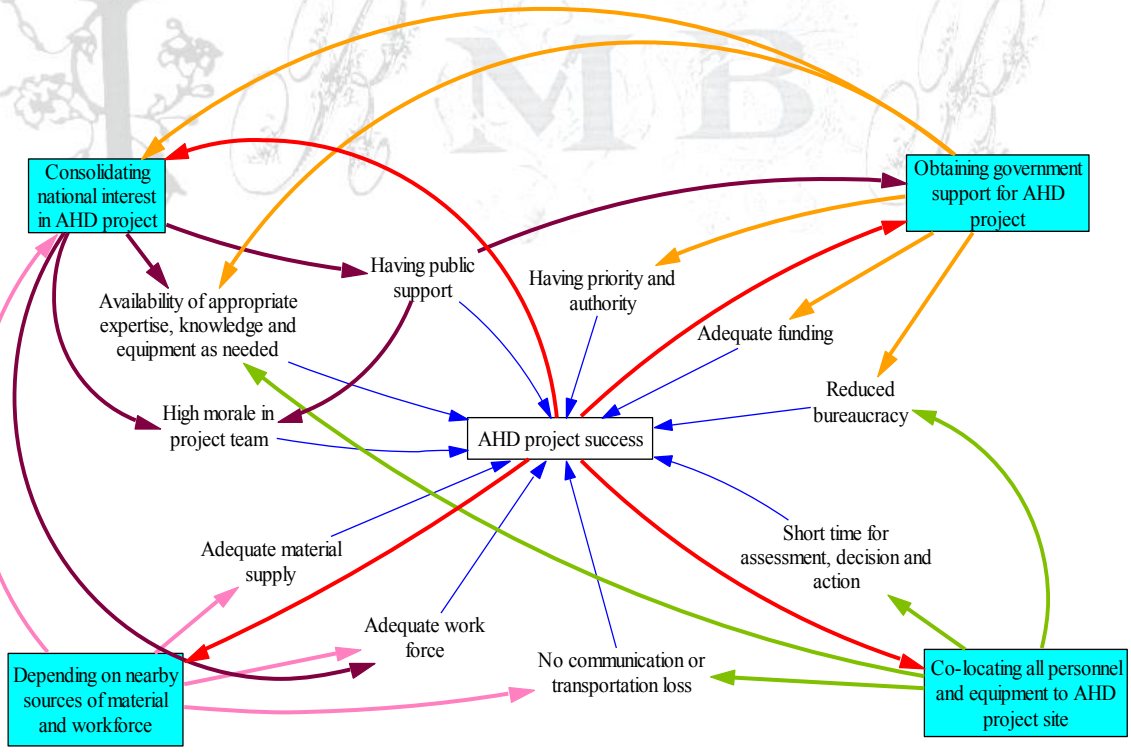

Figure 5: The success model for the AHD project

Strategy No.1: Obtaining government support for the AHD project- an exclusive ministry called the Ministry of High Dam

During times of national crisis, businesses face difficulties in obtaining required resources or permissions to work or special services. In such circumstances, there is a keen need for a strong sponsor who can obtain the required resources or permissions or special services for the project. The AHD project enjoyed the strongest sponsorship possible at that time. Unlike any other project or major endeavor at that time, a dedicated ministry called the Ministry of High Dam was created. This ministry was established exclusively to oversee all aspects of the AHD project. This has some similarity to the cheetah teams proposed by (Engwall & Svensson, 2004)

The Ministry of High Dam was authorized to take any necessary executive, financial or political decisions in relation to the project and reported directly to the President. This gave the project unprecedented priority all over the country.

Another form of government support was the security services the government provided to that project. For example, national security agencies participated in deception plans to protect the shipment of vital project components such as the turbines and generators against possible sabotage by the enemy.

Seeking a strong project sponsor is not an exclusive strategy for times of crisis; however, it is very important to seek a sponsor who can grant the project the required authorities and priorities. An example that matches with this strategy – despite the difference in industry type and geographical location – was the creation of the Ministry of Aircraft Production in the United Kingdom during WW2. This ministry was established exclusively to support the aviation industry in the production of existing aircraft or projects to develop new aircraft. It was exclusive to the crisis period and was established a few months after the war began. It was attached to another ministry three months after war ended, and was abolished eight months later. However, during the period of its operation it played a decisive role in the success of many aircraft projects (Howsawi, Eager, Bagia, & Niebecker, 2014c).

The Chilean miners rescue project in 2010 represents proof for the effectiveness of this strategy. In that project, the country's president was appointed as the topmost responsible person in the rescue endeavor and the mining minister was on site 24 hours a day, seven days a week. All the required authorities and priorities were thus brought directly to the project, which strongly supported the success of that short-term, high-impact project (Crenshaw, 2010) (Useem, Jordan, & Koljatic, 2011).

Strategy No.2: Co-locating all personnel and equipment to AHD project site

One important aspect of any project is schedule management. Faster response to incidents means a higher likelihood of the project staying on schedule. The AHD project was a monumental project, yet it was completed on time despite all the difficulties. The strategy that helped to facilitate this was the relocation of all personnel and equipment to the site. Prior to applying this strategy, the project's top management was located in Cairo, some 1000 km away, and they relied on casual visits to the project site and reports sent to them to keep abreast of progress. As a result, the project slipped more than one year behind schedule. By applying this strategy, all personnel, including the Minister of High Dam, were housed adjacent to the project site. Consequently, the response time to any incident was reduced to the minimum possible. All technical and managerial decisions were taken on the spot. For example, if any incident arose, the Minister of High Dam called for an "on the spot meeting" to assess the incident technically and make an immediate corrective decision. Having all responsible personnel on site also kept bureaucratic correspondence to a minimum, which in turn supported faster action.
This strategy is also not exclusive to the crisis context, but because during a crisis period time becomes a very pressing factor, applying such a strategy becomes critical. Also other risks associated with national

crises, such as the loss of communication and transportation affect the progress of projects but applying this strategy mitigates the negative effect of such risks.

Strategy No.3: Consolidating national interest in AHD project

One of the effects of a national crisis and the stress accompanying it, is that it draws people closer to each other (von Dawans, Fischbacher, Kirschbaum, Fehr, & Heinrichs, 2012). The Egyptian Government (as the AHD project owner) brilliantly exploited this phenomenon and used the national crisis of the 1956 war to create a national interest in the AHD project through massive propaganda. This generated enormous public support, making many of the citizens keen to help, and many bright minds in the country wanted to work on the project.

At first glance, this strategy does not look like a PM strategy. However, when the authors investigated the reasons for the high morale of that project's workers, they found that everyone believed in the AHD as his own family project. Despite the harsh work conditions, such as temperatures above 50 C˚ and poor safety, the number of workers exceeded 30 thousand and more were waiting to join the workforce. The workers often exceeded their shifts without overtime pay.

Strategy No.4: Depending on nearby sources of material and workforce

During a national crisis, the risk of transportation loss increases dramatically. For example, after Hurricane Katrina hit New Orleans in 2005, people remained trapped in evacuations centers such as the Superdome for days because the roads were totally cut off.

In managing projects during national crisis, reliance on sources of materials and workforce that require long distances transportation to the project site put the whole project at the risk of running out of resources due to transportation loss. Also the people who are not indigenous to the place may face more problems in coping with the environment or the social system.

In the AHD project, most of the workforce and the material used in the construction were from the Aswan area. This reduced the risk of transportation loss and also guaranteed an adequate supply of workforce and materials such as concrete and sand. Transporting workforce or importing materials from far away can be cheaper, but the risk will be very high and during national crisis, mitigating the risk of failure has higher priority than cost.

An example that supports this strategy comes from a British aviation project. During WW2, aluminum was the principal metal used in aircraft construction. The UK imported more than half of its aluminum requirement, which put the entire industry at risk of shortages due to the sinking of convoys by German U-boats. Instead of aluminum, the de Havilland Mosquito aircraft project used locally-produced wood, and this contributed significantly to the success of that project by allowing that project to benefit from the abundant resources available nearby.

