

Digital Enterprise Architecture Maturity and Performance (DEAMP) Assessment Framework

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Certificate of Original Authorship

I, Nujud Mohammed J Alsufyani, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy in the Faculty of Engineering and IT, School of Computer Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Research Contributions and Publications

During this PhD research project, I collaborated with my supervisor and other colleagues. I published the components of this research work (DEAMP) in several rigorously reviewed international conference papers and scientific journals. The publication of these papers was an opportunity to present my work for review before including it in this thesis.

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List of Abbreviations

Abbreviation	Description
AAF	Average and Above Frequency
AAP	Average and Above Percentage
ADM	Architecture Development Method
BA	Business Architecture
BSC	Balanced Scorecard
CCP	Content, Context, and Process
DCMM	Digital Capability Maturity Models
DEAMP	Digital Enterprise Architecture Maturity and Performance
DM	Digital Maturity
DSR	Design Science Research
DT	Digital Transformation
EA	Enterprise Architecture
HVAC	Heating, Ventilation, Air Conditioning
KPIs	Key Performance Indicators
Info.	Information
IS	Information Systems
KG	Knowledge Graph
PMI	Project Management Institute
PMIS	Project Management Information System
PI	Performance Indicator
PPI	Project And Portfolio Management
PESTEL	Political, Economic, Social, Technological, Environmental and Legal
SMART	Strategic Measurement Analysis and Reporting Technique
TOGAF	The Open Group Architecture Framework
OWL	Web Ontology Language

Abstract

Organisations increasingly recognise the transformative potential of digitalisation. This phenomenon involves changes in organisational strategy, processes, knowledge, and the entire sociotechnical system. These changes have unpredictable impacts on organisational performance, posing challenges for decision-makers in assessing the feasibility of digitalisation and its intended performance outcomes. However, current research reveals a significant gap in understanding digital maturity (DM) levels and their link to organisational performance outcomes. Thus, this research aims to understand enterprise-architecture-driven DM levels, digitalisation performance outcomes, and their relationships to develop an assessment framework. A well-established DSR method has been employed to construct a theoretically robust framework for assessing digital enterprise architecture maturity and performance (DEAMP assessment framework). This framework comprises two components: the DEAMP model and the DEAMP process. It captures the interconnectivity between DM levels and organisational performance outcomes to provide decision-makers with valuable insights to enhance DM for organisational performance gains. This framework was evaluated using illustrative scenarios and an expert survey. The findings were utilised incrementally to iteratively develop and refine the framework and demonstrate the framework's suitability and effectiveness. The thesis research offers significant contributions to academic and practical knowledge in the field of enterprise architecture and a solid foundation for future directions.

1 Chapter 1 Introduction

Digitalisation has become a powerful force, driving enterprises toward developing and enhancing their digital capabilities across all areas to remain competitive. As a foundational step in guiding the digital transformation (DT) process toward a digitally advanced future, organisations increasingly recognise the need to evaluate their status systematically (Teichert, 2019). With digital technologies reshaping both the internal relationships and external factors of organisations (Carlos Freitas Junior *et al.*, 2020), this shift can, directly and indirectly, influence enterprise performance (Meng and Wang, 2020). Decision makers may face difficulty when evaluating the feasibility of investing in digital innovations and projected benefits due to the unpredictable influence of digitalisation on performance outcomes (Park & Saraf, 2016). Also, digitisation, organisational strategies and structures have become increasingly interdependent, meaning that more than digitisation may fully clarify the complexity affecting its impact on performance (Park & Saraf, 2016).

Organisations must comprehend their existing and anticipated levels of digital maturity (DM) to effectively adjust to the fast-changing pattern of the digital landscape (Kane *et al.*, 2017). Thus, this research proposes using the enterprise architecture-driven approach to link DM and performance assessment across different layers of the enterprise. It provides new knowledge in understanding the link between DM levels and performance that can support informed decision making and advance digitalisation to improve performance outcomes from an enterprise architecture (EA) perspective.

This chapter starts by introducing the research background, problem, and questions. It then details the research aims, objectives, significance, and scope, emphasising the contribution of the DEAMP assessment framework. Finally, the chapter outlines the research strategy and provides an overview of the thesis structure.

1.1 Research context

This research is conducted in the field of information systems (IS). It is inherently multidisciplinary, blending elements from various domains to address the complexities of socially embedded systems, shaped by organisational context, history, and human influence (Symons, 1991). Addressing IS may require a multidisciplinary approach considering social,

organisational, and technological factors, recognising that these systems are deeply interconnected with human and organisational contexts (socio-technical) (Gregor and Hevner, 2013). However, a significant portion of the effort undertaken by IS practitioners and managers revolves around designing the deliberate arrangement of resources to achieve specific objectives (Hevner *et al.*, 2004). Therefore, this research involves the construction of socio-technical artefacts to contribute to the IS research field by focusing on DT, DM and performance using an EA-driven approach. This EA-driven approach was adopted to systematically connect DM and performance elements across various layers of the EA. This also provides a unique perspective to address and navigate the relationship between DM level and performance outcomes in measuring the level of digitalisation and the related performance outcomes that contribute broader field of IS.

Organisations are increasingly interested in DT and digitalisation, they need to frame their digitalisation vision to address the need for digitalisation, develop a strategy, and predict future outcomes (Westerman and McAfee, 2012). This need stems from the potential impact of DT on individuals, culture, communication, the entire enterprise (Gimpel *et al.*, 2018), ecosystems, and industries (Hinings, Gegenhuber and Greenwood, 2018).

Accordingly, it may be necessary to explore how digitalisation influences various elements of organisational architecture and their performance outcomes (Park & Saraf, 2016). One aspect to be considered is the need to understand their current and future DM (Kane *et al.*, 2017). Evaluating maturity levels and linking them to organisational performance has been highlighted as essential (Pedrini and Frederico, 2018). Evidence suggests also that a higher maturity level may correlate with improved performance outcomes (Westerman, Bonnet and McAfee, 2014). Nevertheless, the interrelation between digitalisation and various organisational strategies and other components suggests that digitalisation alone may not comprehensively explain the complicated factors influencing organisational performance (Park & Saraf, 2016). This points to a significant gap in understanding how DM, organisational performance, strategies, and other aspects interrelate.

Given the lack of a unified understanding of integrating DM levels and performance elements, this research addresses the link between DM levels and performance that can support informed decision making and advance digitalisation to improve performance outcomes from an EA perspective. The research context is established by conceptualising

key elements such as DM, performance and EA, a high-level overview, as discussed in the following sub-section, while directing readers to Chapter 2 for a more detailed discussion.

1.1.1 Digitalisation/Digital transformation

Digitalisation commonly interchanges with digitisation and DT, while each term covers a different concept. Digitisation covers the technical element, while digitalisation covers both the social and the technical elements (Bockschecker, Hackstein and Baumöl, 2018).

Digitalisation can be defined as “the manifold sociotechnical phenomena and processes of adopting and using these technologies in broader individual, organisational and societal contexts” (Legner et al., 2017, p. 301). DT, on the other hand, covers a much broader aspect that goes beyond social and technical aspects, including the rapid adaptation of innovative digital technology (Bockschecker, Hackstein and Baumöl, 2018). DT is the state of transforming enterprise elements (Nwankpa & Roumani 2016). Those elements could be products, processes, and organisational structures (Clohessy et al. 2017; Hess et al. 2016) or management concepts (Matt et al. 2015) and leadership practices (Hansen & Sia 2015; Singh & Hess 2017). Organisations implement DT to enhance or gain value propositions (Nwankpa & Roumani 2016). In conclusion, Digitisation, digitalisation and DT convey three levels of transformation to digitally developed organisations (Verhoef *et al.*, 2021). Digitalisation uses technology to improve processes, while DT rethinks how a business can create value through digitalisation and technology (Aras and Büyüközkan, 2023).

1.1.2 Digital maturity

DM is a multidimensional construct with multiple definitions that lack a universally agreed-upon standard (Aslanova and Kulichkina, 2020). For this research, DM is conceptualised as the degree of organisational advancement in digital capabilities by underscoring maturity levels. DM, however, reflects what the firm has achieved from both the technological and managerial aspects of its DT performance (Chanas and Hess, 2016). Thus, it requires a holistic approach (Teichert, 2019) that shows the organisation’s continuous ability to adapt and compete in a rapidly dynamic digital environment (Kane *et al.*, 2017). However, DM is strongly associated with the extent of DT, which can be aimed at improving organisational performance (Aslanova and Kulichkina, 2020). DM offers insights into digitalisation’s current and desired states by examining various aspects, including technological infrastructure and managerial practices (Chanas and Hess, 2016). This analysis may facilitate identifying gaps

and formulating strategic roadmaps to bridge these gaps through targeted investment (Thordsen, Murawski and Bick, 2020). Consequently, to enhance an organisation's maturity level, it must be strategically aligned with its objectives and key performance indicators (KPIs) (Aslanova and Kulichkina, 2020).

1.1.3 Performance

Organisational performance refers to achieving organisational goals and objectives effectively, encompassing financial and non-financial outcomes (Cao and Zhang, 2011; Wardaya *et al.*, 2019). Various methods exist for modelling organisational performance outcomes, among which are the balanced scorecard (BSC) (Kaplan and Norton, 1992) and the strategic measurement analysis and reporting technique (SMART) (Cross and Lynch, 1988). The BSC adopts a cause-and-effect approach, measuring customer, internal, innovation/learning, and financial performance, with performance measurements derived from the organisation's strategy (Kaplan and Norton, 1992). In contrast, SMART is an operational performance-driven framework, forming a pyramid of objectives and measures that integrate strategic aspects with operational performance-focused measurements (Cross and Lynch, 1988). While adaptive EA provides the architecture of the enterprise layers and underpinning elements as an overarching theoretical lens, it does not explicitly provide a performance lens (Alsufyani and Gill, 2022). Consequently, in this research, alongside adaptive EA, the results and determinants framework (Fitzgerald *et al.*, 1991) was adopted as a theoretical lens to investigate and model digitalisation performance indicators (PIs) (Alsufyani and Gill, 2022). The choice of the results and determinants framework was motivated by its ability to provide six technology-independent general classes for performance measurement: financial, competitiveness, quality, flexibility, resource utilisation, and innovation. Additionally, this framework offers valuable insights into the scope of measurements that can be employed for each performance dimension.

1.1.4 Enterprise architecture

EA involves developing a comprehensive overview of an organisation's architecture, encompassing both design and implementation plan (Lee, 2013; Ibrahim Alzoubi, 2015) to improve performance outcomes (Hinkelmann *et al.*, 2016; Hazen *et al.*, 2017; Alzoubi, Gill and Moulton, 2018). There are various EA frameworks from which to choose. For example, Zachman's framework (Zachman, 1987) offers a general ontology that can be used to define

the EA elements at different levels of abstraction, from high-level context to detailed operations. The Open Group Architecture Framework (TOGAF), on the other hand (Andrew, 2016), provides a generic architecture development method. Hence, TOGAF and Zachman mainly focus on the traditional architecture development method and ontologies. However, the scope of this research is to have a human-centric EA and performance outcome-driven approach in the recent context of digitalisation. Therefore, this study employs the adaptive EA (Gill, 2015) meta-framework developed within the context of digitalisation and the digital ecosystem. This framework enables the design of customised, human-centred EA frameworks and capabilities tailored to specific situations to achieve targeted performance outcomes (efficiency and innovation) (Gill, 2015). Furthermore, adaptive EA is utilised because it offers a broader scope and additional layers representing interaction, human, technology, security, facility and environment layers compared to other frameworks. Additionally, it comprises precise performance outcome-driven adaptive EA design layers (Gill and Chew, 2019) that can be incorporated to achieve strategic goals and objectives within digital enterprises (Gill, 2015). Adaptive EA is employed because it offers a systematic, layered approach with essential elements for designing and advancing digitally enabled enterprises as appropriate to the scope of this research. Finally, the adaptive EA-driven approach is essential in this research because it comprehensively presents the organisation's architectural design, key elements, DT roadmaps and implementation plans (Lee, 2013; Ibrahim Alzoubi, 2015).

Adaptive EA (Gill, 2015) introduces six architecture layers: interaction, human, technology, environment, facility, and security layers. In addition to these six EA layers, the adaptability of the adaptive EA framework is achieved through three core activities: identification of changes, analysis of changes, and the determination of appropriate responses for adaptations across EA layers and elements.

Figure 1-1 visually depicts the combination of performance and DM from the perspective of adaptive EA.

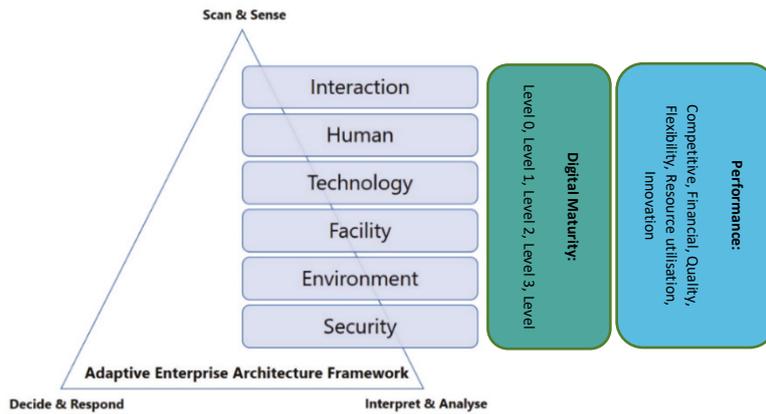


Figure 1-1 Adaptive EA layers (Gill, 2015, 2022) integrated with six levels of DM (Alsufyani and Gill, 2021) and the results and determinants performance dimensions (Fitzgerald *et al.*, 1991)

1.1.5 Decision making

Decision making is a fundamental aspect of management that significantly influences the survival and success of organisations (Pueljić, Skledar and Pokupec, 2015). Decision making in organisations refers to the process of identifying and selecting the best course of action from among multiple alternatives to address a specific problem or opportunity (Snowden and Boone, 2007). It is a critical function performed by managers and leaders at all levels of an organisation to guide its operations and achieve its objectives (López-Cabrales and Bornay-Barrachina, 2019). Managerial decisions significantly impact organisations' performance and success, and understanding decision-making processes can enhance their effectiveness and contribute to organisational success (Ireland and Miller, 2004). Decision making is a complex multi-step process that encompasses defining the problem, identifying decision criteria, gathering information, evaluating alternatives, selecting the best option, and implementing the decision (López-Cabrales and Bornay-Barrachina, 2019). Thus, an assessment framework can be useful for well-informed decision-making and effectively navigating this process since it provides a structured framework and analysis that needs to be addressed to facilitate decision making (Sinnaiah, Adam and Mahadi, 2023). Due to the unknown influence of digitalisation on performance (Meng and Wang, 2020), decision makers may find it challenging to understand the impact of digitalisation on organisations' performance and forecast the anticipated outcomes. Determining the right course of action may become difficult because of this uncertainty. Thus, the organisations' performance can be analysed by applying different frameworks, models, and tools to determine the influence and level of DM (Aras and Büyüközkan, 2023). However, linking performance assessment

with EA maturity enhancement allows organisations to improve their decision making to uplift digitalisation for performance outcomes. It can also help that the DT efforts are aligned with targeted performance, which will lead to improved results.