Practice Recommendations

Based on the results found in this study, to increase the likelihood of project success during national crises, the authors recommend the following:

- Project stakeholders should obtain the strongest sponsorship available, particularly government sponsorship. The intervention of the government is reported to be decisive in solving problems that face projects during crises such as resourcing bottlenecks (Chang, Wilkinson, Potangaroa, & Seville,

2010) (Chang et al., 2012). Government sponsorship can grant the project required permissions, priorities and some special services such as security when thing around are in chaos. This can mitigate the crisis making factors mentioned by Öcal, et al. (2006) such as sabotages and government policies that act against the project.

- All project personnel and equipment should be housed in or adjacent to the project site. It is reported that crises disrupt transportation (Chang et al., 2010) (Natarajarathinam, Capar, & Narayanan, 2009). This recommendation reduces the amount of bureaucratic correspondence to increase the communication effectiveness, increasing the response time to incidents, and mitigating the risk of transportation loss. This can be a practical solution to the ironies mentioned by Loosemore (1998) "at a time when effective communication is important it is less likely" (Loosemore, 1998). Also this is a practical application of the success pillar "responsive and functioning structure at the organizational level" mentioned by Geraldi, et al. (2010).
- The project stakeholders should spend a portion of the resources to build nationwide interest in the project. This will attract various types of help to the project that are otherwise difficult to obtain directly. This will also induce more support from the government based on public support for the project. The effect of this recommendation can be seen in the Apollo program in the 1960s. The Unites State found itself lagging behind the Soviet Union in the space race after the Soviets successfully launched the first ever satellite; the Sputnik . This situation was considered " a national crisis" and it was titled as "sputnik crisis" (Kennedy, 2005). In response the United State government launched several projects one of which was the Apollo program. This project was very expensive to tax payers money yet it enjoyed huge public support because of the effort made to consolidate national consensus upon the project (Gisler & Sornette, 2009). Without that public support such a project would not have succeeded
- The project should depend on and make use of nearby sources of material and workforce to guarantee supply as required. Mallak, et al (1997) recommended that the successful management of projects in the crisis context need a project manager who is indigenous to the place (Mallak et al., 1997). Actually it is recommended that not only the project manager but other project team members are better to be indigenous to the place. They are more adapted to the environment and more sensitive to the social aspects.

The Contribution of the study

This paper contributes to the existing PM knowledge by expanding the focus of crisis management in the field of PM beyond internal project crises to include external contextual crises such as national crises. The contribution of this paper has been, in general, to solidify the concept of project management during a national crisis (Howsawi et al., 2014b) by presenting four strategies proven to increase the likelihood of project success in such a context. Because the context of a project has a significant impact upon a project (Howsawi et al., 2011) and the peacetime context is different from national crisis context, a different project management approach is needed to increase the likelihood of project success during a national crisis.

For the first time in PM literature, this study addressed the success of the AHD construction project with focus on the context of national crises surrounding the project. The significance of this is that, in a generation, there are few projects of such size and context worldwide so when they occur there is no time for learning from trial and error. The costs and consequences of trial and error in such projects are very high, so there is a need for understanding the proven strategies of success and presenting them for the benefit of current and future projects in similar context. The results of this study are building blocks in understanding how to deliver projects successfully during national crises. The strategies presented by this study improve the immunity of project against the impacts of national crises.
Moreover, this study strengthens previous research findings related to project success during national crises. Previous studies suggested strategies to increase the likelihood of mega project success during a

national crisis. For example, Kwak et al.(2014) revealed that federal government support was a key factor for the success of the Hoover Dam project during the national crisis of the great depression in the 1930s in the United States (Kwak, Walewski, Sleeper, & Sadatsafavi, 2014). The results of this study support the findings of other t case studies such as that of the Hoover Dam. This mutual support between different studies makes the results more generalizable to the context of national crisis rather than individual project cases.

Also it is widely acknowledged that national crises promote some social changes. The results of this study show how a project can benefit from this social change. It is very useful to utilize of the phenomenon of emerging collaboration attituded between people during national crisis (Rodríguez, Trainor, & Quarantelli, 2006) (von Dawans et al., 2012) as this phenomenon can be turned into valuable resources and support for the project.

The contribution of this study is particularly important nowadays because of the increasing frequency and scale of national crises worldwide.

Limitations of the study

The theme of this study – delivering successful projects during national crises – is relatively rare in the PM literature. The case study of a huge construction project, the AHD, formed the basis for the results of this study.

The research was limited to a macro view of project success during national crisis. This means that the results are top level strategies. The investigation of micro level details of success factors during national crises was not attempted in this research, and this level of investigation is needed to expand the knowledge about successful project delivery during national crises.

The research is based on one case study which, while big enough to constitute a case study, still represents only one type of industry - construction. There has been some reference to other industries and cases but more case studies are necessary to reach an acceptable level of generalizability.
The results of this research are based on the data available, and because the AHD was such a huge project, it is anticipated that more results could be obtained if more data were made available. However, the results of the research identified the most important strategies and factors and support the claim that they contributed significantly to the success of the AHD.

Meanwhile, the authors are designing a framework for success during national crises based on this case and other cases. So far, there is a great deal of similarity between the results, despite differences in industry type, geographical location and socioeconomic system.
The results of this study might be applicable to other cases, although it is not necessary for all strategies to be applied simultaneously. Suitable strategies should be employed as needed.

Conclusion

This research has investigated the reasons behind the successful delivery of projects during national crises. With the increased occurrence of national crises, there is a correspondingly greater need to understand how to deliver projects successfully. Based on the case of the AHD project, this research has revealed several effective strategies and factors, such as obtaining government support and having short decision-making times. The results have limited generalizability because of the limited number of cases involved in this research, and more research is needed to enhance generalizability. Nevertheless, this research forms a very sound foundation for understanding the successful delivery of projects during national crises.

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A Success Model for Project Management During National Crises

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Abstract

In project management, success is the ultimate goal. Success requires appropriate tools and techniques. Given the multi-dimensions of uniqueness in projects, success tools and techniques should be customized to suit a particular project or a set of closely related projects. In this paper the national crisis was selected as the context in which project success is sought. After reviewing the notion of project context, success factors and project strategy, the authors provided a theoretical explanation and a generic model of the relationship between project strategy, success factors and project success. Following this explanation, the authors analyzed a set of 24 cases from the British aviation industry that occurred during the crisis of World War 2. Based on the results of such analysis, the authors created a success model containing the strategies and success factors needed for successful project management in such a context. The authors then analyzed another case that is different from the first set of 24 cases. The model was validated and refined based on the second case. The authors then showed the application of the model on other cases unrelated to the previous ones. The authors concluded with remarks about the importance, contribution, implication and limitations of this study.

Key Words: *Project Management, Project Success, National Crisis, Success Strategy, Success Factor*.

Introduction

Project management as a discipline emerged in the middle of the 20th century to enhance the chances of successful delivery of complex projects (Johnson, 2013). Since then, the research about project success has not stopped. This paper fits into this theme of project management research.

Project success is very popular theme in the area of project management research. It has been addressed under many sub-themes such as success factors (Müller & Jugdev, 2012), success criteria (Wai *et al.*, 2012), success definition (Van Niekerk & Steyn, 2011) and success frameworks (Howsawi *et al.*, 2011). These sub-themes are often coupled with a certain context such as the industry type, the geographical location or the cultural medium. The context, or in other words, the environment and circumstances of a project can influence the aspects of project success such as the success factors and strategies (Balachandra & Friar, 1997; Engwall, 2003; Maaninen-Olsson & Müllern, 2009). Different contexts may have different effects; consequently, the aspects of project success may differ from one context to another (Balachandra & Friar, 1997). For example, competent project manager is a common project success factor (Pinto & Slevin, 1987). However, in the construction industry it is necessary to have a physically capable construction project manager because this type of projects needs many on-site movements; while in a software project, a project manager with a mobility limitation can perform well because this type of industry does not require a lot of movement.

There are a wide variety of possible contexts for projects. **Table 1** presents examples of such contexts from project management literature.

Table 1: Examples of research articles with context focus

The research topic	**The context**
Studying the challenges of project management in public sector (Waddell, 2010)	Ownership type: Public vs. Private
The cultural barriers to the use of western project management in Chinese enterprises (Wang & Liu, 2007)	Culture: Western vs. Chinese
Critical managerial factors affecting defence projects (Dvir *et al.*, 2006)	Industry type: Defence
Analysis of factors critical to construction project success in Malaysia (Yong & Mustaffa, 2012) A study on project success factors in large construction projects in Vietnam (Nguyen *et al.*, 2004)	Industry type: Construction Geographical locations: Malaysia +Vietnam

Among these contexts is the context of national crises. Managing projects in such a context may require different approach from that of peacetime (Howsawi *et al.*, 2014c). However, until now the knowledge about project management during national crises has been very limited (Hrůzová & Thornton, 2011). One of the first definitions of project management during national crises was proposed by Howsawi *et al.* (2014c) as "the application of knowledge, skills and techniques to execute and deliver projects effectively and efficiently in a situation or time at which a nation faces intense difficulty, uncertainty, danger or serious threat to people and national systems and organizations and a need for non-routine rules and procedures emerge accompanied with urgency". The newness of this concept encourages research on project success in this context; that is project success during national crises.

When success happens once in a national crisis context, the factors or strategies that led to success in that context can be extracted from that particular case. However, when the success is repeated in different cases of similar contexts then the search can be for the pattern or the model that enables the repetition of that success. Based on that, the objective of this paper is to develop a qualitative generic success model that can be applied to managing projects during national crises so the chances of successful delivery of those projects will increase. This objective will be achieved using multiple case studies for the creation and the validation of the model.

The topic of this paper draws its importance from the fact that national crises are more prevalent now than ever before in terms of severity and frequency. For example, the frequency of financial crises has doubled

since the 1970s (Bordo *et al.*, 2001). Also, the frequency and severity of natural disasters is also rising (Degg, 1992; Gurenko & Dumitru, 2009). In 2011 five incidents of civil unrest broke out in five Middle Eastern countries three, of which are neighbours. These are real national crises that the authors witnessed one of them during a visit to Egypt in 2012. These crises resulted in thousands of deaths, lack of security, economic recession and regime overthrow.
Despite the odds of national crises, projects continue to be initiated and implemented. Consequently, there is a need for the knowledge about how to succeed during national crises and this is the rationale of this paper.

Research Design

The field of project management is a learning discipline that benefits from the past experiences and what are believed to be best practices (Atkinson, 1999). Since the discipline is practice-based, the knowledge creation should also be conceived as practice-derived. In this regard, management expert Drucker said "What constitutes knowledge in practice is largely defined by the ends, that is, by the practice" (Drucker, 1985). This philosophy is the fundamental, theoretical base of knowledge creation in this paper.

In applying this philosophy, the authors firstly analyzed a portfolio of case studies consisting of 24 aircraft projects from the British aviation industry during the national crisis of World War 2 (WW2)(Howsawi *et al.*, 2014d). The resulting success strategies and their dynamics form the foundation for creating the initial success model for project management during national crises. Secondly, the authors analyzed a case study of a project in a national crisis setting, but with significant differences as shown in Table 2. This second case study is the construction of the Aswan High Dam in Egypt during the national crises of the 1960s (Howsawi *et al.*, 2014a). This second case study works as a validation case for the initial model created after the first portfolio of case studies from the British aviation industry. Necessary re-wording might be done on some titles of the initial model.

Table 2: The differences between the main two stages of case studies of this paper

	The first portfolio of case studies (The British aviation projects)	**The second case study (The AHD project)**
The context	National crisis	National crisis
The type of the national crisis	War	War
Number of projects included in the analysis	24 small projects	Single mega project
The industry	Aviation – aircraft	Construction- dam
The cultural surrounding	English- European-Industrialized nation	Arab- Middle Eastern-Agricultural nation
The political regime	Democratic	Military
The geographical location	UK-Europe	Egypt- Middle East
The time period	1940s	1960s

Thirdly after the validation of the model, the authors discuss the model with reference to several cases different from those used in the creation and validation of the model. The basic premise of these three stages is that if the model can fit the three very different stages, then it is a valid model.

Project Success, success Factors and success strategies: Definition and Relationship

There is no single universal definition for project success. Rather, success is specifically defined for each project or closely related projects (Howsawi *et al.*, 2014b). Whatever the definition is, there must be some

causes or elements that caused that success. Many studies about project success use the term "success factor" to describe the contributing element in the success of a given project. The word "factor" means "a circumstance, fact, or influence that contributes to a result" (OxfordUniversity, 2012). It is defined by project management scholars as "those inputs to the management system that lead directly or indirectly to the success of the project" (Cooke-Davies, 2002). Also is defined as " the elements of a project which, when influenced, increase the likelihood of success" (Müller & Jugdev, 2012).

The literature of project management contains many lists of success factors. These lists are often called critical success factors (CSFs). Table 3 below presents some of these lists.

Table 3: Selected critical success factor lists

Author	CSFs
(Nguyen, *et al.*, 2004)	1. Competent project manager 2. Adequate funding until project completion 3. Multidisciplinary competent project team 4. Commitment to the project 5. Availability of resources
(Iyer & Jha, 2006)	1. Project manager's competence 2. Top management support 3. Monitoring and feedback 4. Favourable working conditions 5. Commitment of all project participants 6. Owner's competence 7. Interaction between project participants 8. Good coordination among project participants 9. Availability of trained resources 10. Regular budget update
(Jo & Barry, 2008)	1. Projects are designed in accordance with government objectives 2. A trained and experienced project manager is required for project success 3. Stakeholder involvement is important for project success 4. Full-time project managers are required in order to ensure project success 5. The availability of technical experts to implement projects is important for project success 6. Political support is an important factor to ensure successful project implementation 7. Lack of funding to complete projects is the main factor that hampers project success 8. Timely payment to the client is important for successful project completion 9. A regular progress meeting on projects, to ensure that implementation is progressing according to plan 10. Detailed planning of projects, according to which projects are measured during implementation 11. Holding of close-out meetings at the end of projects, in order to capture lessons learned 12. The lessons learned during close-out meetings are used to improve future projects
(Yu & Kwon, 2011)	1. Minimization of conflict between stakeholders 2. Optimization of legal and administrative services 3. Standardization of decision making process 4. Good communication and information sharing 5. Reasonability of project master and implementation plans 6. Suitability of project management system 7. Establishment of appropriate organizational structure

	8. Cooperativeness of stakeholders on project 9. Performance management at each phase 10. Balanced adjustment between the public and the private interests
(Yong & Mustaffa, 2012)	1. Financial capability 2. Control of subcontractors' works 3. Cooperation in solving problems 4. Competence 5. Commitment 6. Skilful workers 7. Adequacy of design details and specifications 8. Industry-related issues (availability of resources) 9. Communication among project stakeholders 10. Involvement to monitor the project progress 11. Effective allocation of man power 12. Shared authority and responsibility between the clients, consultants and contractors 13. Nature (weather conditions)

These lists keep evolving and there is no consensus upon them. However, different lists agree upon several individual CSF despite the different contexts of the studies such as different geographical location or different ownership type; public or private (Chan *et al.*, 2004; Dvir *et al.*, 1998; Fortune & White, 2006). For example, a study on large construction projects in Vietnam (Nguyen*, et al.*, 2004), a study from Indian construction industry (Iyer & Jha, 2006), a third study about the success factors in government owned projects (Jo & Barry, 2008) and a fourth on multiple public and private firms in multiple industries (Mishra *et al.*, 2011) all agree that the first or second most important factor for success is the competency of the project manager. This highlights the fact that several success factors are generic or common but can be tailored to fit a specific project. For example "competent project manager" is a common success factor. It can be customized by adding industry and culture dimensions so it becomes "competent IT project manager in Chinese enterprises". This example leads to the next fact that projects (and consequently their success factors) are not isolated islands (Engwall, 2003). They are necessarily linked to several elements such as their environment or stakeholders or parent organization (Besner & Hobbs, 2008). For example "availability of resources" is an essential success factor mentioned in many studies. This factor was influenced by other elements at higher level. For example, the control of raw materials in United Kingdom by the British government during WW2 significantly affected the availability of resources to many projects (Backman & Fishman, 1941). This example shows how a contextual or environmental element affects an essential project success factor. Based on this fact the authors assume that success factors are dependent variables that are affected by "something" at higher level. We may at this point call that "something" a strategy.