1.2 Research problem

Digitalisation is a growing trend pushing enterprises to adapt and improve digital capabilities to stay competitive and successful. It enables organisations to overcome uncertainties and effectively meet business demands (Deepu and Ravi, 2021). Beyond adopting technology, digitalisation can imply a major transformation in business strategy, process, knowledge and socio-technical systems (Park and Saraf, 2016). With digital technologies reshaping both the organisations' internal and external elements, along with their interconnected relationships (Freitas Junior, Cabral and Brinkhues, 2020), this can impact business performance directly and indirectly (Meng and Wang, 2020). The effects of digitalisation on performance can present a challenge for decision-makers, who must assess investment feasibility and anticipate potential outcomes. Although the impact of digitalisation on performance outcomes has gained significant attention from both researchers and industry professionals, there is still ambiguity in regard to what aspects should be measured and how to assess the impact effectively (Rungi, 2019; Verhoef *et al.*, 2021). To effectively respond to rapid digital advancements, corporations must understand both their as-is and to-be DM. As an initial step in managing the DT journey toward a digitally mature future, systematically evaluating the as-is DM status is increasingly essential in many organisations (Teichert, 2019). Higher DM levels, mainly digital and leadership capabilities, are often linked to improved corporate performance, as these organisations leverage leadership strengths and a digitally mature foundation for strategic advantages (Westerman, Bonnet and McAfee, 2014). A maturity model can be a foundational development planning tool (Becker, Knackstedt and Pöppelbuß, 2009). Although scholars and practitioners have created numerous maturity models, there remains no consensus on a universally applicable maturity model or ontology adaptable to diverse contexts (Reis *et al.*, 2018).

The research problem is focused on addressing the gaps in understanding how to link DM levels with performance elements that can support informed decisions, to enhance digitalisation for improved performance outcomes.

1.2.1 Research gaps

Drawing on the conducted review of literature in Chapter 2, this research aims to contribute to DM and performance by addressing the following gaps.

- There is a lack of theoretical underpinning and empirical evidence in DM and organisational performance assessment.
- There is a lack of linking between the DM level and organisational performance outcomes.
- There is a lack of theoretical and practical comprehensive understanding regarding the integration of DM and performance elements, limiting informed decision-making that could enhance digitalisation efforts to improve performance outcomes.

This research proposes to assist organisations in self-assessing their current and intended levels of digitalisation using the concept of DM levels. It can be a planning tool to align DT efforts with their specific goals and needs from an EA perspective. Adopting an EA as a lens addresses the identified gaps, as shown in Figure 1-2. Thus, this research suggests using an EA-driven approach to systematically connect DM and performance elements across various layers of the EA.

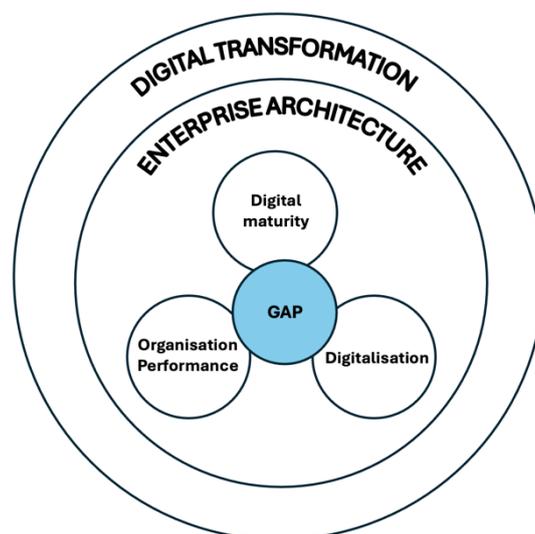


Figure 1-2 Research gap

1.3 Research questions, aims and objectives

The investigation of DM and performance outcomes indicates the need for a theoretical and practical comprehension and provides the motivation and foundation for integrating two

often disjointed but related digital and performance elements (see Chapter 2). This is key for informed decision-making to advance digitalisation for enhanced performance results. To achieve this holistic understanding and design and deliver research artefact, this research employs the design science research (DSR) approach. This approach provides guidelines for a methodical, iterative process for producing and evaluating an artefact that addresses real-world challenges (Hevner *et al.*, 2004). According to Hevner *et al.* (2004), it aims to produce innovative artefacts that improve the efficiency of IS in real-world applications through analysis, design, and implementation. The produced artefact can be frameworks, models, methods, architectures, constructs, and instantiations that can play a crucial role in bridging theory and practice (Vaishnavi and Kuechler, 2007). As a result, this research addresses the research problem by designing an artefact that links the DM's level and related performance outcomes for well-informed decision making from a holistic EA standpoint. Consequently, this research addresses the following research questions:

RQ: How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain?

- RQ 1 How to measure the DM of an organisation?
- RQ 2 How to measure the digitalisation performance of an organisation?
- RQ 3 How to link DM levels and the performance of an organisation?

Thus, this research aims to develop the DEAMP assessment framework that will allow organisations to define whether to initiate a digitalisation activity or not to meet intended performance outcomes. It will provide a framework to be used as a tool to help organisations self-assess and navigate their as-is and intended DM level and intended performance outcomes. Thus, it is a tool that can be facilitated by organisations that need or want to understand their current level of DM and performance outcomes, either to navigate their options on how to overcome weaknesses, seize an opportunity or gain a competitive position. It is a planning tool that allows organisations to self-assess their DM to understand and identify the best-fit level of digitalisation for their intended performance outcomes. It helps organisations seek and acquire an understanding of elements that need to be measured, such as the level of digitalisation and the related performance outcomes in every layer of the EA perspective and the relationship between the DM level and

performance outcomes to create an artefact measuring the intended performance outcomes from digitalisation.

Table 1-1 outlines the research aims and objectives to address the research questions.

Table 1-1 Research questions, aims and objectives

RQ	Aim	Objective	Source
RQ 1: How to measure the DM of an organisation?	RA1: To understand adaptive EA-driven levels of digitalisation maturity.	RO1: Conduct an SLR to identify and understand adaptive EA-driven levels of DM.	Chapter 2
RQ 2: How to measure the digitalisation performance of an organisation?	RA2: To understand digitalisation performance outcomes.	RO 2: Conduct an SLR to identify and understand adaptive EA-driven digitalisation organisational performance.	Chapter 2
RQ 3: How to link DM levels and the performance of an organisation?	RA3: To understand the relationship between DM levels and performance outcomes.	RO3: Develop a conceptual, logical and physical model to link the level of digitalisation maturity and performance outcomes across EA layers.	Chapter 4
How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain?	RA4: To assist in measuring and linking inherently isolated DM and performance elements for performance gain.	RO4: Develop a framework to assist in measuring and linking inherently isolated DM and performance elements for performance gain.	Chapter 4

1.4 Research scope

This research scope encompasses the development of a framework aimed at measuring and linking DM and performance elements for performance gain from an EA perspective. Thus, this research’s scope is limited to recognising and understanding levels of DM and digitalisation organisational performance through the lens of EA (the human layer (business and information aspect)). The EA framework is outside the scope and is used as a lens. The proposed framework is an assessment framework to help organisations navigate the relationship between DM level and performance outcomes in measuring the level of digitalisation and the related performance outcomes across EA layers. It allows

organisations to self-assess their enterprise’s DM and performance to understand and identify the best fit of DM for their intended performance outcomes. It is not restrained to any specific geographical region. This research employs the DSR method (Hevner *et al.* 2004; Vaishnavi & Kuechler 2015) to develop and evaluate the proposed framework.

1.5 Contribution

This section highlights the primary contributions of this study. As illustrated in Figure 4-1, the key contribution of this study is the proposed DEAMP assessment framework.

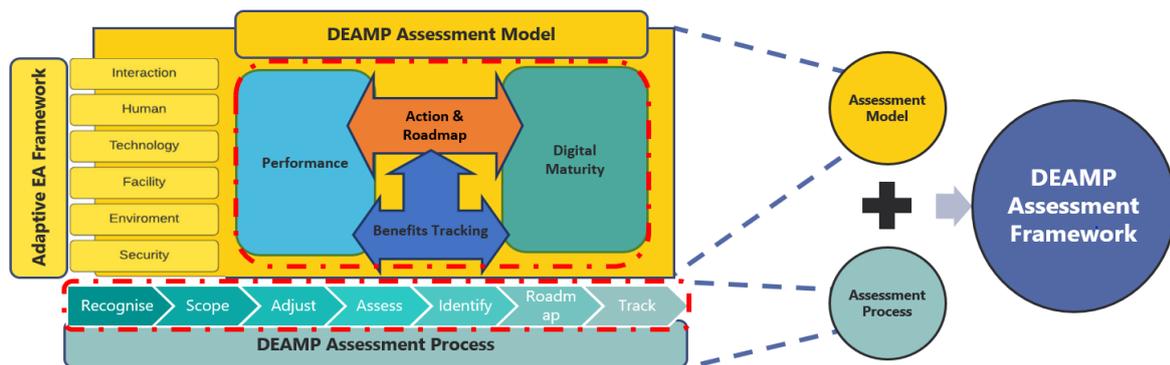


Figure 4-1 High-level contextual view of the DEAMP assessment framework (recalled)

1.5.1 DEAMP assessment framework

In this thesis, the primary contribution is the DEAMP assessment framework, as visually presented in Figure 4-1. The construct of the framework draws on existing knowledge, both theoretical and practical perspectives and expert feedback. The uniqueness of this framework is concluded by offering both an assessment model and an implementation process to guide organisations to enhance DM across EA layers for performance gains. This framework provides a comprehensive self-assessment tool that enables organisations to determine whether to initiate digitalisation activities to achieve their intended performance outcomes. Also, the conclusion of this thesis provides new insights into DM and its link to performance outcomes from an EA perspective, which contributes to the body of knowledge in the fields of DM, digitalisation performance, and EA.

The DEAMP assessment framework consists of two components, as visually presented in Figure 4-1. The DEAMP model captures the interconnectivity between DM levels and performance outcomes across EA layers, while the DEAMP process provides a seven-stage process. Both components help decision makers understand valuable insights from

capturing this interconnectivity for informed decision making (refer to Chapter 4 for a detailed discussion). The framework is structured into three levels: a conceptual model for high-level abstraction, a logical model for detailed representation and a physical model (refer to Chapter 4). The physical model is introduced to implement the assessment process for specific scenarios or cases, which applies the structured concepts and relationships defined in the logical model, as discussed in Chapter 5.

1.5.2 Publications

As a contribution of this research, two papers have been published in well-known conferences in IS and one in a high-ranking (Q1) peer-reviewed journal. Two more papers have been drafted to be submitted to high-ranking journals.

1.6 Application and users

The DEAMP assessment framework targeted users are DT, business architecture, EA experts, and researchers in the field of IS. This assessment framework enables practitioners to assess the current digitalisation level and define a target state that addresses weaknesses or seizes opportunities. Selecting specific metrics and PIs across the EA that align measurable outcomes with strategic goals to achieve a competitive performance gain from an EA perspective. Also, it allows for the facilitation of improvement and tracks the progress of DT objectives. Additionally, the framework provides a structured approach to understand the relationship between DM levels and performance outcomes. This enables informed decisions making regarding digitalisation initiatives. The framework consists of two components: the assessment model and the assessment process. Firstly, the assessment model is presented in both a conceptual and a logical model. The conceptual model ensures ease of use, adaptability, and compatibility with existing frameworks. It allows for seamless integration with current systems. The logical model (ontology) formalises the concepts and relationships between DM and performance by providing a consistent understanding and a foundation for further research and practical application for practitioners and researchers. Secondly, the assessment process is designed to operationalise the model into actionable steps and procedures that can be implemented in practice. Consequently, the physical model offers concrete illustrative examples using the framework to enhance its usability and demonstrate the operational aspects of the framework.

1.7 Research strategy

This section outlines the research strategy for developing and evaluating the DEAMP assessment framework. This research employs DSR as the most relevant methodology to develop and evaluate the DEAMP assessment framework. The rationale for using DSR lies in its iterative nature, which facilitates the systematic development and evaluation of solutions to complex research problems grounded in established theories and existing knowledge (Hevner *et al.*, 2004; Hevner, 2007; Peffers *et al.*, 2007; Vaishnavi and Kuechler, 2007; Brocke and Maedche, 2019). In this research, the adopted DSR approach is outlined by Vaishnavi and Kuechler (2007). Also, it is accompanied by the proposed guideline by Hevner *et al.* (2004) for a rigorous and comprehensive research approach.

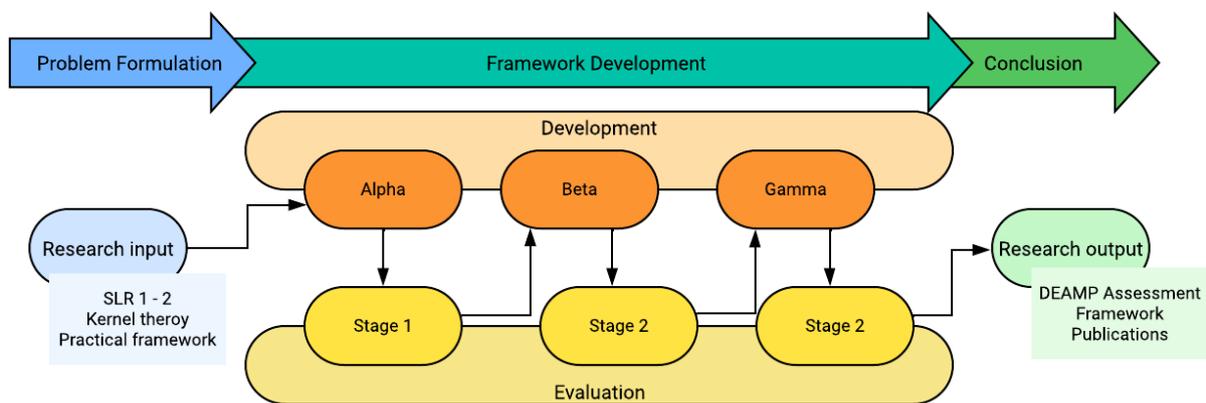


Figure 1-3 Research strategy

The DSR method applied in this study comprises three stages: problem formulation, framework development, and conclusion. The initial stages, problem formulation and framework development, are based on the existing literature, relevant kernel theories, and recognised EA and performance frameworks. Two SLRs were conducted to generate a comprehensive understanding of the research scope and identify relevant research gaps (as detailed in Chapters 1 and 2), which formalised the research problem.