The concept of strategy is probably as old as the early writing about the art of war. This concept was initiated in the military arena then it found its way to other fields of science (Patanakul & Shenhar, 2012). The linguistic meaning of strategy is "a plan of action designed to achieve an overall aim" (OxfordUniversity, 2012).

In the project management arena the term "project strategy" is relatively new (Patanakul *et al.*, 2012). There are several definitions for project strategy in the project management literature. It is defined as "a direction in a project that contributes to success of the project in its environment" (Artto *et al.*, 2008). Also it is defined as "The project perspective, position, and guidelines for what to do and how to do it, to achieve the highest competitive advantage and the best value from the project" (Patanakul & Shenhar, 2012; Poli & Shenhar, 2003). Other attempts to define the project strategy such as (Poli, 2006; Yang, 2012; Zhiye *et al.*, 2009) all used one of the mentioned definitions. Apparently both definitions are similar with more elaboration in the second one.

On the basis of the definitions of the terms, "project strategy" and "project success factors", the authors assert that the strategy is a higher-level driver to enhance or diminish a particular factor or factors. The project strategy should be well-formulated at the beginning of the project as it holds significant importance in the success of or failure of a project (Anderson & Merna, 2003). Using a general influence diagram, Figure 1 illustrates the strategy-factor relationship in regards to project success.

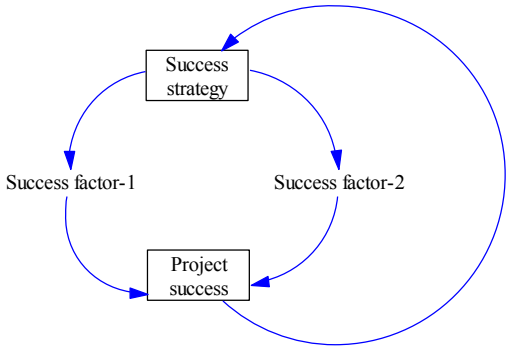

Figure 1: Basic project success-factor-strategy relationship model

The success strategy enhances the success factor which in turn increases the likelihood of project success. When a project succeeds, this success supports the strategy and endorses its correctness. In reality there are multiple strategies that can be applied simultaneously in a project. These strategies can have mutual impact upon each other. Also the factor can be supported by more than one strategy. This leads to more a complex model to describe the strategy-factor relationship to project success as shown in Figure2.

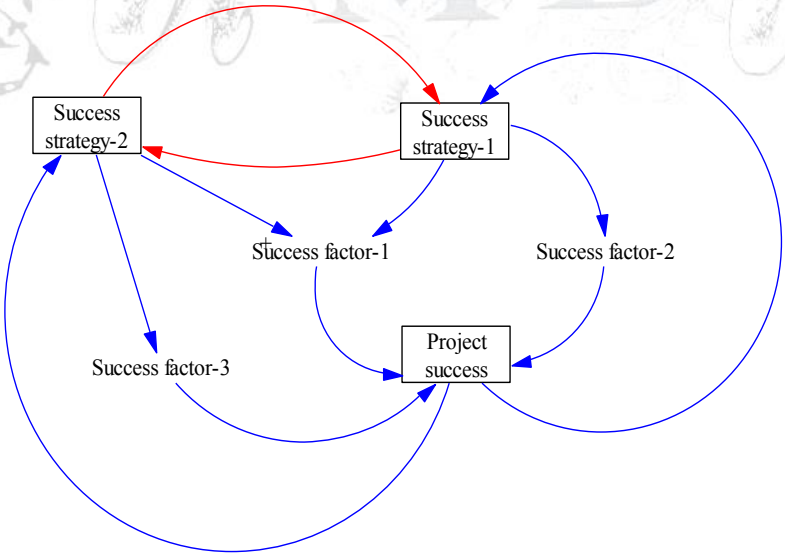

Figure 2: Multiple-link project success-factor-strategy relationship model

The complexity of the model increases by increasing the number of strategies included, the number of factors included and the number of relationships between each factor and the supporting strategies. This complexity is illustrated in Figure 3. For abbreviation, the authors will call this model the "generic success model".

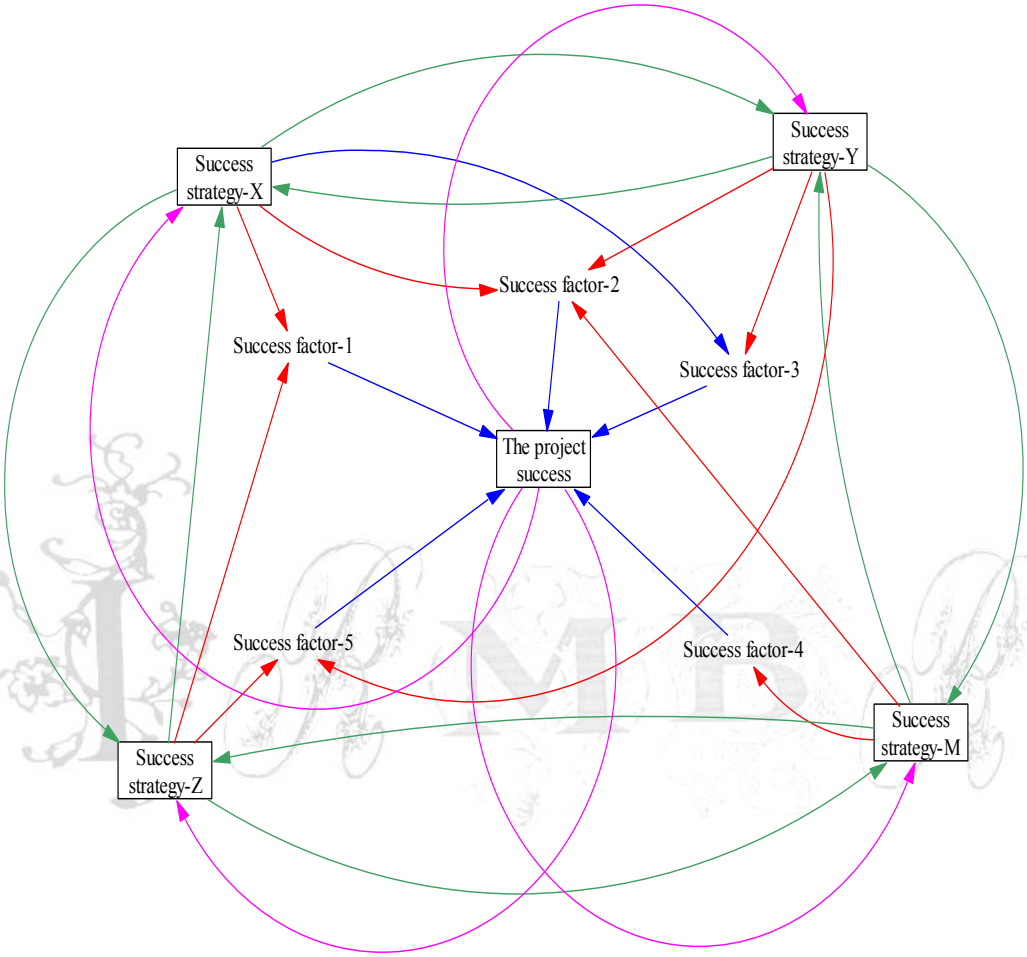

Figure 3: Generic success model

Figure 3 depicts the generic success model that describes the relationship between project success, success factor and success strategy.

Effective strategies for Successful Project Management during WW2 in the British aviation industry

The first stage of this research comprises an investigation of the successes of British aviation projects during the crisis of WW2.

WW2 was a global crisis that affected the whole British socioeconomic system. The characteristics of a national crisis as a context of project management which was mentioned by Howsawi *et al.* (2014c) materialized in this crisis as follows:

- **Government intervention:** The British Government intervened in all aspects of the British socioeconomic system such as material supply and employment, even in private firms (Backman & Fishman, 1941; Murphy, 1942). The British Government gave special support to the aviation industry.
- **Emerging threats and opportunities:** Threats such as bombing and sabotage disturbed industries. These threats prevented workers from reaching their work site and destroyed the work site itself killing or wounding workers.
- **Urgency:** Many projects needed to be delivered urgently because the changing situation might render a product obsolete if it was delayed.
- **Resources and supply disturbanc**e: The UK is a group of islands dependent to a large degree on imports of raw material (Edgerton, 2011). The Nazi occupation of Europe and the sinking of convoys caused a shortage of raw material.
- **Uncertainty:** During WW2, the citizens and industries in the UK were uncertain as to when a bombing raid would occur and the potential consequences of that raid. The designers of many projects were uncertain about final specifications because of the rapidly changing tactical situation.