Following the SLR, the initial design of the DEAMP assessment framework was introduced as a solution to the identified research problem. Then, the appropriate methods were selected to develop this solution. The DEAMP assessment framework comprises two core components: the DEAMP assessment model and the DEAMP assessment process. The framework was developed incrementally to address the research questions detailed in Section 1.3 (RQ1, RQ2 and RQ3). This development process included a comprehensive

review of the relevant kernel theories, established EA and performance frameworks, and existing studies to build a robust and efficient solution.

The proposed framework evolved in six increments to introduce the artefact into three different versions: alpha, beta, and gamma. Each version undergoes an evaluation process (illustrative scenario and expert evaluation) to conclude whether the framework meets the criteria: applicability, comprehensiveness, understandability, and generalisability. The alpha version was developed with the initial two increments to introduce the DM and performance models separately and then their integration using the action model. The beta version was derived from the first evaluation process which includes a benefit tracking model to complete the assessment model loop. The final gamma version emerged from the second round of evaluations. This version underwent three additional increments: one focused on improving the DEAMP model, while the remaining two were dedicated to developing and enhancing the DEAMP process. Chapter 5 covers the development and evaluation of the framework, while the last version (gamma) is detailed in Chapter 4. Lastly, Chapter 6 presents the research contributions, limitations, and suggestions for future work.

1.8 Thesis outline

This thesis is structured into six chapters. Each chapter addresses a different aspect of the research, as illustrated in Figure 1-4. Chapter 1 introduces the research background, aims, problem, questions, scope, contributions, and strategy. Chapter 2 presents the SLR conducted for this study, while Chapter 3 elaborates on the adopted DSR methodology. Chapter 4 introduces the primary contribution of the thesis (DEAMP assessment framework). Chapter 5 details the development and evaluation process to iteratively develop and assess the DEAMP assessment framework. Chapter 6 summarises the research journey, which includes the research problem and solution. Also, it sheds light on research implications for practice and research, research contributions and limitations, and suggested areas for future investigation. The appendices contain the SLRs studies, SLR 2 synthesised data, research data, ethics approval documentation and the online survey questionnaire. Additionally, the thesis includes a brief author declaration.

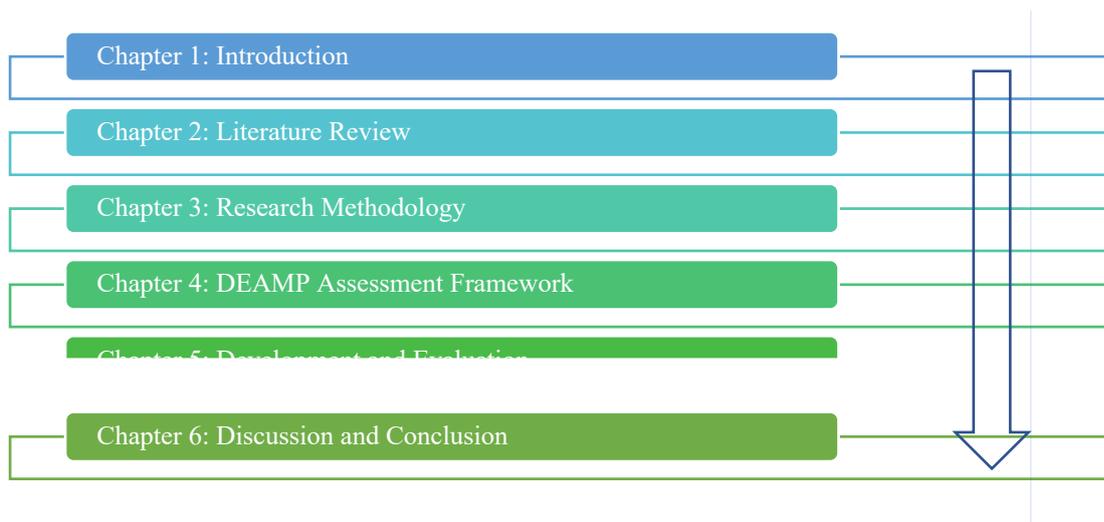


Figure 1-4 Thesis outline

1.9 Summary

This chapter introduces the research foundation by presenting an overview of the existing body of knowledge on DT, particularly DM and digitalisation performance. It also outlines the research problem and identifies areas where additional research is needed.

Furthermore, the chapter clarifies the research questions, aims, and objectives. The core contribution of this thesis (DEAMP assessment framework) is introduced, followed by the roadmap to conduct the research. This framework is designed to address the critical question of how to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? However, this requires understanding how to measure the DM and digitalisation performance of an organisation to link DM levels and the performance of an organisation. In conclusion, the research contribution and the adopted research strategy are discussed. The following chapter presents a comprehensive preview of the relevant literature underpinning this research.

2 Chapter 2 Research Background and Literature Review

Chapter 2 sheds light on a comprehensive journey through the literary landscape that underpins this research. The literature review is a crucial element in this thesis. It serves as a foundation to accomplish two different yet interrelated stages of the DSR method. It aids in clarifying the problem definition, laying the conceptual groundwork, and selecting core theories and frameworks to approach the research problem and develop the artefact. This chapter is structured as follows as detailed in Table 2-1. This chapter highlights the theoretical gaps that this thesis addresses in order to tackle the research questions.

Table 2-1 Literature review

Literature review	Purpose
Background	To understand the research problem, the existing research is explored to establish a solid foundation for the study and outline the major perceptions and insights from previous studies.
SLR 1	To understand DM, the existing research is critically examined through an in-depth analysis of studies published in well-known academic digital databases, as reported in a published paper (Alsufyani and Gill, 2021).
SLR 2	To understand digitalisation performance, existing research is critically examined through an in-depth analysis of studies published in well-known academic digital databases as reported in a published paper (Alsufyani and Gill, 2022).
Additional review	An additional review through a manual search was conducted, covering the latest studies appropriate to the scope of this research.

1.1 Research background and related work

2.1.1 Digitalisation

While no consensus exists on the precise definition of digitalisation, it is frequently conflated with digitisation and DT, though each term represents a distinct concept (Bockshecker et al. 2018). DT, however, has a more wide-range scope, extending beyond social and technical considerations to include the integration of innovative digital technologies (Bockshecker et al. 2018). This study focuses on digitalisation, defined as “the manifold socio-technical phenomena and processes of adopting and using these

technologies in broader individual, organisational and societal contexts” (Legner et al. 2017). In this context, digitalisation has the potential to apply considerable influence on multiple aspects of organisations.

DT is the state of transforming enterprise elements (Nwankpa and Roumani, 2016). These elements could be products, processes, and organisational structures (Hess *et al.*, 2016; Clohessy, Acton and Morgan, 2017) or management concepts (Matt, Hess and Benlian, 2015) and leadership practices (Hansen and Sia, 2015; Singh and Hess, 2017). Organisations implement DT to enhance or gain a value proposition (Nwankpa and Roumani, 2016) either by enhancing the consumer experience (Piccinini *et al.*, 2015; Reis *et al.*, 2018), developing a new business model (Fitzgerald *et al.*, 2014; Horlacher, Klarner and Hess, 2016; Singh and Hess, 2017; Liere-Netheler, Packmohr and Vogelsang, 2018), or improving performance (Berger *et al.*, 2020) or scalability (Goerzig and Bauernhansl, 2018). Also, DT can be initiated to meet the digital needs of customers and stakeholders (Schallmo, Williams and Boardman, 2017; Teichert, 2019). This transformation is driven by applying digital technology (Demirkan, Spohrer and Welser, 2016; Nwankpa and Roumani, 2016), observed as both an enabler and a tactical driver for the digitisation of the existing enterprise elements (Berghaus and Back, 2016).

Digital technology is a wide-ranging concept. It covers the development of digital solutions and applications intended to transform and enhance business capabilities and underlying processes. In other words, “Digital technologies (viewed as combinations of information, computing, communication, and connectivity technologies) are fundamentally transforming business strategies, business processes, firm capabilities, products and services, and key interfirm relationships in extended business networks” (Canetta, Barni and Montini, 2018, p. 2). This may include adopting various technologies such as robotics, artificial intelligence, big data, the Internet of Things, and more (Teichert, 2019). Digital technology is essential for restructuring businesses (Remane *et al.*, 2017) regarding cross-functional collaboration (Earley, 2014) and enabling integrated and distributed processes that create new ways to understand and generate value (Vial, 2019).

2.1.2 Digital maturity

DM has been defined in various ways which conclude that no single definition is universally accepted (Aslanova and Kulichkina, 2020). To unpack that, the concept of maturity refers to

the stage of a progress result (Teichert, 2019) that enables the organisation to reach its goals (Andersen and Jessen, 2003). In other words, a certain level of capabilities allows organisations to attain desirable outcomes. DM, on the other hand, is closely linked to the degree of DT and may correlate with improved organisational performance (Aslanova and Kulichkina, 2020). DM offers insights into DT's current and desired states by examining various aspects, including technological infrastructure and managerial practices (Chaniias and Hess, 2016). DM can be used to assess as-is and to-be levels of digitalisation or maturity, helping to identify gaps and support informed investment decisions (Thordsen, Murawski and Bick, 2020). Thus, it requires a holistic approach (Teichert, 2019) that shows the organisation's continuous ability to adapt and compete in a rapidly dynamic digital environment (Kane *et al.*, 2017). This perspective aligns with the broader notion of maturity as an anticipated state or change aimed at accomplishing desirable and valuable outcomes (Becker, Knackstedt and Pöppelbuß, 2009).

Maturity models are often structured with multiple levels or stages, detailing different organisational capabilities and development phases to guide assessment processes (Poeppebuss *et al.*, 2011). It can estimate the level of maturity through predefined dimensions and their measures, as stated by Lasrado, Vatrapu and Andersen (2015). Aligning strategic goals and KPIs is perceived as a requirement to reach a higher level of maturity (Aslanova and Kulichkina, 2020). The maturity model is usually structured as a multilevel and dimensional framework that outlines organisational capabilities and development stages (Poeppebuss *et al.*, 2011). Also, it can estimate the level of maturity through predefined dimensions and their measures, as stated by Lasrado, Vatrapu and Andersen (2015) recognise that the maturity levels can be estimated through predefined dimensions and their measures. Thus, the maturity levels represent idealised benchmarks against which an organisation can evaluate its system performance relative to its defined maturity criteria. These maturity levels could be used to evaluate the maturity of any system in the organisation. Such models can be foundational tools for development planning (Becker, Knackstedt and Pöppelbuß, 2009). However, numerous maturity models have been developed by scholars and practitioners, but there is still no agreement on a universally applicable maturity metamodel or ontology that can be adapted to diverse contexts (Reis *et al.*, 2018). This thesis focuses on changes in maturity levels, where maturity refers to an

expected state or progress aimed at achieving desired outcomes (Becker, Knackstedt and Pöppelbuß, 2009).

2.1.3 Organisational performance

Organisational performance reflects the outcomes of achieving the organisational goals and objectives (Cao and Zhang, 2011). These outcomes could be either financial or non-financial (Wardaya *et al.*, 2019). Various approaches exist for capturing organisational performance outcomes, such as the balanced scorecard (BSC) (Kaplan and Norton, 1992), strategic measurement analysis and reporting technique (SMART) (Cross and Lynch, 1988), Performance Prism (Neely, Adams and Crowe, 2001) and the Performance Matrix (Keegan, Eiler and Jones, 1989).

The BSC adopts a cause-and-effect approach, measuring customer, internal, innovation/learning, and financial performance, with performance measurements derived from the organisation's strategy (Kaplan and Norton, 1992). In contrast, SMART is an operational, performance-driven framework. It forms a pyramid of objectives and measures that integrate strategic aspects with operational performance-focused measurements (Cross and Lynch, 1988). The Performance Prism focuses on stakeholder satisfaction and contribution. It links stakeholder needs to organisational strategies and processes to provide a holistic view of organisational performance (Neely, Adams and Crowe, 2001). The Performance Matrix, also known as the Performance Measurement Matrix (Keegan, Eiler and Jones, 1989), categorises performance measures into four dimensions: cost and non-cost and internal and external. The results and determinants framework by Fitzgerald *et al.*, (1991), however, encompasses two primary types of performance elements: results, which include lagging factors such as financial and competitiveness performance measurements, and determinants, which encompass leading factors such as innovation, flexibility, resource utilisation, and quality performance measurements. Each performance class is associated with specific types of measurements. For illustration, financial PIs involve targets related to liquidity, profitability and market ratios.

This research adopts the results and determinants framework (Fitzgerald *et al.*, 1991) as a theoretical lens to study and model PIs (Alsufyani and Gill, 2022). This framework stands out from the other performance models for its unique focus on the service industry and its clear description between outcome measures (results) and their drivers (determinants). While

BSC measures customer, internal, innovation/learning, and financial performance, with performance measurements, the results and determinants framework emphasises the relationship between past actions and current performance. It integrates lead (determinant) and lag (result) indicators and a future-oriented approach that helps identify key performance drivers. This framework enables organisations to enhance their understanding and manage the factors influencing their performance outcomes by clearly linking determinants to results.

The choice of the results and determinants framework was motivated by its ability to provide six technology-independent general classes for performance measurement: financial, competitiveness, quality, flexibility, resource utilisation, and innovation. Additionally, this framework offers valuable insights into the scope of measurements that can be employed for each performance dimension. Additionally, it offers possible types of measurements for each performance dimension to help organisations gain insights into their performance outcomes.

2.1.4 Enterprise architecture

EA offers a holistic view of the architecture design of an organisation and the implementation plan (Lee, 2013; Ibrahim Alzoubi, 2015) to improve performance outcomes (Hinkelmann *et al.*, 2016; Hazen *et al.*, 2017; Alzoubi, Gill and Moulton, 2018). There are various EA frameworks from which to choose. For example, Zachman's framework (Zachman, 1987) offers a general ontology that can be used to define the EA elements at different levels of abstraction (from high-level context to detailed operations). TOGAF (Andrew, 2016), on the other hand, offers a general method for developing architecture. However, both TOGAF and the Zachman Framework were established within traditional architectural methods and ontologies. This study, therefore, adopted the adaptive EA framework (Gill, 2015), which was explicitly developed within the context of digitalisation and digital ecosystems, making it suitable for creating customised EA frameworks and capabilities tailored to specific situations (Gill, 2015). Adaptive EA is selected for its broader scope, incorporating additional layers, such as interaction, facility, and environment layers, not found in traditional frameworks like TOGAF and Zachman. It also features defined, performance outcome-driven design layers (Gill and Chew, 2019) that can be integrated to achieve strategic objectives in digital enterprises (Gill, 2021). Adaptive EA delivers a

structured, layered approach with essential elements for designing and evolving digitally enabled enterprises. This EA-driven approach also provides a comprehensive view of the organisation's architectural design, including foundational components, DT roadmap, and implementation planning (Lee, 2013; Ibrahim Alzoubi, 2015).

Adaptive EA (Gill, 2015) provides a comprehensive approach to EA through six distinct layers: interaction, human, technology, environment, facility, and security. Each layer has its specific focus areas, for example, the interaction layer involves actors and their experiences across digital touchpoints and channels. In contrast, the human layer addresses business, information, social, and professional architecture domains. The technology layer focuses on infrastructure, application, data, and platform aspects, and the security layer ensures the protection of elements across all other layers. Additionally, the environmental layer integrates PESTEL factors (political, economic, social, technological, environmental, and legal), and the facility layer covers heating, ventilation, air conditioning (HVAC), spatial, energy, and ancillary needs. The framework incorporates three key activities to ensure adaptability: identifying and analysing changes, determining the optimal response, and facilitating dynamic adjustments across all EA layers and elements.

2.1.5 Ontology and knowledge graphs (KGs)

Ontology is "an explicit specification of a conceptualisation" (Gruber, 1993, p.199). This conceptualisation may involve defining a set of concepts, their meanings, and their interrelationships (Uschold, 1996). These serve as the foundational constructs in conceptual modelling (Guizzardi *et al.*, 2015). In general, ontology offers a shared understanding within a field to facilitate improved communication and knowledge exchange (Guizzardi and Halpin, 2008).

Ontology can be categorised based on the level of formality, ranging from highly informal to rigorously formal structures (Uschold and Gruninger, 1996; Smith, 1998; Roussey *et al.*, 2011; Hakkarainen and Keinänen, 2023). Highly informal ontologies are usually expressed in natural language that includes simple taxonomies and controlled vocabularies, such as glossaries. Structured informal ontologies and basic taxonomies use restricted forms of natural language with relationships. Semi-formal ontologies, often found in Semantic Web applications, implement formal languages while retaining some informal elements. Formal

ontologies, on the other hand, use detailed logical structures and formal languages such as OWL (Web Ontology Language) to define concepts, relationships, and axioms with precision.

Ontology provides a standardisation of definitions that enables the reuse of knowledge across multiple applications and groups. Gruber (1993) highlights that ontology is instrumental for promoting knowledge exchange. It facilitates shared use across several players such as people and organisations, to improve the system's interoperability. Noy and McGuinness (2001) highlight that semantic inconsistencies that may occur among different data sources can be reduced by ontologies. Moreover, Guarino, Oberle and Staab (2009) note that ontologies serve as a formal and shared domain conceptualisation. They emphasise that ontologies provide a common vocabulary to enable effective communication between different stakeholders. As Uschold and Gruninger (1996) debate, ontology is a type of structured knowledge representation to improve information retrieval and system interoperability. Ontology can also be considered a formal abstract specification of a shared conceptualisation that allows semantic knowledge modelling as a KG (Ehrlinger and Wöß, 2016).

A KG organises and models real-world knowledge through a network of entities (nodes) and the relationships (edges) connecting them (Hogan *et al.*, 2021). An ontology represented as a graph can be classified as a KG when it includes populated instances. The KG is particularly valuable for depicting connected elements and their instances, such as integrated performance and maturity components (Bellomarini *et al.*, 2019). The graph-based approach (Pokorný, 2016) illustrates this ontology by using labelled nodes to represent entities (concepts) and labelled arrows to indicate the relationships between these nodes. Therefore, a KG-based methodology is well-suited for modelling the integrated elements of DM and performance ontology and their interconnections. This approach is deployed to this research context to help with the visual illustration of the ontology. This approach aligns with initiatives related to knowledge graphs in conceptual modelling (Medvedev, Shani and Dori, 2021; Smajevic and Bork, 2021). The DEAMP ontology can be represented using various methods, such as the KG used in the evaluation, due to its flexibility in portraying real-world entities and their relationships (Bellomarini *et al.*, 2019).

The previous sections cover an overall literature review of the main concepts. The next section covers the SLR methods and two SLR studies.

2.2 Systematic review

Two separate SLRs have been conducted to cover DM models and digitalisation performance outcomes, published in studies (Alsufyani and Gill, 2021, 2022). The reason for conducting two separate SLRs is due to insufficient research covering DM and performance. Thus, the purpose of the first SLR is to acquire a comprehensive understanding and analysis of the latest DM models, measurements, and maturity levels. The second SLR aims to identify the digitalisation performance outcomes addressed by the existing literature.

The following section highlights the methods to conduct these SLRs, the selected studies, and the results obtained from the two SLRs.

2.2.1 Systematic literature review method

Both SLRs applied a well-known SLR approach (Kitchenham and Charters, 2007; Rowe, 2018) to scan, select, and synthesise the published literature on DM models and digitalisation performance from an EA perspective. For illustration, two different frameworks were used to map and analyse extracted data. SLR's strategy to synthesise the extracted data was inspired by Rowe (2018). The quality assessment criteria established by Dybå and Dingsøyr (2008) were implemented to ensure the quality of the studies selected for this review. These SLRs also adopt adaptive EA (Gill, 2015) and results and determinants (Fitzgerald *et al.*, 1991) as theoretical lenses to synthesise insights from the literature concerning digital EA performance. These SLRs are discussed as follows:

2.2.2 Systematic review 1: DM models as reported in (Alsufyani and Gill, 2021)

To obtain a comprehensive understanding and analysis of the latest DM models, measurements, and maturity levels, an SLR was conducted (Alsufyani and Gill, 2021). This SLR aimed to systematically review and synthesise existing maturity models, dimensions, and levels of DM. Following the methodology outlined by Kitchenham and Charters (2007), a sum of 30 studies were carefully retrieved from recognised academic databases relevant to DM and EA using the SLR method (see Appendix A). They were carefully selected and reviewed according to the search method described in section 2.2.1. For clarity and ease of reference, each study was labelled with the letter "A" for the systematically selected studies and "M" for the manually selected studies (refer to Appendix A). This representation is used through the manuscript and tables to recognise and discuss the studies.

The findings of this SLR were analysed by adopting the EA framework and the results and determinants framework as theoretical lenses. This approach effectively categorised the results, providing a comprehensive view of DM models and their application. The findings of the SLR are reported according to the following categories: (1) existing maturity models, (2) elements assessed by DM models from an EA perspective, and (3) different scales or levels for assessing DM. Additional details discussing the research methodology of this SLR are detailed in (Alsufyani and Gill, 2021).

2.2.2.1 Existing maturity models in the literature

The SLR identified 30 maturity models from 36 selected studies, as shown in Table 2-2. Most of these models were published recently, suggesting a growing interest in the field. Domain-specific models continue to dominate the landscape. Approximately 80% of the identified models use a descriptive approach to assess current maturity levels. To provide a comprehensive overview of the existing literature, data on industries, model functionality, levels, and dimensions were synthesised (see Table 2-2). Appendix A contains a list of 36 academic papers discussing DM. However, only 30 of these papers explicitly presented maturity models. The vast majority of these models focus on analysing the current state (descriptive approach), with only two of 30 being prescriptive and two models incorporating comparative capability alongside descriptive assessment. Additionally, only four of the 30 identified models offer a roadmap concept outlining how to progress to higher maturity levels beyond merely assessing the current state.

Table 2-2 DM models

ID	Dimensions	Stages/ Levels	Model functionality	Industry
A1	2	6	Prescriptive	General
A2	4	5	Descriptive	Software Development
A3	5	5	Descriptive	Education / ICT
A4	6	-	Prescriptive	Manufacture
A5	9	5	Descriptive	General
A6	4	-	Descriptive	Public sector
A7	6	5	Descriptive	Social media
A8	2	-	Descriptive	Public sector
A9	4	-	Descriptive & comparative	General

ID	Dimensions	Stages/ Levels	Model functionality	Industry
A10	5	4	Descriptive, Prescriptive & comparative	Manufacture
A12	7	5	Descriptive	Education
A14	6	-	Descriptive	General
A15	4	-	Descriptive	Healthcare
A16	5	-	Descriptive	IT
A17	3	6/3-4	Descriptive & Prescriptive	General
A18	2/8	5	Descriptive	Manufacture
A19	2	4/3	Descriptive	Management
A20	6	5	Descriptive	Manufacture
A21	2/5	-	Descriptive	General
A23	10	5	Descriptive	General
A24	8	4	Descriptive & Prescriptive	Manufacture
A27	4	-	Descriptive	Manufacture
A29	4	3	Descriptive	ICT
A30	10	-	Descriptive	Industry
M1	9	5	Descriptive	Manufacture
M2	4	5	Descriptive	Industry/IT
M3	4	5	Descriptive & Prescriptive	Manufacture
M4	5	6	Descriptive	General
M5	6	5	Descriptive	Education
M6	5/7	5	Descriptive	Manufacture

2.2.2.2 Elements assessed by the available DM models from an EA perspective

Following identifying the maturity models, a thorough analysis was conducted using the components and layers of the adaptive EA framework proposed by Gill (2015). This framework was selected because it offers a comprehensive perspective on enterprise design that extends beyond technological aspects, enabling a methodical documentation and synthesis of findings. While DM primarily focuses on organisational and technological competencies, EA ensures these competencies are designed and aligned holistically, as Gebayew *et al.* (2018) noted. Consequently, the enterprise design components and tiers outlined in Gill's adaptive EA framework served as the conceptual framework for this review.

Adaptive EA is structured into six conceptual layers: interaction, human, technology, facility, environment, and security, as described by Anwar and Gill (2019). The identified maturity models were thoroughly examined using these adaptive EA layers and their corresponding elements (refer to Table 2-3). This analysis aimed to determine the extent to which existing maturity models support the assessment of architecture design layers and their underlying components collectively representing the enterprise design.

Interaction layer: This layer encompasses the various actors and their engagements through diverse digital touchpoints, channels, and overall journey experience. A channel refers to the communication technique organisations provide to their customers, while touchpoints are specific interaction instances within these channels. This layer is used to identify whether the selected models assess the DM of the “interaction” layer elements. As shown in Table 2-3, most models primarily focus on measuring actor interactions. More than half of the models incorporate channels and experience in their DM assessments. However, only three models explicitly mention the touchpoint component. This analysis reveals significant gaps in the reviewed maturity models' coverage of the interaction layer elements, particularly in addressing touchpoints and providing a comprehensive view of the customer journey across all interaction elements.

Technology layer: This layer encompasses the architecture domains of applications, data, platforms, and infrastructure. Nearly all the selected maturity models acknowledge the importance of technology in this layer, apart from two models that did not include it.

Human layer: This layer includes the domains of business, information, social, and professional architecture. Most DM models recognise this layer, addressing all or some of its non-technological elements. Most dimensions in the DM models focus on this layer's business and professional aspects. However, three models neglect the human elements of the organisation, likely due to their emphasis on technological aspects.

Security layer: This layer addresses security concerns across all other layers and elements. The SLR reveals that existing maturity models inadequately cover the security layer. For example, models A10, A4, M2, and M4 mention IT security as a general dimension, which may not encompass all elements of the security layer (e.g., asset, value, risk, resilience).

Model A16 explicitly mentions the ability to respond quickly to security risks, while model A2 primarily focuses on game security (product-specific).

Environment layer: The PESTEL analysis is a strategic management tool used to examine macro-environment factors, aiding strategists in identifying opportunities and risks (Witcher and Chau, 2010). It mirrors external environmental factors to capture opportunities and threats. As demonstrated in Table 2-3, only seven maturity models briefly explored PESTEL, mainly focusing on legal, social, and technological factors when assessing maturity. Six models mentioned legal aspects, four concentrated on technological elements, and model A12 acknowledged monitoring global trends as a factor in DM, potentially including social and/or technological trends.

The facility layer, which includes spatial, energy, heating, ventilation, air conditioning (HVAC) and ancillary elements, is not addressed by any of the selected models in terms of digitalisation. This omission represents a significant gap that should be considered alongside the other identified gaps in the existing maturity models.

Table 2-3 Analysis of maturity models - adaptive EA layers and element perspectives

ID	Interaction layer				Technology Layer				Human Layer				Security Layer				Environment Layer					
	Actors	Touch-point	Channel	Experience	Application	Data	Platform	Infrastructure	Business	Info.	Social	Professional	Asset	Value	Risk	Resilience	P	E	S	T	E	L
A1			✓	✓		✓			✓	✓	✓	✓	✓	✓	✓							
A2	✓			✓		✓			✓	✓	✓	✓	✓	✓	✓	✓						
A3	✓		✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓						
A4	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
A5	✓		✓	✓			✓	✓	✓	✓	✓	✓										
A6	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
A7	✓					✓	✓	✓	✓	✓		✓										
A8	✓		✓	✓			✓	✓				✓										
A9	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓											
A10	✓				✓	✓	✓	✓	✓	✓		✓										
A12	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓		✓
A14	✓		✓	✓	✓	✓	✓															
A15	✓			✓	✓	✓	✓															
A16	✓		✓	✓					✓	✓	✓	✓			✓	✓					✓	✓
A17	✓		✓			✓		✓	✓	✓	✓											
A18	✓		✓	✓		✓	✓		✓		✓											

ID	Interaction layer				Technology Layer				Human Layer				Security Layer				Environment Layer						
	Actors	Touch-point	Channel	Experience	Application	Data	Platform	Infrastructure	Business	Info.	Social	Professional	Asset	Value	Risk	Resilience	P	E	S	T	F	L	
A19	✓				✓	✓		✓	✓			✓											
A20	✓								✓	✓													
A21									✓			✓									✓		
A23			✓					✓	✓	✓		✓											
A24	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓					✓		✓
A27	✓		✓	✓				✓	✓			✓											
A29	✓				✓	✓	✓	✓				✓											
A30	✓			✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓							✓
M1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												✓
M2	✓				✓	✓	✓	✓					✓	✓	✓	✓							
M3					✓	✓	✓	✓	✓	✓													
M4					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
M5					✓	✓	✓	✓	✓	✓	✓												
M6	✓			✓		✓		✓	✓			✓											✓

2.2.2.3 Scales or Levels for Assessing DM

The concept of maturity level, stage, or degree is defined by Lasrado, Vatrapu and Andersen (2015) as a means to provide an overall summary or maturity assessment of an entity at the highest level of abstraction. It represents the level of competency, capability, or complexity in each selected area (De Bruin *et al.*, 2005). An analysis of the 30 maturity models mapped earlier reveals that approximately 68% employ multiple levels to assess the extent of digitalisation, as detailed in Table 2-4.

Various approaches have been developed to conceptualise maturity levels. These range from simple scales assigning scores to dimensions based on digitalisation development and implementation, to complex multi-faceted levels represented in three-dimensional diagrams. The analysis shows that most models use 4 to 6 levels, starting from the lowest (e.g., basic, absent, initial) to the highest maturity level (e.g., mature, developed, integrated), as depicted in Table 2-4. The aim is to comprehend the different levels, their semantics, and meanings, as well as to analyse how they are labelled to identify common patterns. The review reveals significant disparities among the models in terms of labelling

and meanings. Some levels are denoted by numbers, others by text, and they often carry different semantic implications.