Despite the impact of this crisis, the British aviation project could deliver many successful projects. The authors investigated a portfolio of case studies consisting of 24 projects shown in Table 4.

Table 4: Case studies in the first stage of this research

	Aircraft name		Aircraft name		Aircraft name
1	de Havilland Mosquito	9	Fairey Firefly	17	Bristol Brigand
2	Avro Lancaster	10	Hawker Tempest	18	Bristol Buckingham
3	Handley Page Halifax	11	Hawker Sea Fury	19	Westland Welkin
4	Bristol Beaufighter	12	Avro Lincoln	20	Supermarine Spiteful
5	Hawker Typhoon	13	Fairey Fulmar	21	Hawker Tornado
6	Fairey Barracuda	14	de Havilland Hornet	22	Vickers Windsor
7	Short Stirling	15	Avro Manchester	23	Miles M.20
8	Armstrong Whitworth Whitley	16	Blackburn Firebrand	24	Supermarine Type 322

The data on these cases studies was compiled from several resources such as original documents and recorded interviews with WW2 industry veterans. The data was obtained from sources such as the National Archives; The UK Government's official archive, the Imperial War Museum in London and the Royal Air Force Museum in London. Also, the video data was used as an innovative and effective way to understand the context of WW2 in general and the aviation industry then in particular (Howsawi *et al.*, 2014e).

The data was analysed using content analysis technique. The analysis revealed six strategies effective in delivering successful projects during a time of crisis. Table 5 summarizes these strategies and nine common success factors supported by these strategies. These factors are common success factors mentioned in the literature of project management. Each factor appeared in many studies; at least three references are mentioned here for each factor. There might be a little paraphrasing in the factors but the meaning is exactly the same as that intended by the original authors.

Table 5: Summary of the success strategies based on first set of case studies

Success strategies resulting from this study	Success factors considered in this study	References from which the success factors extracted
1. Obtaining Government support. A dedicated ministry for aircraft production. 2. Depending on nearby alternative material and workforce 3. Consolidating interagency collaboration 4. Applying a common platform strategy in new product development projects 5. Implementing the strategy of simultaneous development and testing of subsystems. 6. Incorporating versatility in the product design	Adequate material supply	(Pinto & Slevin, 1987); (Belassi & Tukel, 1996); (Nguyen, *et al.*, 2004) (Fortune & White, 2006)
	Adequate work force (includes competent, committed, motivated project manager and team members as well as sufficient staff)	(Pinto & Slevin, 1987); (de Wit, 1988); (Belassi & Tukel, 1996) (Gemuenden & Lechler, 1997) (Chua & Kog, 1999); (Chan *et al.*, 2001);(Dvir, *et al.*, 2006);(Fortune & White, 2006);(Salleh, 2009);(Yong & Mustaffa, 2012);(Kwak *et al.*, 2014)
	Reduced bureaucracy	(Pinto & Slevin, 1987);(Pinto & Prescott, 1988);(Nguyen, *et al.*, 2004)
	Having priority and authority	(Pinto & Slevin, 1987);(Pinto & Prescott, 1988);(Belassi & Tukel, 1996);(Gemuenden & Lechler, 1997) (Nguyen, *et al.*, 2004);(Fortune & White, 2006);(Yong & Mustaffa, 2012);(Kwak, *et al.*, 2014)
	Short time for assessment and rework	(Pinto & Prescott, 1988);(Fortune & White, 2006);(Ika *et al.*, 2011) (Yong & Mustaffa, 2012)
	Adequate funding	(Chua & Kog, 1999);(Nguyen, *et al.*, 2004);(Dvir, *et al.*, 2006);(Fortune & White, 2006);(Kog & Loh, 2012) (Yong & Mustaffa, 2012);(Kwak, *et al.*, 2014)
	Having appropriate expertise, knowledge and equipment as needed	(Pinto & Prescott, 1988);(Nguyen, *et al.*, 2004);(Dvir, *et al.*, 2006);(Fortune & White, 2006);(Jo & Barry, 2008)
	No communication or transportation loss	(Pinto & Slevin, 1987);(Gemuenden & Lechler, 1997);(Nguyen, *et al.*, 2004) (Dvir, *et al.*, 2006);(Kwak, *et al.*, 2014)
	Having public support	(Nguyen, *et al.*, 2004); (Kennedy, 2005) ; (Jo & Barry, 2008) ; (Ika, *et al.*, 2011); (Yu & Kwon, 2011) (Yong & Mustaffa, 2012)

Putting these strategies and factors into the generic success model illustrated in Figure3 resulted in the specific model for the case of the British aviation industry during WW2 as shown in Figure 4.

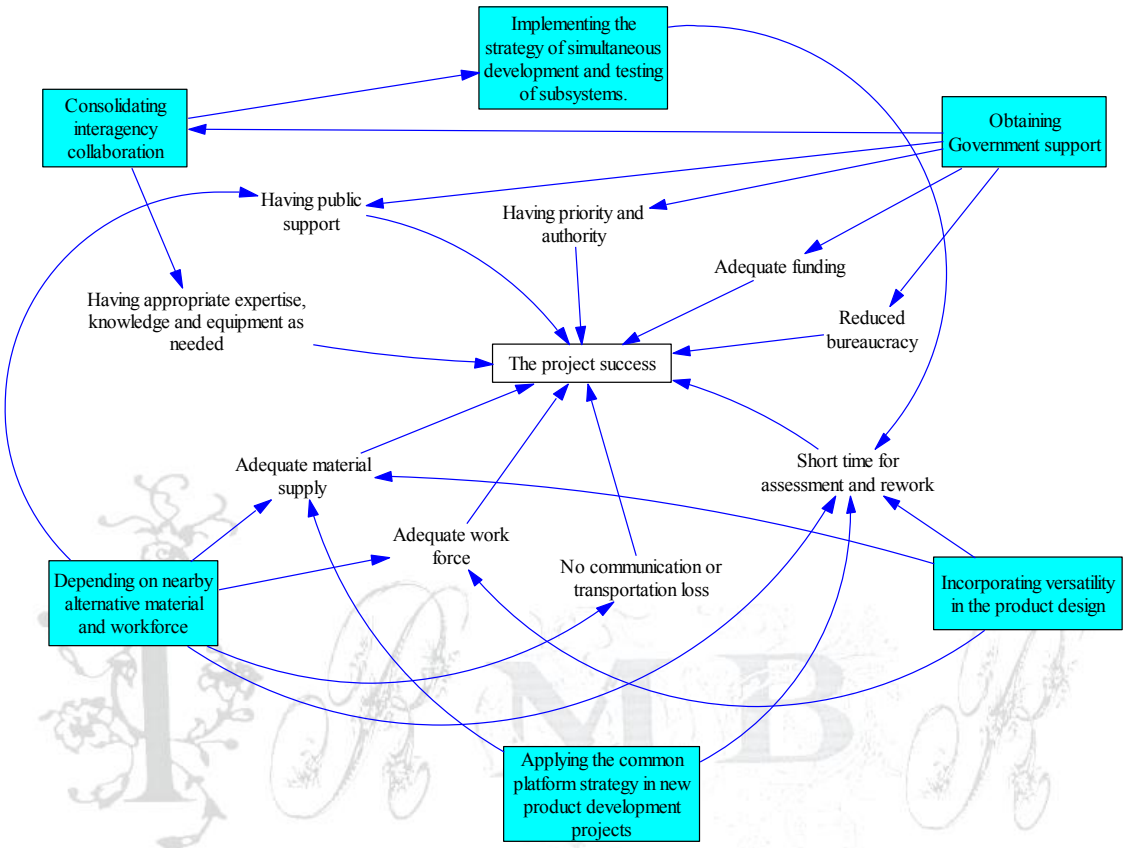

Figure 4: Specific success model for British aviation projects during WW2 (Howsawi, *et al.*, 2014d)

The following is a summary of the strategies implemented by the British aviation industry. A more detailed discussion is available in (Howsawi, *et al.*, 2014d).

Strategy No.1: Obtaining government support: a dedicated ministry for aircraft production.

During times of crisis such as in the UK during WW2, businesses face difficulties in obtaining required resources, work permissions or special services. In such a situation, government support is an essential success ingredient. The aviation industry enjoyed the privilege of having a dedicated ministry called the Ministry of Aircraft Production to exclusively support aviation projects. The impact of this ministry was that the obstacles hindering aircraft projects were discussed at Cabinet level. Decisions made by the War Cabinet were translated into priority for aircraft projects in terms of resources. Also government support took the form of security services provision. This was essential because during national crises new types of threats emerged (such as sabotage) which exceeds the capacity of normal business firms to handle (Howsawi, *et al.*, 2014c). For example, national security agencies provided deception plans and camouflage to disguise projects sites and production facilities against air raids.

Strategy No. 2: Depending on nearby alternative material and workforce

During national crises the disturbance of supplies, transportation loss and the shortage of skilled labour increases dramatically (Howsawi, *et al.*, 2014c) so that reliance on sources of materials and workforce that require long distance transportation to the project site, put the whole project at risk of running out of resources. Some projects avoided this condition and succeeded; for example, the de Havilland Mosquito project. This project succeeded because of the dependence on nearby alternative material and workforce. The project used wood instead of aluminium. The wood supply was plentiful and available within Britain (Edgerton, 2011) unlike aluminium, of which more than half was imported (Weir, 2009). Also, by using wood, the project benefited from the availability of skillful carpenters.

Strategy No. 3: Consolidating interagency collaboration

In the course of managing a project, there might be phases that require information, knowledge or technologies that are not in-house; for example, the results of the research and development phase of a product component. In peacetime, companies usually retain their information, knowledge and technology especially the secrets of their R&D as competitive advantage, and may refuse to collaborate with rivals no matter what the immediate financial benefits might be.

In the UK during WW2, interagency collaboration was well-practiced, and that helped to reduce the development time. This collaboration was ordered and enforced by the government. There were many government orders to companies to share the results of their R&D or their facilities with other companies (peacetime rivals) to reduce development time.

Strategy No. 4: Applying the common platform strategy in new product development projects: the conservative approach.

National crisis brings about greater uncertainty (Howsawi, *et al.*, 2014c) and there is need for uncertainty reduction strategy.

In the UK during WW2 when a project to develop an aircraft was initiated, the project design team followed one of two approaches:

1. Designing an airframe around an existing and fully operationally tested engine. The authors call this the conservative approach; or
2. Designing an airframe based on a perceived engine where the engine was at either the specification stage or factory test stage but was not in full operational use. The authors call this the pioneering approach.

All projects in this research which achieved more than 500 units of production were the result of projects that followed the conservative approach; that is 13 out of 24 projects. On the other hand, some of the unsuccessful aircraft which scored less than 250 units of production followed a pioneering approach; namely, the Avro Manchester and Hawker Tornado projects. For example, the Avro Manchester failed because the Vulture engine was under development when the aircraft was designed. The same design was later modified to accommodate the Merlin engine, which was fully operational, and the result was the Avro Lancaster, which was one of the most successful bombers in British aviation history.

Following a conservative approach reduces the uncertainty that might result from using new, untried complex components in a new product development project.

Strategy No. 5: Implementing the strategy of simultaneous development and testing of subsystems

During national crisis, time is among the top pressing factors (Howsawi, *et al.*, 2014c). Things need to be done quickly otherwise the rapidly changing circumstances may bring unwanted surprises. This was the case during WW2; the urgency to produce weapons was a pressing condition for British industries. To deal with this condition, the British aviation industry adopted a strategy of simultaneous development and testing of subsystems to reduce the overall development time. In applying this strategy, they developed and tested the subsystems of an intended aircraft on multiple experimental aircraft before assembling them all in the intended airframe.

Strategy No. 6: Incorporating versatility in product design

During times of crisis, requirements change rapidly leading to many changes in the product specifications. The versatile product strategy helped some WW2 British aviation projects to neutralize the impact of changing requirements. For example, the de Havilland Mosquito and the Avro Lancaster were easy to modify to serve new roles. This feature considerably reduced the response time needed for changing requirements.

An initial generic success model for project management during national crises

The model presented Figure 4 is a particular model for the British aviation cases. Some re-writing is needed to make the model generic. The strategy *Obtaining government support* is general so that no need for re-writing. The strategies *Applying a common platform strategy in new product development, Incorporating versatility in the product design* and *Implementing the strategy of simultaneous development and testing of subsystems* are components of what is known now as "concurrent engineering". For example the *Journal of Concurrent Engineering Research and Application* contains many article that address topics similar to these strategies. Also, concurrent engineering advocates for strong communication and information sharing (Pardessus, 2004) and multiple expertise or cross functional teams in projects (Smith, 1997).

Table 6: Re-writing the success factors

Success factors as mentioned above	Reworded success factors
Adequate material supply	Adequate material supply
Adequate work force (includes competent, committed, motivated project manager and team members as well as sufficient staff)	Adequate work force
Reduced bureaucracy	Reduced bureaucracy
Having priority and authority	Having priority and authority
Short time for assessment and rework	Timely response to incidents and change
Adequate funding	Adequate funding
Having appropriate expertise, knowledge and equipment as needed	Availability of appropriate expertise, knowledge and equipment as needed
No communication or transportation loss	Efficient communication and transportation
Having public support	Sufficient public support

Because of that the authors combined these strategies under the title *Adopting concurrent engineering.* This will be more compatible with the terminology of modern research and also the readers will easily know

which literature they should review for more knowledge about this strategy. The strategy *Consolidating interagency collaboration* is actually a specific form of collaboration which is a subtype of national collaboration. This collaboration can be between agencies, professionals or the general public. It is a matter of having the nation interested in and committed to supporting the project. Thus, this strategy will be re-written as *Consolidating national interest and collaboration for the project*. The strategy *Depending on nearby and alternative material and workforce* is about making the best possible use of the material available in the area of the project and also about having the personnel either from the area or in the area of the project. The material may not necessarily be alternative; it could be the main type and yet be available nearby. Thus, this strategy will be re-written as *Depending on nearby material and workforce*.
Also the success factors will be re-written as in Table 6 for the sake of better wording.

Figure 5 represents the generic success model for project management during national crises.

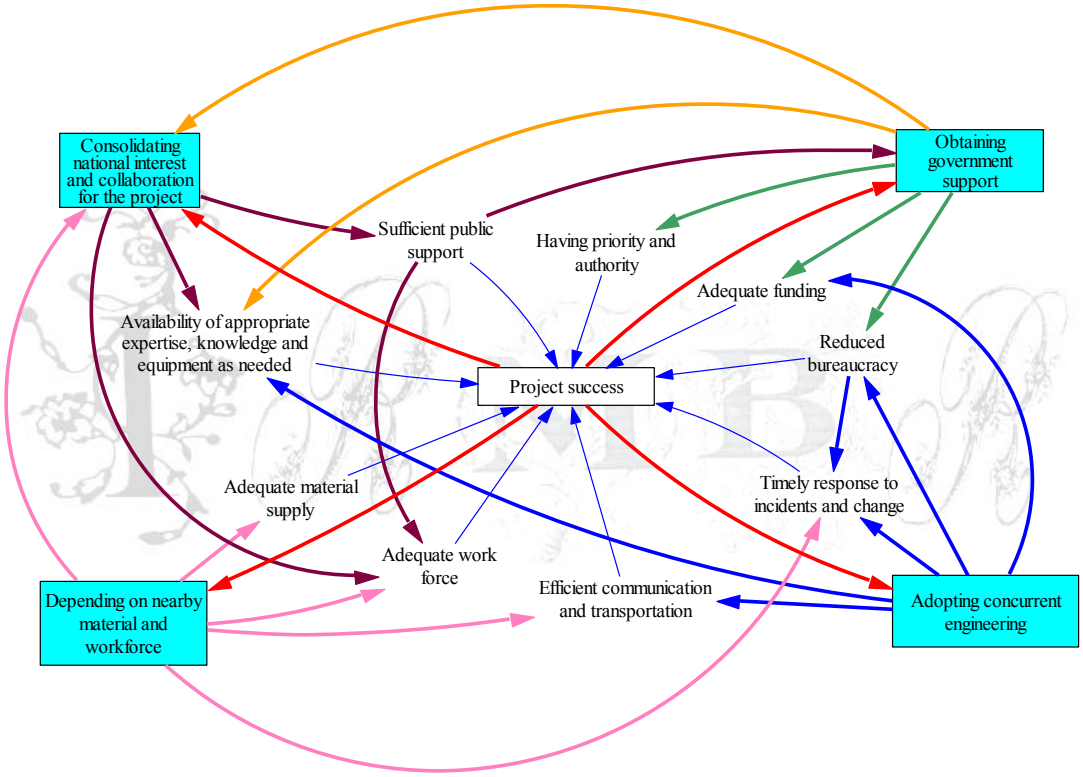

Figure 5: Generic success model for project management during national crises

Effective strategies for successful project management during the 1960s crises in Egypt