This diversity highlights the importance of streamlining and consolidating maturity levels and their measurement methods. It suggests the potential benefit of developing different guidelines for each level to ensure consistency and standardisation in maturity assessment. Implementing a principle-based strategy for maturity evaluation could provide a versatile yet universal framework capable of accommodating context-specific measurements as required. Such an approach would balance the need for consistency across different models with the flexibility to adapt to unique organisational contexts.

Table 2-4 Analysis of maturity models - levels of maturity

ID	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
A1	Incomplete process / Process capability	Performed process / Process capability	Managed process / Process capability	Established process / Process capability	Predictable process / Process capability	Innovating process
A2		Ad-Hoc	Opportunistic	Consistent	Organised	Optimised
A3	Basic	Initial		E-enabled	E-confident	E-mature
A5	-	Promote and support	Create and build	Commit to transform	User-centered & elaborated processes	Data-driven enterprise
A7	Level 1	Level 2	-	Level 3	Level 4	Level 5
A10	Absence	Novice	-	Intermediate	-	Expert
A12	Basic	Initial	-	E-enabled	E-confident	E-mature
A17	Basic infrastructure		Computerisation	Connectivity	Transparency	Adaptability
A18	-	Digitalisation awareness	Smart networked products	Service-oriented enterprise	Thinking in service system	Data-driven enterprise
A19	-	Reactive Management	Real-time Management	-	Predictive Management	Proactive Management
A20	0	1	2	3	-	4

ID	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
A23	Absence of digital initiatives	Planned	Just started	Under development	-	Developed and ongoing
A24	Level 1	-	Level 2	-	Level 3	Level 4
A29	Low	-	-	Medium	-	High
M1	Level 1	Level 2		Level 3	Level 4	Level 5
M2	Basic Digitisation Level	-	Cross-Departmental Digitisation	Horizontal and Vertical Digitisation	Full Digitisation	Optimised Full Digitisation
M3	-	Initial	Managed	Defined	Integrated and Interoperable	Digital-oriented
M4	None	Basic	Transparent	Aware	Autonomous	Integrated
M5	Digitally minimalist	Digitally conservative	Digitally pragmatist	-	Digitally advanced	Digitally trailblasing
M6	Novice	Beginner	Learner	Intermediate	-	Expert

2.2.2.4 Result of systematic literature review: DM models

First, a comprehensive analysis of DM models reveals a significant oversight in assessing interaction-related aspects. While 80% of the reviewed models discuss actor interactions and their DM, indicating a need for enhanced cooperation and integration, fewer consider the actual experiences of those involved, such as customers, partners, and employees. Additionally, the concept of touchpoints, or specific interaction touchpoints, is often overlooked. For example, study A15 devotes an entire dimension to assessing the DM of non-human actor integration. However, when evaluating human actors' interaction experiences, nearly half of the models fail to incorporate it as a dimension or measurement. Interaction maturity should be assessed across multiple levels, ranging from 0 to 5, with specific principles adapted to the context. Furthermore, 43% of the models fail to consider the digital experience aspect.

Secondly, DM involves evaluating and enhancing an organisation's digital capabilities for human and technology layers. While most models address both human and technology aspects, there are notable gaps in certain areas, particularly within the human layer, such as

social architecture (refer to Table 2-3). This suggests a need for more comprehensive assessments in these areas.

Thirdly, from a security standpoint, it is widely recognised that one of the traditional challenges of digitalisation is the increased exposure to various cyber risks. However, it is shocking to note that approximately 63% of DM models appear to neglect this critical issue. Even those models that acknowledge security often discuss it superficially, mentioning it as a concern without providing in-depth details. This oversight highlights the need for more comprehensive research into assessing and enhancing "digital security" maturity.

Fourthly, the analysis of the environment layer reveals that less than a quarter of the models consider external environmental factors, with only limited attention given to legal and technological aspects. Notably, the review highlights a significant oversight in existing DM models, namely the lack of attention to facility digitalisation. This gap in the literature needs to be addressed to assess and manage facility DM levels properly.

Finally, an investigation of the terminology, scales, and labelling used to express maturity levels shows considerable variation. Maturity scales range from qualitative descriptors (low to high) to numerical ratings (0 to 6). This diversity underscores the need for research to standardise the concept of DM levels. Such formalisation would provide a consistent knowledge base for both practitioners and researchers in developing and applying DM models. The findings point to the need to create a comprehensive taxonomy and ontology for DM assessment, which would enhance consistency and clarity in the field.

In conclusion, the findings of this study analysed through the lens of adaptive EA, lay the groundwork for developing an architecture-driven framework for maturity assessment. It is important to note that organisations may not need to achieve maturity across all architectural areas; instead, they can focus on specific layers and elements that align with their business objectives. Further research could explore additional aspects of maturity levels and success criteria, potentially incorporating these into existing maturity assessment models. These maturity assessment models could be abstracted into a generic metamodel and ontology to ensure consistency and facilitate reuse. This approach would enable organisations to develop tailored DM models based on a standardised framework, allowing for customisation while maintaining a common underlying structure. A notable finding from

the analysis of maturity models is the apparent lack of guidance for assessing maturity within and across various adaptive EA layers and their components. This is a significant oversight that is crucial for achieving a cohesive and coordinated enterprise design. This gap highlights an important area for future research. It's worth noting that while maturity levels and their descriptions are key features of maturity model structures, they represent only one aspect. This observation opens opportunities for further research to explore additional features from the perspective of architecture layers. Such research could potentially uncover new dimensions for assessing and understanding DM more comprehensively.

2.2.3 Systematic review 2: digitalisation performance as reported in (Alsufyani and Gill, 2022)

To explore the performance outcomes of digitalisation and DT, an SLR was conducted, following the methodology outlined by Kitchenham and Charters (2007). This SLR aimed to systematically review and synthesise the PIs associated with digitalisation from the perspective of EA design. A sum of 30 studies were carefully selected and reviewed from recognised academic databases relevant to DT and enterprise performance (refer to Appendix B). They were carefully selected and reviewed according to the search method described in section 2.2.1. For clarity and ease of reference, each study is marked with “B” followed by a number; for instance, B1 represents the first selected study. This representation is used through the manuscript and tables to identify and discuss the selected studies.

The findings of this SLR were analysed using the adaptive EA framework (Gill, 2015) and the results and determinants framework (Fitzgerald *et al.*, 1991) as theoretical lenses. This approach effectively categorises the results of the SLR, providing comprehensive coverage of the performance outcomes of digitalisation. The review findings are reported according to the following categories: (1) performance outcomes of DT; (2) measures, scales and metrics of performance outcomes of digitalisation / DT; (3) the process or method of measurement of PIs. Additional details discussing the research methodology of the second SLR are provided in (Alsufyani and Gill, 2022).

2.2.3.1 Performance outcomes of digitalisation / DT

The literature on the performance outcomes of digitalisation is diverse and fragmented, as scholars such as Hanelt *et al.* (2017) and Nandkumar *et al.* (2018) noted. To address this, an

adaptive EA framework was employed as a theoretical lens to systematically organise and synthesise the scattered findings in the existing literature. PIs related to specific digitalisation aspects were extracted using the results and determinants framework and then mapped to corresponding EA layers. These PIs were categorised according to six generic performance dimensions outlined in the results and determinants framework (Fitzgerald *et al.*, 1991). For example, in study B20, market share was identified as a PI under the competitiveness dimension, measuring the impact of market intelligence capability, which was interpreted as a business capability within the EA's human layer. Similarly, additional PIs are aligned with the dimensions of the results and determinants framework as well as the layers of adaptive EA. An analysis of the selected studies revealed that a significant majority (73%) explored the financial influence of digitalisation, including profitability, cost efficiency, and market value (Figure 2-1). Resource utilisation was explored in 43% of studies, while competitiveness outcomes were the focus of one-third (33%) of the research. Interestingly, only 16% of studies highlighted the impact of digitalisation on innovation, and a mere 6% studied quality and flexibility performance outcomes. Notably, most extracted PIs are related to resource utilisation, with only 14 PIs associated with financial aspects (refer to Figure 2-2). 51 PIs were identified across various performance dimensions, further discussed in this section. The analysis also showed that both the count of studies and PIs could be allocated to multiple PI types or categories.

Figure 2-1 and Figure 2-2 provide visually contrasting views of the research findings, demonstrating the distribution of studies and PIs across different performance dimensions and categories.

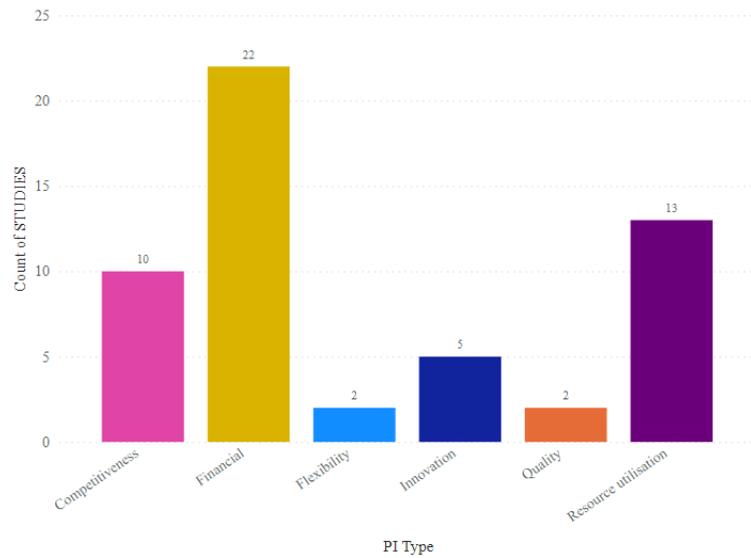


Figure 2-1 Count of studies by PI type

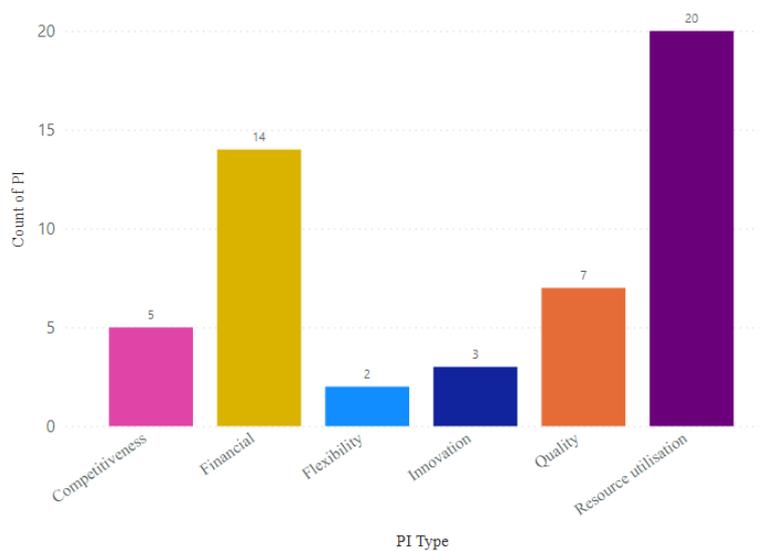


Figure 2-2 Count of PI by PI type

Interaction Layer: The analysis identified 12 PIs associated with the interaction layer of digitalisation. Appendix C shows that these indicators predominantly focus on actor interactions, with only one indicator addressing the impact of digital channels and touchpoints. Most of these PIs are financial, while single indicators were found for competitiveness, resource utilisation, and flexibility. Only six papers (20% of the reviewed literature) acknowledged this layer, revealing a significant gap in the current research landscape.

Human Layer: A significant portion of the reviewed literature (77% or 23 studies) focused on digitalisation outcomes within the human layer, particularly in business contexts. Our analysis, as detailed in Appendix C, revealed 46 PIs across results and determinants categories within this layer. These PIs predominantly fell under resource utilisation (37%) as determinants and financial outcomes (26%) as results. The financial indicators largely emphasised profitability over cost efficiency (10%). Most studies (60%) concentrated on determinant results, with resource utilisation being the most prominent (33%), followed by innovation (17%), quality (7%), and flexibility (3%). Conversely, more than half of the papers examined result outcomes, with 50% focusing on financial aspects and 20% on competitiveness. While most indicators related to business layer digitalisation, only 17% of the studies specifically addressed social and professional aspects. Interestingly, none of the reviewed studies explored the performance impact of digitalisation in the information layer, highlighting a significant research gap in this area.

Technology Layer: The analysis revealed that only 20% of the reviewed studies (6 papers) addressed performance outcomes from a technology viewpoint within this layer (as shown in Appendix C). These studies primarily focused on resource utilisation (5 studies) and financial aspects (4 studies). Notably, papers B5 and B11 were the only ones to examine the impact of digital infrastructure on performance specifically. The remaining studies discussed the influence of digital technology and capabilities in general terms without detailing which specific elements of the technology layer affected performance outcomes. This observation highlights a significant gap in the literature, particularly considering the crucial role of technology in digitalisation. Our review identified 16 PIs associated with the technology layer, distributed as follows: six financial, five resource utilisation, three competitiveness, one innovation, and one flexibility PI. This distribution underscores the need for more comprehensive research into the technology layer's impact on various performance dimensions in the context of digitalisation.

Security Layer, Environment Layer and Facility Layer: Surprisingly, the analysis revealed that only one study (B4) explored the impact of digital technology and supply-chain platforms on both financial and environmental performance. This study's findings were influenced by several factors that could be considered part of the environment layer, including significant changes in production and service delivery methods, shifts in consumer demographics,

frequent regulatory changes, and shortened product lifecycles (Li et al. 2020). None of the 30 reviewed studies addressed performance outcomes related to digitalisation's security and facility aspects. This observation and the other gaps identified in this literature review represent a significant oversight in the current research landscape.

2.2.3.2 Measures, scales and metrics of performance outcomes of digitalisation / DT

Various measures, scales, and metrics of digitalisation performance outcomes were extracted to facilitate a more structured analysis of these performance measures; then, the extracted PIs were categorised into six primary dimensions, utilising the results and determinants framework as the guiding structure. This approach allowed for a more systematic exploration and understanding of the different types of PIs identified in the literature.

As illustrated in Figure 2-3, the analysis identified 22 different measures across six PI types. Profitability indicators within financial performance outcomes were reported in approximately 27% of the studies, while market value and cost-effectiveness were addressed in less than 10%. Competitiveness measures, including sales growth, market share, and customer base, were found in fewer than 7% of the reviewed studies. The remaining four dimensions focus on performance determinants: 50% of the studies examined resource utilisation efficiency, while less than 10% explored productivity, integration, and autonomy. Quality satisfaction was addressed in 10% of the studies, and only 3% investigated the efficiency and effectiveness of innovation and flexibility. These data from Appendix C demonstrate how various indicators can be grouped to assess different measures. For instance, return on assets, revenue, and profit collectively represent profitability, counting as a single measure.

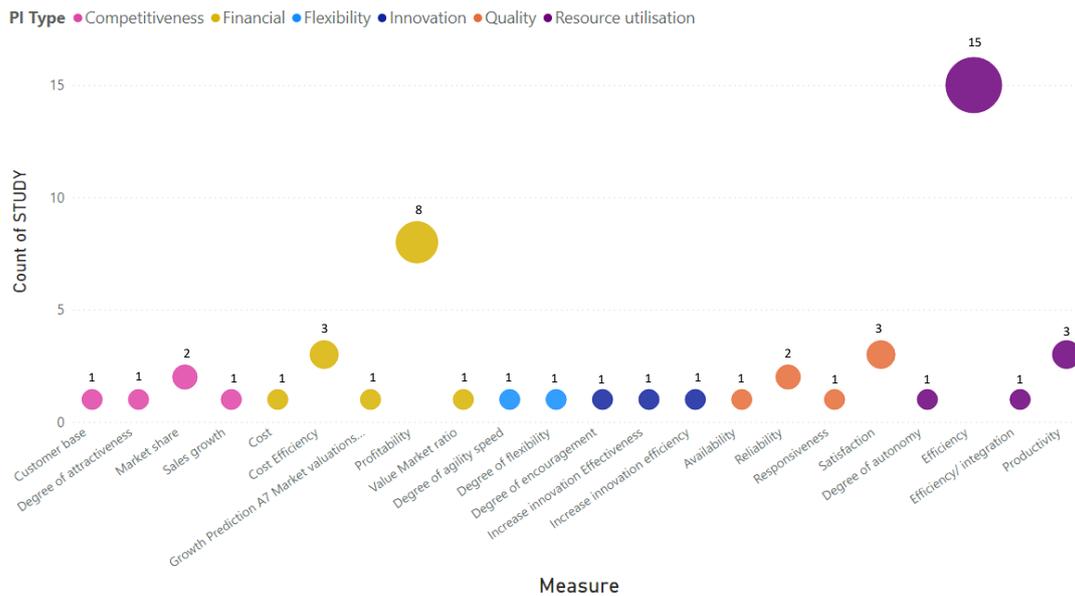


Figure 2-3 Count of studies by PI type and measure

This diversity in measurement approaches highlights the complexity of assessing performance across different dimensions, particularly when comparing financial and non-financial metrics. Financial performance metrics exhibit more significant variability than the other five performance dimensions. These financial metrics can be expressed as ratios, means, or averages, depending on the scales or units used to measure the PIs. The analysis revealed that 45% of the studies derived financial performance data directly from financial reports. This approach involved either examining a specific year's financial figures or comparing them to the previous year's performance. Interestingly, less than 25% of the studies used Likert scales (3, 5, or 7-point scales) to assess financial dimensions. These scales were used to compare performance against the previous year or competitors. This analysis observed that the five non-financial performance dimensions were predominantly evaluated using Likert scales, with some exceptions. For instance, study B5 reported on the impact of a digital network (the inter-bank financial telecommunication network SWIFT) by measuring the reduction in the labour-capital ratio compared to previous years.

2.2.3.3 The process or method of measuring the PIs

This section examines the methods employed in measuring PIs related to digitalisation. Our literature review uncovered a variety of approaches, including surveys, financial report analysis, and qualitative interviews. Most studies (63%) utilised questionnaire-based methods for PI measurement. Financial data extraction was employed by 30% of the

studies, while 10% calculated the ratios for non-financial indicators. Regarding financial indicators, nine studies analysed data directly from financial reports, whereas 12 studies used questionnaires to assess financial performance. Profit, the most commonly identified financial indicator, was predominantly evaluated using survey-based methods to gauge the impact of digitalisation on profitability, with study B16 being an exception. The preference for survey-based methods extends to both financial and non-financial indicators. This approach is favoured for capturing subjective measures, facilitating efficient data collection, and maintaining confidentiality. However, it is worth noting that this method may face challenges such as low response rates and desirability bias, as highlighted by Patten (2016). This analysis reveals a clear trend towards survey-based assessments in measuring the impact on the performance of digitalisation while also acknowledging the use of other methods in the field.

2.2.3.4 Results of systematic literature review: Digitalisation performance

As a result of the SLR, performance outcomes were extracted as PIs and associated with one or more relevant adaptive EA layers and their underlying elements. The results and determinants framework categorised Each PI across six performance dimensions. Additionally, where possible, each PI's measures, metrics, and scales were identified. By navigating PIs within the context of adaptive EA and the results and determinants frameworks to synthesise the extracted data (refer to Appendix C), various significant observations emerged:

First, the analysis of 30 selected studies yielded a substantial set of 51 PIs related to the digitalisation of interaction, human, and technology layers. While resource utilisation indicators were prominent in 40% of the studies, financial indicators were the focus of two-thirds despite representing less than 30% of the extracted PIs (as shown in Figure 2-3). This finding underscores the importance of both financial indicators and resource utilisation metrics when evaluating and planning digitalisation performance outcomes within an adaptive EA framework.

Second, only 23% of the identified PIs pertained to the interaction layer (Figure 2-4). Most were associated with actors in this subset, while only one PI addressed digital channels and touchpoints. This observation highlights a significant gap in the current research landscape. It suggests that the interaction layer, particularly aspects such as touchpoints, channels, and

user experience, has not been thoroughly explored regarding its potential impact on performance. This finding points to a clear need for further investigation into the PIs related to the digitalisation of interaction and their influence on organisational outcomes.

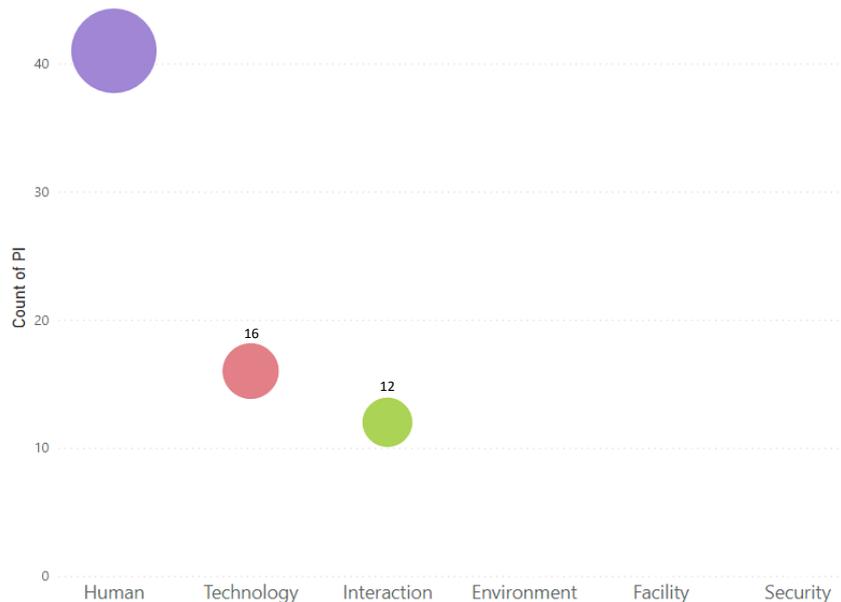


Figure 2-4 Count of PI by layer

Third, the analysis revealed that most of the identified PIs correspond to the human layer of the adaptive EA framework, as illustrated in Figure 2-4. Specifically, 70% of these indicators relate to the business element, as detailed in Appendix C. Additionally, 17% of the indicators address social and professional aspects within this layer. Interestingly, the study found no indicators associated with the information element, considered a crucial aspect of digitisation and digitalisation. This absence is particularly striking, given the central role of information in DT processes, as emphasised by scholars like Gill (2021). This finding highlights a significant imbalance in the focus of the reviewed studies. While the business aspects of the human layer are well-represented, there is a notable lack of attention to the impact of information digitalisation on performance outcomes.

Fourth, the analysis, as detailed in Appendix C, revealed that only 20% of the reviewed studies focused specifically on the technology layers, resulting in the identification of only 16 PIs related to this aspect (as shown in Figure 2-4). This observation highlights a significant gap in the current literature regarding the technology perspective of digitalisation. It is important to note that while digitalisation is only one of many organisational factors that can influence performance outcomes directly or indirectly, it plays a crucial role in managing

various organisational tasks across the entire system. Digitalisation can be conceptualised as a cross-cutting element in enterprise design, interconnected with other elements throughout the organisation. This finding underscores the need for more comprehensive research exploring digitalisation's technological dimensions and their impact on organisational performance. Future studies should bridge this gap by examining how digital technologies integrate with and influence other organisational elements, providing a more holistic understanding of the role of digitalisation in EA and performance.

Fifth, this study has uncovered a significant oversight in the current research landscape: the impact of digitalisation on security, environment, and facility layers, along with their underlying elements, has been largely neglected. This observation points to a critical gap in the literature that needs to be addressed to fully understand the performance implications of digitalising these crucial aspects of organisational infrastructure.

Sixth, the insights from this review were synthesised into a comprehensive set of PIs, as presented in Table 2-5. These PIs are categorised under six performance dimensions, reflecting various aspects of organisational performance measurement. This consolidated set of PIs represents an initial step towards developing a digital performance metamodel. This concept explored further in future research directions, aims to provide a more holistic framework for understanding and measuring the multifaceted impacts of digitalisation on organisational performance across various layers and elements of EA.

Table 2-5 Consolidated set of PI digital performance

	PI Type	Measure	PI	Source
1	Competitiveness	Market share	Market share	B20 B23 B4 B11 B2 B19
2			Internationalisation performance	B13
3		Sales growth	Sales growth	B4 B12 B23 B24 B15
4		Customer base	Customer acquisition	B20
5		Degree of attractiveness	Sales per customer	B20
6	Financial	Cost efficiency	Enterprise efficiency ratio	B7 B5
7			Operating cost	B3
8			Sales cost	B3
9		Cost	IT investment - infrastructure	B2
10		Growth prediction market valuations	Enterprise stock market measures	B7 B18
11		Market value	Enterprise market value	B16 B18 B28 B29

	PI Type	Measure	PI	Source	
12		Profitability	Income	B21	
13			Operating margin	B5	
14			Operating return on assets	B10	
15			Return on asset	B3 B7 B9 B10 B11 B29	
16			Return on investment	B4 B15	
17			Revenue	B6 B19 B20 B29 B5 B11	
18			Turnover	B2 B29	
19			Profit	B4 B15 B2 B16 B12 B17 B23 B24 B27 B29	
20			Flexibility	Degree of agility speed	Enterprise agility
21	Degree of flexibility	HR flexibility		B12	
22	Innovation	Degree of encouragement	Talent management performance	B1	
23		Degree of innovation efficiency	Enterprise innovation efficiency	B18	
24		Degree of innovation effectiveness	Enterprise innovative effectiveness	B13 B15 B17 B18	
25	Quality	Satisfaction	Demand rationalisation	B30	
26			Purchases quality	B30	
27			Customer satisfaction	B23	
28		Availability	Availability	B23	
29		Reliability	Awareness	B23	
30			Brand associations	B23	
31		Responsiveness	Consumer attitudes	B23	
32	Resource utilisation	Efficiency	Customer retention	B15	
33			Ecotourism performance	B26	
34			Enterprise in ecosystem connectivity	B8	
35			HR development performance	B1	
36			Business flexibility	B14	
37			Cost-effective use of IT	B14	
38			IT for asset utilisation	B14	
39			IT for growth	B14	
40			Labor-capital ratio	B5	
41			Market value capture	B20	
42			Market value creation	B20	
43			Operational performance	B25 A30	
44			Procurement savings	B30	
45			Environmental performance	B4	
46			HR efficiency	B12	
47			Efficiency/ integration	Process digitisation	B8
48			Productivity	Work performance	B1

	PI Type	Measure	PI	Source
49			Employee job performance	B22
50			Information visualisation	B8
51		Degree of autonomy	Business unit IT autonomy	B11

Figure 2-5 visually represents the frequency with which each PI is discussed across the reviewed studies.

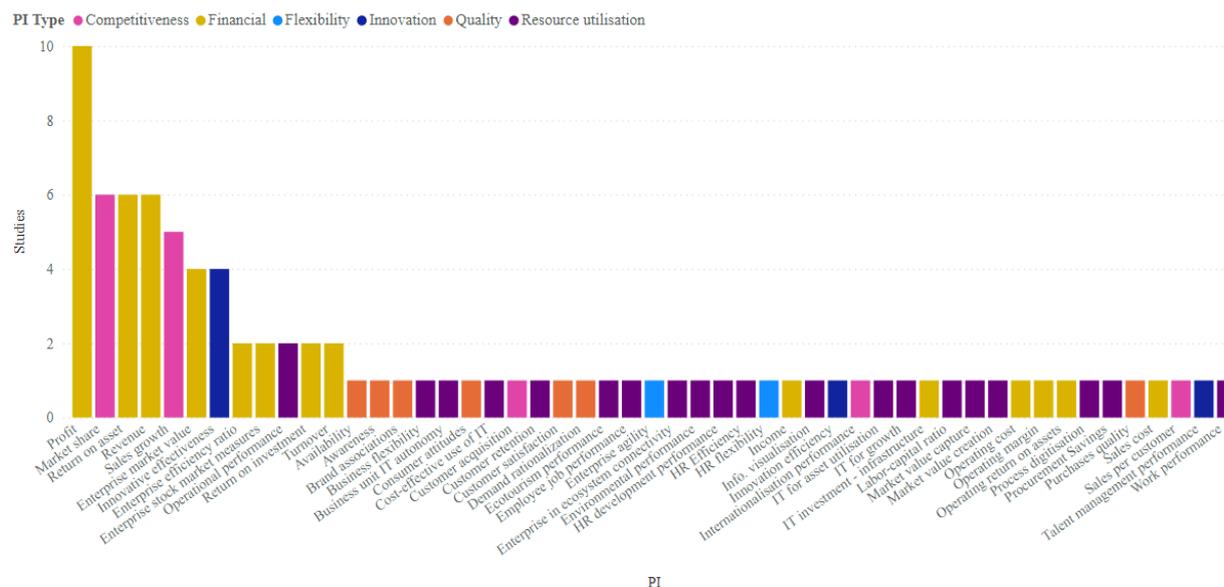


Figure 2-5 Count of studies addressing each PI

Finally, the SLR examined the measures, scales, and metrics used in the existing literature to evaluate the impact of digitalisation on performance outcomes (detailed in Appendix C). These measures were analysed and synthesised based on PI types, initially categorised using the results and determinants framework. Key measures identified include profitability, cost-effectiveness, market value, market share, customer base, sales, customer base, product attractiveness, efficiency, satisfaction, productivity, responsiveness, reliability, flexibility, innovation, and availability (as shown in Figure 2-3). Scales and metrics vary between financial and non-financial performance dimensions. Non-financial measures typically employ 3, 5, or 7-point Likert scales, while financial measures use either financial report data or Likert scales. Metrics range from ratios to means or averages. Nonetheless, some studies (B4, B15, B17, B24, B29, B30) used means to summarise ordinal or categorical data, which is statistically unreliable. This observation highlights the need for more rigorous, scientifically grounded research in this field. Data collection methods in the reviewed

studies primarily included surveys, financial report analysis, non-financial aspect ratios, and qualitative interviews.