The second stage of this research comprises an investigation of the success of the construction of the Aswan High Dam (AHD) in Egypt during a series of national crises in the 1960s (Howsawi, *et al.*, 2014a).That era involved many national crises such as the North Yemen civil war, the Six-Day War and the war of attrition.
This series of national crises impacted the AHD project and made it vulnerable to high probability, high impact risks. Those risks required government intervention to provide various types of support such as financial support. Also the project needed to be completed urgently and on time to meet the pressing

demand of uncontrolled population growth. Furthermore, due to the state of war in the country, the project and its logistics were at risk of sabotage or aerial bombing. Despite all these difficulties, the AHD construction project succeeded.

To ensure research rigor, data was compiled from various sources through data source triangulation. The authors conducted interviews with engineers who held key roles in the AHD project as well as contemporary Egyptian expert project managers. Also the author collected several recorded interviews with workers who worked in the AHD project. Additionally an extensive literature review about the AHD and other relevant topics necessary to understand the historical context of the AHD project was carried out.

The data was analyzed using content analysis technique. Four success strategies resulted from this analysis namely; consolidating national interest in the project, obtaining government support, co-locating all personnel and equipment at the project site and depending on local material and workforce. These strategies support similar factors as mentioned in Table 5 and 6 with negligible differences.

These strategies and factors formed the specific success model for the AHD project as shown in Figure 6.

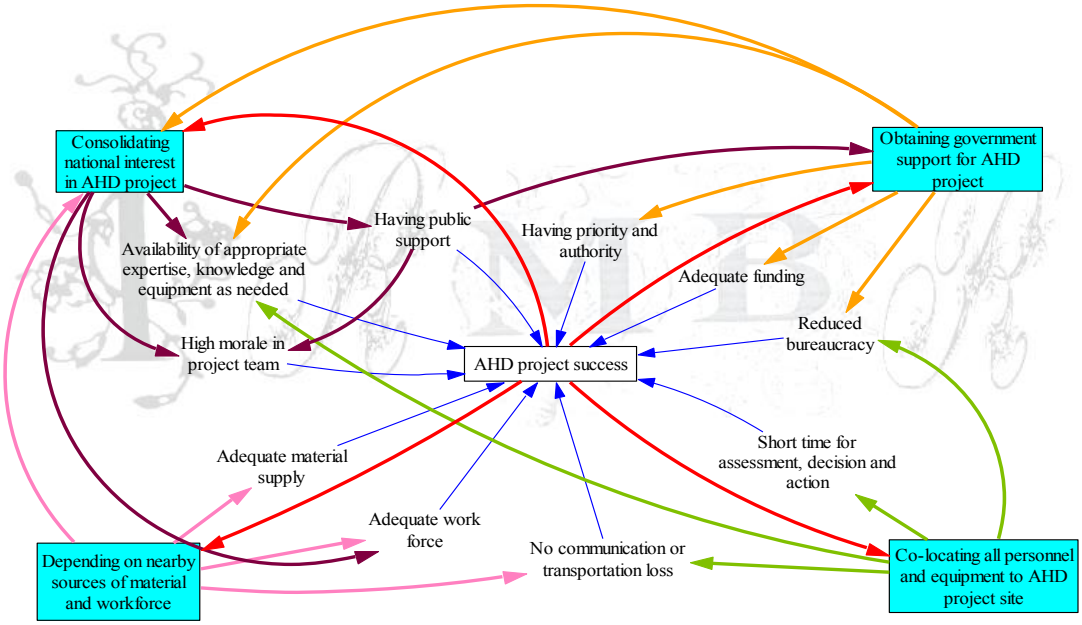

Figure 6: The specific success model for the AHD project

The following is a discussion of the strategies implemented by the AHD project. More details are available in (Howsawi, *et al.*, 2014a)

Strategy No.1: Obtaining government support for the AHD - an exclusive ministry called the Ministry of High Dam

During times of national crisis there is a keen need for a strong sponsor who can obtain the required resources or permissions or special services for the project. The AHD project, unlike any other major endeavor at that time, had a dedicated ministry called the Ministry of High Dam. This ministry was

established exclusively to oversee all aspects of the AHD project. This ministry was authorized to take any necessary executive, financial or political decisions in relation to the project and reported directly to the President. This gave the project unprecedented priority all over the country. Also, the government provided security services to that project. For example, national security agencies participated in deception plans to protect the shipment of vital project components such as the turbines and generators against possible sabotage by the enemy.

Strategy No.2: Co-locating all personnel and equipment to the AHD project site

The AHD project was a monumental project, yet it was completed on time despite all the difficulties. The strategy that helped to facilitate this was the relocation of all personnel and equipment to the site. Prior to applying this strategy, the project's top management was located in Cairo, some 1000 km away, and relied on casual visits to the project site and reports sent to keep abreast of progress. As a result, the project slipped more than one year behind schedule. By applying this strategy, all personnel, including the Minister of High Dam, were housed adjacent to the project site. Consequently, the response time to any incident was reduced to the minimum possible. Also, having all responsible personnel on site kept bureaucratic correspondence to a minimum, which in turn supported faster reaction.

Strategy No.3: Consolidating national interest in the AHD project

One of the effects of the stress accompanying a national crisis is that it draws people closer to each other (von Dawans *et al.*, 2012). The Egyptian Government (as the AHD project owner) brilliantly exploited this phenomenon and used the national crisis of the 1956 war to create a national interest in the AHD project through the use of massive propaganda. This generated enormous public support, making most of the citizens keen to help. Many bright minds in the country wanted to work on the project. At first glance, this strategy does not look like a project management strategy. However, when the authors investigated the reasons for the high morale of that project's workers, they found that everyone believed in the AHD as his own family project.

Strategy No.4: Depending on nearby sources of material and workforce

In managing projects during a national crisis, reliance on the transportation of materials and workforce over long distances to the project site puts the provision of resources at risk if transportation is lost. Also the people who are not indigenous to the place may face more problems in coping with the environment or the social system.

In the AHD project, most of the workforce and the materials used in the construction were from Aswan area. This reduced the risk of transportation loss and also guaranteed an adequate supply of workers and of materials such as concrete and sand. Transporting the workforce or importing materials from far away can be cheaper, but the risk will be very high and during national crisis. Mitigating the risk of failure has a higher priority than reducing the cost of the project.

Does the generic model accommodatethe validation case?

As mentioned above, the model in Figure 5 is a generic model based on the case studies from the British aviation industry during WW2. The next step is to validate this model on a case sufficiently different from those used to create it. The model in Figure 6 is a specific success model for the AHD project. The differences between the aviation cases and AHD case are mentioned Table 2.

The first strategy in the AHD success model is *Obtaining government support for the AHD*. This is exactly the same strategy in the generic model in Figure 5 and also the same strategy in the aviation projects in Figure 4. Furthermore, the application of the strategy is identical; creating a dedicated ministry to supervise particular endeavour for limited time bounded by the life cycle of such endeavour. Nevertheless, government support is not limited to the creation of particular ministry but it can be in many forms such as financial and legislative support.

The second strategy in the AHD success model is *Co-locating all personnel and equipment to the AHD project site*. This strategy is comparable to the strategy *Depending on nearby material and workforce* in the generic model and in the aviation projects. As explained above, this strategy is about having all required personnel, equipment and material nearby the project to enhance several success factors such as the availability of material and response time to incidents.

The third strategy in the AHD success model is *Consolidating national interest in the AHD project*. This is comparable to the strategy *consolidating national interest and collaboration for the project* which includesthe strategy *consolidating interagency collaboration* from the aviation projects. The national interest and collaboration took different forms in theAHD and the aviation projects. At AHD the national interest was obvious in the form of the individuals being eager to collaborate in the project. Workers in that project endured and withstood the harsh work conditions - such as temperatures above 50 C° and poor safety for the national pride.

The workers often exceeded their shifts without overtime pay. Despite that, the number of workers exceeded 30 thousand and more were waiting to join the workforce. In the British aviation projects national collaboration was obvious in the form of collaboration between companies who were rivals in peacetime. For example, Vickers and Avro were heavy bomber manufacturers who competed during peacetime but turned to full cooperation during the crisis of WW2. In both cases, the AHD and the aviation projects, the governments supported and encouraged this national collaboration and this is the reseaon why the strategy *consolidating national interest and collaboration for the project* is supported by the strategy *Obtaining government support*.

All the four strategies of the AHD model are included in the generic model but the generic model still has one strategy that does not appear in the specific model of AHD; that is *adopting concurrent engineering*. The data available for the research did not show concrete evidence of such an approach in the AHD project. Also, AHD is a dam project. The dam is unique so that it cannot be versatile and the major component which is the dam's body, cannot be shared. Importantly, however, the generic model accommodates the AHD case and other cases. It is not necessary that all the strategies of the generic model appear together in every cases. While there are 9 success factors in the generic model, there are 10 in the AHD model.This is a negligible difference because the extra factor in the AHD model which is *High morale in the project team* is included in the factor *adequate workforce* in the generic model. This factor means competent, committed, motivated project manager and team members as well as sufficient staff. While the generic success model in Figure 5 accommodates the initial case studies of the British aviation industry and the validation case of the AHD project, will it be able to interpret the success of other cases? This will be addressed in the discussion to come.

Discussion

The generic success model for project management during national crises presented in Figure 5 can interpret the success of many cases other than those used to create it. For example, the great depression in the United States in the 1930s was a typical example of a national crisis. During that crisis the Hoover Dam construction project was completed successfully (Kwak, *et al.*, 2014). Kwak *et al.* (2014) reported that "the

concept of the project was well understood by both public and private agencies leaving no doubt about approving the project idea" and this is comparable to *Consolidating national interest and collaboration for the project* in this study's success model. Furthermore, the authors asserted that the collaboration can take several forms including interagency collaboration.

Interestingly, Kwak *et al.* (2014) reported that "Cooperation between Six Companies' project personnel and the resident construction engineer assigned by the Bureau of Reclamation helped the project team overcome various technical and operational difficulties of the project". Also they reported that "The Bureau of Reclamation, as the government agency in charge of the project helped the entire project team to overcome serious challenges, such as debates and critics during review of the legislation in Congress, labour strikes during the construction phase, lobbying to secure the adequate annual funds" and "the Hoover Dam project team enjoyed a supportive relationship with the federal government during the course of the project from the initiation phase to the final stages of the construction.". This is exactly what is meant by the strategy *obtaining government support* in this study's success model. Moreover, the authors in this study proposed the strategy of *Adopting concurrent engineering* and interestingly, Kwak *et al*. (2014) reported that "the contractor worked on the four diversion tunnels at the same time during winter 1931–1932 and finished the job before spring, this strategy contributed to the project completion two years ahead of the schedule". The success model proposed in this study could almost completely interpret the success of the Hoover Dam project.

Other broad cases which can be explained by the success model of this study are post-disaster reconstruction projects. The post-disaster context (e.g. post-war, post-flood, and post-earthquake) is another typical example of a national crisis which contains conditions mentioned by Howsawi *et al*. (2014c) such as "emerging threats and opportunities" and "resources and supply disturbance". In such contexts, community empowerment and participation are critical to the success of the reconstruction project (Sadiqi *et al*., 2013). From a post-war reconstruction case study it is concluded that developmental approaches to reconstruction must be culturally rooted and dependent to a large extent on the empowerment of local communities (El-Masri & Kellett, 2001). This is exactly comparable to the strategy *consolidating national interest and collaboration for the project* in the success model of this study. Also it is reported that "local government support" Sidiqi *et al*.(2013) and "Government response and intervention" (Chang *et al*., 2012) are essential for reconstruction project success. This is identical to the strategy *obtaining government support* presented by the authors in the success model.

The scattered distribution of the material is reported as a major problem for post-disaster reconstruction projects (Baradan, 2006). Also, transportation is a major concern in the post-disaster context because of the loss of the means of transportation or roads due to the disaster (Chang, *et al*., 2012). The strategy *Depending on nearby material and workforce* in the model of this study is a remedy for such a problem. In a post-disaster reconstruction project it is reported that effective communication and coordination among stakeholders would result in enhanced project performance (Kim & Choi, 2013). Also, Sidiqi *et al*. (2013) reported that "communication and information dissemination" is an important factor for the success of reconstruction projects. In fact these conditions are essential parts in the concurrent engineering strategy which the authors presented in the success model.

Another case that can be interpreted using the success model of this study is the Chilean miners rescue project in 2010. The context of rescue endeavor is an example of a crisis that has an international as well as national impact. The characteristics of national crisis mentioned by Howsawi *et al*. (2014c) appeared in this short-term, high-impact project. The government intervened and took over the rescue operation, the operation was urgent and uncertain and the 33 lives trapped more than 2000 feet below ground were at great threat. Nevertheless, the rescue endeavor lasted for 69 days and was a great success; all the 33 lives were saved. In that project, the country's president was the topmost responsible person in the rescue

endeavor. This brought total government support to the project. The mining minister was on site 24 hours a day, seven days a week and this is comparable to the strategy *Depending on nearby material and workforce*. By the support of the government and the relocation of the minster to the site, all the required authorities and priorities were brought directly to the project. Also this project enjoyed the collaboration of more than 20 companies which volunteered their equipment, personnel and expertise. This was a practical application of the strategy *Consolidating national interest and collaboration for the project* mentioned in the success model. Furthermore, the mining minster formed a top crisis management team with diverse expertise and specialties (e.g. mining engineering and psychology) from different companies and government departments to oversee the rescue effort. This action is in the heart of the concurrent engineering strategy mentioned in the success model. These actions strongly supported the success of that project (Crenshaw, 2010; Useem *et al.*, 2011).

As shown above, the generic project success model can interpret the success of cases other than those used to create it. It can interpret particular cases such as the Hoover dam project or a broad type of cases such as post disaster reconstruction. This gives the model better generalizability.

Conclusion

The authors in this study provided a number of contributions to the project management literature. First, they provided a new theoretical explanation of the relationship between project strategy and project success factors; that is, the strategy is a higher-level driver that enhances or diminishes a success factor or a set of success factors. This implies that the formulation of suitable strategies for particular project should be preceded by defining the required success factors for that particular project. As the success factors can be common or project-specific, the strategies can also be common or project-specific.

Second, based on this theoretical foundation and the concept of project management during national crisis, the authors provided a generic success model for project management during national crisis. This model links four strategies to nine common success factors that contribute to the success of projects. The model was based on a portfolio of 24 case studies then refined and validated on another sufficiently different case. The validated model interpreted cases other than those use in the creation and refinement of the model.

The model works as a guiding tool for action to achieve the success in the context of a national crisis. Also, it can be used as a diagnostic tool to evaluate cases of projects implemented during national crises and to extract lessons. In practice, this model can improve the immunity of projects against the impacts of national crises. Nevertheless, there is no single model that can perfectly fit all projects, so this model is not the ultimate answer to the success question for all projects during all types of crises. Rather, it is an important and well-evaluated addition to the literature of project management. This work draws its importance from the fact that national crises are increasing in frequency and severity yet the literature of project management is lagging in providing applicable models for successful project management in such a context. When a national crisis occurs there is no time for learning from trial and error. The costs and consequences of trial and error in such context are very high, so that, there is a need for having a proven success model and presenting it for the benefit of current and future projects in similar context.

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