Significantly, some PIs could be associated with multiple EA layers, underscoring the interdependent and integrative nature of the impact of digitalisation. This finding suggests that future research needs to adopt a holistic, systems-thinking approach rather than focusing on individual layers or elements. Such an approach would help avoid sub-optimisation when assessing and planning digitalisation performance outcomes across an enterprise. In conclusion, this review reveals opportunities for more scientifically robust and practically applicable research in the field of digitalisation performance assessment, emphasising the need for a comprehensive, integrated perspective on the topic.

2.3 Additional review

This section incorporates the latest relevant literature through a manual search to ensure comprehensive coverage of the relevant literature. The manual search specifically targets studies addressing DM and organisational performance for informed decision making to uplift digitalisation for performance outcomes.

Most of the recent literature focuses only on the DM assessment models, not the link between DM levels and organisational performance for informed decision making to uplift digitalisation for performance outcomes. For example, Haryanti et al. (2023) concluded that a digitalisation self-assessment maturity model is designed to identify and improve DT maturity levels across seven interrelated dimensions. Such a model provided practical implications for organisations by utilising the Emprise test of the ISO/IEC Assessment. Another study by Hortovanyi *et al.* (2023) focuses on delivering a measurement scale for the digital capability maturity model (DCMM). It provides a structured framework for managers to prepare to assess, and advance through the DT stages. Aras and Büyüközkan (2023) developed a comprehensive DM model based on an SLR to define six key dimensions for assessing DM without directly linking these maturity levels to organisational performance outcomes. The focus is primarily on developing an assessment tool rather than demonstrating how maturity levels impact organisational performance. Moreover, Tubis (2023) developed a comprehensive DM assessment model focusing on organisational and process dimensions, providing a five-step scale for evaluation and a diagnostic tool for auditing DT progress. While both offer a valuable tool for assessment, they do not address

how different levels of DM correlate with the performance metrics necessary for informed decision making to enhance DT efforts. Those studies provide methods for organisations to evaluate the DM, yet, it does not offer insights into how this assessment can be used to make informed decisions to improve digitalisation and enhance performance outcomes. The efforts of these studies are either to provide an assessment tool for DM levels or identify capability gaps for DT progression process; however, they do not consider the impact or the relationship between DM and organisational performance.

There is a lack of empirical data investigating the relationship between DM and performance and the level of DM and organisational performance (Thordsen and Bick, 2023; Kalender and Žilka, 2024; Telukdarie, Sishi and Tshukudu, 2024). This indicates that the research problem remains relevant due to a continued lack of research efforts to address it. This gap in knowledge highlights the ongoing need for further investigation to tackle the issue comprehensively.

2.4 Research gap

Investigating DM and performance revealed the necessity for, and provided the drive and basis for, combining two frequently disconnected yet interrelated digital and performance components, as discussed in this chapter. It highlighted the lack of theoretical underpinning and empirical evidence in maturity and performance assessment and the lack of linking between maturity level and organisation performance outcomes. This highlights the importance of developing a comprehensive theoretical and practical understanding of how DM and performance elements can be integrated. Such an understanding is crucial for making well-informed decisions to enhance digitalisation efforts to achieve improved performance outcomes. Drawing on the gaps above, the research problem approaches DM and performance assessment and links them together using further theoretical lenses to provide a much-needed theoretical foundation for these ad-hoc and disparate domains (Figure 1-2).

This research aims to contribute to the understanding of DM and organisational performance by tackling the requirement for a comprehensive theoretical and practical grasp of how DM and performance components interrelate. This understanding is essential for making well-informed choices to boost digitalisation efforts and yield enhanced performance results. This research proposes the need for a digital by-design approach to

address the gap. Thus, this research proposes to use the adaptive EA-driven approach to link DM and performance assessment across different layers of the enterprise.

The research gaps explored in this thesis stem from the problem outlined in Chapter 1 (refer to Section 1.2) and the findings of the comprehensive analysis conducted in SLR 1 and 2 across academic and industry fields (chapter 2). These gaps are addressed by the research questions established in Chapter 1 (refer to Section 1.3). The proposed DEAMP assessment framework aims to bridge the research gaps outlined in Table 2-6 by offering a comprehensive framework that addresses the linkage between DM levels and organisational performance for informed decision making to uplift digitalisation for performance outcomes. These research gaps, detailed in Table 2-6, are directly linked to the research topic and questions.

Table 2-6 Research gaps

Broad Topic	Narrowed Topic	Research Gap	Research Question
Digitalisation and DT	DM models.	1. There is a lack of theoretical underpinning and empirical evidence in maturity and performance assessment. 2. There is a lack of a link between maturity level and organisational performance outcomes.	RQ 1 focuses on identifying and understanding the elements and factors involved in measuring the DM of an organisation. This involves reviewing the existing literature, frameworks, and methodologies for assessing DM and determining the key indicators or metrics that can effectively measure the DM levels within an organisation.
Organisational performance	The influence of digitalisation on organisational performance outcomes.	3. There is a lack of both theoretical and practical comprehensive understanding regarding the integration of DM and performance elements. This limit informed decision-making that could enhance digitalisation	RQ 2 concentrates on exploring methodologies and approaches for measuring the digitalisation performance of an organisation. This may involve examining various performance metrics, tools, and techniques used to assess the extent to which an organisation has implemented digitalisation initiatives and achieved the desired outcomes. RQ 3 addresses the linkage between DM levels and organisational performance,

Broad Topic	Narrowed Topic	Research Gap	Research Question
		efforts to improve performance outcomes.	considering both theoretical perspectives and empirical studies for informed decision making to uplift digitalisation for performance outcomes.

2.5 Summary

This chapter reviews the relevant studies to understand the research scope comprehensively. The research background and related work encompass studies on digitalisation, DM organisational performance, EA, ontology and KG. Additionally, the chapter discusses the outcomes and results of two SLRs conducted using the methodology outlined by Kitchenham and Charters (2007) to recognise the research gaps and formulate the proposed solution. This highlighted the need to address the critical question of how to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? However, this requires understanding how to measure the DM and digitalisation performance of an organisation to link DM levels and the performance of an organisation. Additionally, it includes a review of recent studies identified through a manual search relevant to the focus of this research. The methodological approach employed for this research will be discussed in the subsequent chapter (Chapter 3).

3 Chapter 3 Research Method

This chapter explores the methodological approach for this research, detailing the iterative process utilised in DSR to identify the research problem, analyse the literature review data, develop and evaluate the DEAMP framework, and shape the research output. The research methodology outlines the steps involved in creating and evaluating an artefact. The choice of methods and tools depends on the research problem and goals set out in Chapter 1 and the resources and data available from the literature review conducted in Chapter 2. While various methods could have been employed, the practical requirements of the research question necessitated an iterative approach. Thus, a DSR method, following the guidelines by (Vaishnavi and Kuechler, 2007), was chosen to develop and evaluate the proposed DEAMP framework.

3.1 Research methods overview

Research methodology, according to Kothari (2004), is defined as a systematic method to resolve research problems and demonstrate the research process. It outlines suitable methods to construct and evaluate an artefact (Guba & Lincoln, 1994). As Crotty (1998) described, research methods refer to a collection of techniques for gathering and analysing data related to specific research questions or hypotheses. Choosing a research method hinges on various considerations, such as the characteristics of the research problem and its goals, the resources and data available, and the research policies associated with the institution or organisation (Benbasat *et al.*, 1987). However, IS research encompasses various research methodologies, as highlighted by Vaishnavi and Kuechler (2015), with which this study aligns. Consequently, multiple methodologies are available in the literature for selection, including DSR, case studies, grounded theory, analytical surveys, action research and experimental research (Crotty, 1998; Gray, 2014; Vaishnavi & Kuechler, 2015). However, sections 3.1.1 to 3.1.4 provide a brief definition of each of the available research methods to logically build a foundation for comparison and contrast of these methodologies, leading to section 3.1.5 clarifying why DSR is the most appropriate choice for this study.

The next section discusses a range of existing research methodologies and their suitability for this research.

3.1.1 Action research

Action research is a research methodology that involves active participation and collaboration between researchers and practitioners to address real-world problems or challenges within a specific context, generate practical knowledge, and bring positive change or improvement to the situation under study. Action research typically involves planning, action, observation, and reflection cycles, where insights gained from each cycle inform subsequent actions, leading to iterative improvements (Reason and Brandbury, 2008). This approach emphasises the collaboration of multiple stakeholders by integrating theory and practice to generate contextually relevant and applicable knowledge (Coughlan and Coughlan, 2002). Nevertheless, the research problem currently under investigation does not centre around the involvement and cooperation of industry stakeholders. Thus, this approach was deemed inappropriate for this research.

3.1.2 Grounded theory

Grounded theory research is a qualitative methodology that develops theories based on systematically collected and analysed data (Fernández, Lehmann and Underwood, 2002). This type typically begins with data collection. Then it is followed by iterative data coding, categorising, and theorising to identify patterns, themes, and relationships. The methodology aims to generate new insights and theoretical frameworks grounded in the empirical reality of the data rather than relying on pre-existing theories or hypotheses (Urquhart and Fernández, 2006; Urquhart, Lehmann and Myers, 2010). This approach is ideal to investigate research issues with limited existing literature, where new theories are needed (Urquhart, Lehmann and Myers, 2010). However, the aim of this research does not require new theories.

3.1.3 Experimental research

Experimental research is a systematic and scientific approach that mainly studies cause-and-effect relationships between variables by manipulating one or more variables and observing the effect on other variables in a controlled environment (Gray, 2014). It aims to determine whether changes in independent variables cause changes in dependent variables, allowing researchers to test hypotheses and theories. As Kirk (2009) outlined, the design process

typically involves formulating hypotheses, selecting variables, and determining appropriate measurement techniques. While experimental research offers many advantages, including the ability to isolate specific effects, Creswell and Creswell (2017) caution that it may have limitations regarding external validity or generalisability to real-world settings. The advantage of experimental research lies in its systematic replication of laboratory results, which ensures the precise measurement of outcomes (Gray, 2014). Yet, given that the research problem does not require the systematic manipulation of independent variables in a controlled environment, experimental research is unsuitable for the current project.

3.1.4 Design science research

DSR is a research methodology focused on creating and evaluating artefacts to address complex problems or challenges involving people, organisations, and technology interaction. Hevner et al. (2004) define DSR as achieving "knowledge and understanding of a problem domain and its solution... in the building and application of the designed artefact" (p. 75). Unlike traditional research, which primarily focuses on understanding and explaining phenomena, DSR emphasises developing and testing solutions. DSR aims to design, implement, and evaluate innovative artefacts, such as systems, models, methods, or frameworks, that contribute to solving real-world problems or advancing knowledge in the IS field (Hevner *et al.*, 2004; Peffers *et al.*, 2007). DSR offers several advantages, including bridging theory and practice, producing relevant outcomes, and contributing to both practical problem-solving and theoretical knowledge. DSR typically follows an iterative process involving problem identification, artefact design and development, evaluation, and reflection to produce valuable and actionable outcomes (Hevner *et al.*, 2004; Hevner, 2007; Peffers *et al.*, 2007; Vaishnavi and Kuechler, 2007). While different DSR methodologies exist, they generally share a focus on creating artefacts to address organisational problems and contribute to the scientific knowledge base (Vaishnavi and Kuechler, 2007). Hevner et al. (2004) provide seven guidelines for conducting rigorous and relevant DSR, covering aspects such as design as an artefact, problem relevance, design evaluation, research contributions, research rigour, design as a search process, and communication of research.

3.1.5 The rationale for choosing DSR

1. DSR has been widely used to develop socio-technical artefacts and accepted approaches in the IS field (Gregor and Hevner, 2013). The core outcome of this

research is to design and build a (level 2 – model and implemented process) artefact to contribute to the IS research field.

2. DSR provides an iterative process that aids in iteratively developing the DEAMP assessment framework by leveraging kernel theories and existing knowledge. (Hevner *et al.*, 2004; Peffers *et al.*, 2007).
3. DSR provides well-defined evaluation methods and criteria for measuring and testing the developed DEAMP assessment framework (Peffers *et al.*, 2012; Prat, Comyn-Wattiau and Akoka, 2014)
4. DSR has been applied in many research studies focused on IS fields, maturity models and digital performance assessment models (Hevner, 2007; Peffers *et al.*, 2007; Van Den Berk, Jansen and Luinenburg, 2010; Lasrado, Vatrapu and Andersen, 2015).
5. DSR provides guidelines for conducting rigorous and relevant DSR (Hevner *et al.*, 2004).

3.2 The DSR method

This study employs a widely recognised DSR methodology (Vaishnavi and Kuechler, 2007), characterised by five steps tailored to a particular field of study to generate and present top-tier research artefacts. Since DSR focuses on delivering contributions by designing, developing, and evaluating such artefacts, the methodology is structured across three sequential phases: problem formation, framework development, and conclusion. The initial two phases, problem development and framework development, are grounded in a comprehensive review of existing research and pertinent theoretical frameworks. Each phase comprises multiple iterative steps, with outputs informing and refining the subsequent stages to develop and evaluate the proposed artefact. This process involves reviewing existing theories and knowledge to create a solution or artefact suitable for the intended audience and purpose. This process involves an iterative development process to create the framework. This iterative development intertwines with the evaluation process. As such, to evaluate this artefact, several evaluation criteria were adopted (see Table 3-4) (Prat, Comyn-Wattiau and Akoka, 2014) using two different techniques (Peffers *et al.*, 2012). Subsequently, it concludes by incorporating the outcomes of the research efforts, highlighting the main contributions, published works, implications, limitations, and

prospective avenues for future directions. The adoption of DSR in this research, including tasks, purposes, and outcomes of each step, is presented in Figure 3-1.

Figure 3-1 illustrates each step's DSR phases, steps, purposes, tasks and outputs.

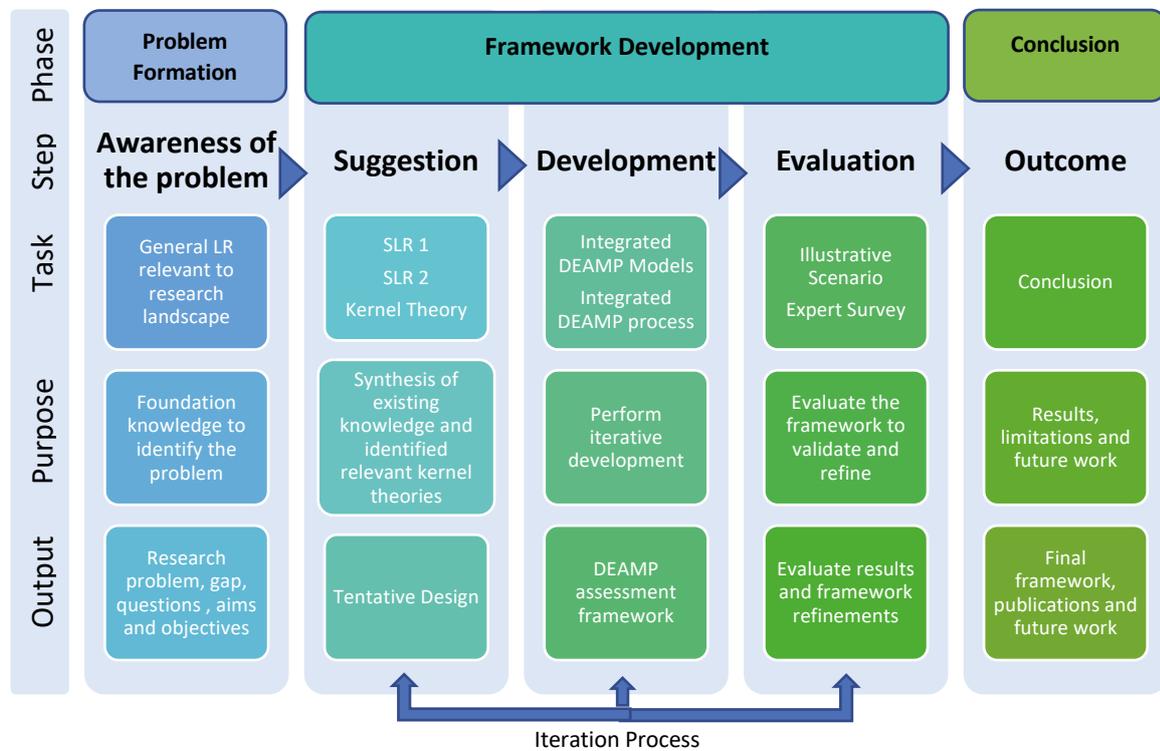


Figure 3-1 Applying DSR

The next section discusses the guidelines introduced by (Hevner *et al.*, 2004) for conducting and evaluating the DSR process.

3.3 The DSR guidelines

The DSR process proposed by Vaishnavi & Kuechler (2007) is adopted in this thesis; besides the guidelines outlined by (Hevner *et al.*, 2004), to ensure a successful DSR implantation and to clarify the requirements for efficient research.

Table 3-1 provides a detailed description of these guidelines and explains how they are implemented in this study.

Table 3-1 DSR guideline requirements and their implementation

Guideline	Description
G1: Design as an artefact	<p>Requirement: DSR must produce viable artefacts to solve research problems in the form of a construct, model, method, or an instantiation of these.</p> <p>Implementation: The proposed artefact is designed to tackle the research problem outlined in Chapter 1. It comprises two main components: the DEAMP assessment model and process. Further details discussing the DEAMP assessment framework are provided in Chapter 4.</p>
G2: Problem relevance	<p>Requirement: The objective of DSR in the field of IS is to develop technology-based solutions to important and relevant business problems.</p> <p>Implementation: The research problem addressed in this thesis is the lack of a unified understanding of integrating DM levels with performance elements to support informed decisions to enhance digitalisation for performance gain, as detailed in Chapter 1. The proposed DEAMP assessment framework is designed to tackle this problem and bridge the research gaps. The research gaps and problem are grounded on the analysis and findings from two SLRs detailed in Chapter 2.</p>
G3: Design evaluation	<p>Requirement: The design evaluation must be rigorously demonstrated to measure the predefined criteria via clear and well-executed evaluation methods.</p> <p>Implementation: In this research, the DEAMP assessment framework is assessed to display its relevance for representing the field and addressing the research gaps identified in Section 1.2.1 of Chapter 1, as well as answering the research questions detailed in Section 1.3. The evaluation considers criteria such as applicability, understandability, comprehensiveness, and generalisability (see Table 3-4). Evaluation methods include illustrative scenarios and expert reviews (Peffer <i>et al.</i>, 2012). A comprehensive explanation of the DEAMP assessment framework's evaluation discussion based on these methods and criteria is provided in Chapter 5.</p>
G4: Research contributions	<p>Requirement: Effective DSR must provide clear and verifiable contributions in the areas of the artefact, foundations, and/or methodologies design.</p> <p>Implementation: This research makes a notable contribution to artefact design by creating the DEAMP assessment framework, which tackles a key research problem (refer to Section 1.2, Chapter 1) and provides new insights into linking DM levels and performance elements to support informed decisions to enhance digitalisation for</p>

Guideline	Description
	performance gain. The details of the development of the DEAMP assessment framework are covered in Chapter 5.
G5: Research rigor	<p>Requirement: Relies on the application of rigorous methods in both the construction and evaluation of the design artefact.</p> <p>Implementation: In this thesis, existing frameworks and guidelines (kernel theories) are employed as theoretical and practical lenses to inform and shape the DEAMP assessment framework (see Table 3-3). This method delivers essential insights for addressing the research problem. Additionally, rigorous approaches were employed to evaluate the DEAMP assessment framework (see Chapter 5). To evaluate this framework, two recognised DSR methods were employed: expert review and illustrative scenarios. Research tools, including a survey and specific scenarios, were reviewed by domain experts externally and by supervisors internally. Feedback from these experts led to updates and improvements to confirm the quality and relevance of the developed tools. A survey conducted with experts in DT, EA and business architecture (BA) provided valuable feedback, which was used to refine and enhance the framework and its components.</p>
G6: Design as a search process	<p>Requirement: The search for an effective artefact requires utilising available means to reach the desired outcomes while sustaining problem environment's laws.</p> <p>Implementation: The DSR process outlined by Vaishnavi and Kuechler (2015) is employed to produce new artefacts. This process consists of five key steps: (1) identifying the problem, (2) proposing a tentative solution, (3) developing the solution, (4) evaluating the proposed solution, and (5) drawing conclusions. The DSR process used throughout this thesis heavily relies on iterative reviews of existing knowledge while developing and assessing the DEAMP assessment framework. This iterative approach involves repeatedly identifying the problem, proposing and refining the solution, and evaluating it until it meets the research objectives.</p>
G1: Communication of research	<p>Requirement: DSR must be presented effectively both to technology-oriented as well as management-oriented audiences.</p> <p>Implementation: The results of the DSR in this thesis are disseminated through peer-reviewed publications, including conferences and high-quality journals (Alsufyani and Gill, 2021, 2022, 2023).</p>

The previous section covers the implementation of DSR guidelines. The next section covers a discussion of the applied DRS process.

3.4 The application of DSR in this research

The research process approach adopted in this thesis involves five key steps: awareness of the problem, suggestion, development, evaluation, and conclusion. Each of these steps is discussed in detail below.

3.4.1 Awareness of the problem

The initial step of the DSR involves background studies and an analysis of the related work (as discussed in Chapters 1 and 2). To embark on these comprehensive transformations, organisations require guidance in evaluating their existing capabilities to explore viable DT options (Matt, Hess and Benlian, 2015). As companies strive towards a more digitally sophisticated future, a methodical assessment of their current state is becoming increasingly crucial for many institutions (Teichert, 2019). Given that higher DM levels are often linked to improved corporate performance (Westerman, Bonnet and McAfee, 2014), the research aims to create an assessment framework for organisations to determine whether to initiate digitalisation activities to achieve desired and/or improved performance outcomes. The analysis undertaken in Chapter 1 facilitated the identification of the research problem. Subsequently, the research question and its underlying objectives were formulated based on the issues clarified in the research gaps (refer to Chapter 2, Table 2-6). These research gaps are further discussed, as well as the lack of a theoretical underpinning and empirical evidence in DM and performance assessment and the lack of linking between DM level and organisation performance outcomes. The purpose, tasks and outputs of this step are visualised in Figure 3-1

3.4.2 Suggestion

This step captures the potential solution for the problem at hand. It embodies a creative process to originate functionality by rearranging existing, new elements or a blend of both, reflecting the inherent creativity in crafting suitable constructs for organisational phenomena (Vaishnavi and Kuechler, 2007). A significant realisation was that assessing DM and establishing connections to organisational performance is a critical aspect to consider. This will assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain, which is the main research question. This

creative process was informed by the De Bruin framework (De Bruin *et al.*, 2005) as a theoretical lens and foundation to design the assessment model, detailed as follows:

A. Scope of the design:

This step defines the boundaries and focus of the model and ensures the design elements are clearly understood and defined before developing the model. The model should reflect why the audience seeks to apply it, how it can be used, how it can be adapted to different organisational structures, who should be involved, what the method of application is, how it can be adapted to different organisational structures and the outcome of its application. This research aims to create an assessment framework for organisations to determine whether to initiate digitalisation activities to achieve the desired performance outcomes. This framework will help organisations self-assess their current and intended digitalisation levels, serving as a planning tool to align digitalisation efforts with their specific goals and needs from an EA perspective (Table 3-2). The input of this step originated from the research problem formulation discussed in Chapter 1.

Table 3-2 outlines and clarifies each of the design elements.

Table 3-2 Design elements of the DEAMP model adopted from (De Bruin *et al.*, 2005)

Element	Description
Focus	The primary goal is to create an assessment framework that helps organisations decide whether to start digitalisation efforts to achieve their desired performance outcomes.
Purpose	The prescriptive model goes beyond description as an as-is diagnosis assessment to investigate and define the relationships between maturity and business performance to enable the development of a roadmap to improve maturity with the goal of enhancing performance gain.
Audience	Internal audiences in the organisation, such as executives, enterprise architects, business architects and IT managers.
Participants	Management and staff.
Method	The framework will act as a self-assessment tool for organisations. This means it will provide a structured way for organisations to evaluate their current state ("as-is") and their desired state ("intended level") of digitalisation.
Organisational adaptability	The EA approach is applied as a lens to navigate how these structural elements interact with each other and contribute to enhanced organisational performance.

Element	Description
Outcome	It guides organisations in determining the most appropriate level of digitalisation that aligns with their goals and needs. This ensures that digitalisation efforts are purpose-driven and effectively contribute to the organisation's performance objectives.

B. Development of the model:

This step identifies the specific aspects and components that need measurement and how they will be assessed. This process often begins with an extensive literature review to gather existing knowledge and insights. This systematic approach aims to construct the artefact that captures and articulates how different levels of DM influence various aspects of organisational performance. The SLR was complemented by identifying and adopting relevant theoretical frameworks and practical perspectives as lenses to structure, facilitating a deeper understanding. This step was accomplished while conducting the Suggestion and Development phase.

C. Evaluation of the model:

In this step, the construct of the model and the instruments used for evaluation are rigorously tested to ensure they are understandable, applicable, and comprehensive (as illustrated in Table 3-4). It also focuses on assessing the generalisability of the model across different contexts. Continuous testing and refinement based on feedback and outcomes are integral parts of this evaluation process. Understandability determines whether the constructs are clearly understood and correctly translated for the intended users by expert surveys. The model must be considered practical and applicable within its identified scope, achieved by illustrative scenarios. The comprehensiveness of the model in covering relevant aspects of the domain it aims to represent is evaluated through the thoroughness of the literature reviews and expert surveys. Generalisability determines whether it is generic enough to support different contexts to guide the improvement of DM for the desired performance across EA layers.

While various frameworks or theories suitable for similar investigations exist, the DEAMP assessment framework was constructed by drawing on existing literature, relevant kernel theories, and expert evaluation feedback as theoretical and practical lenses. Table 3-3

outlines the set of theoretical and practical lenses applied during the development phase of the DEAMP assessment framework. The application of the selected lenses in producing the framework components is detailed in Chapter 5.

Table 3-3 Applied Theoretical and Practical Lenses

Lenses	Description
Adaptive EA	Adaptive EA (Gill, 2015) provides a comprehensive approach to EA through six distinct layers: interaction, human, technology, environment, facility, and security, which originated in the digitalisation context and digital ecosystem. It was utilised because it offers a systematic, layered framework and components for the design and evolution of digitally enabled enterprises. Also, This EA-driven approach also provides a comprehensive view of the organisation's architectural design, including foundational components, DT roadmap, and implementation planning (Lee, 2013; Ibrahim Alzoubi, 2015).
Results and determinants performance framework	The results and determinants performance framework (Fitzgerald <i>et al.</i> , 1991) categorises performance into two main types: results, which are lagging indicators (such as financial and competitiveness performance dimensions), and determinants, which are leading indicators (such as resource utilisation, innovation, flexibility, and quality performance dimensions). Each of these dimensions includes specific types of measures. For example, financial performance is assessed through profitability, liquidity, and market ratios. This framework has been chosen for its provision of six technology-independent, generic dimensions for performance measurement: competitiveness, financial, quality of service, flexibility, resource utilisation, and innovation. Additionally, it offers clarity on what each performance dimension can evaluate, helping organisations gain targeted insights into their performance outcomes.
De Bruin framework	The De Bruin framework (de Bruin <i>et al.</i> , 2005) is a structured methodology designed to create a comprehensive framework for assessing the maturity levels of processes, capabilities, or organisations within a specific domain. The framework is used as a theoretical lens in development phase of the DEAMP framework. This approach ensures that the boundaries and focus of the maturity assessment models are theoretically sound, empirically evaluated, and practically applicable.
Structured methodology in TOGAF ADM	Structured methodology in TOGAF ADM (<i>The TOGAF® Standard, 10th Edition, 2022</i>) uses the terms objectives, inputs, steps, and outputs as part of the structured methodology used in the Architecture Development Method (ADM) to ensure a comprehensive and structured methodology for developing and managing EA. Thus, it has been used to define objectives, inputs, steps and outputs of each of the DEAMP

Lenses	Description
	processes to ensure a comprehensive and structured methodology for establishing and conducting the assessment, then roadmapping and tracking enhancements.
The Architectural technique of TOGAF standard 10	In TOGAF (<i>The TOGAF® Standard, 10th Edition, 2022</i>), architectural techniques such as conceptual, logical, and physical abstraction are used to refine the architecture from high-level concepts to detailed implementations progressively. This approach is adopted to develop the design of the DEAMP assessment framework in three levels: conceptual, logical, and physical (see Chapter 4).
CCP interpretive framework	The CCP interpretive framework (Stockdale and Standing, 2006) is a framework for conducting an effective assessment process using the content, context and process (CCP) constructs (Symons, 1991). Those constructs can be interpreted as what needs to be assessed, why it needs to be assessed, when it needs to be assessed, who needs to be involved and how to conduct the assessment (Stockdale and Standing, 2006). These five main components are used to guide the development of the stage-by-stage process to assist organisations in effectively assessing maturity and performance using the DEAMP model.

The following proposed solutions align with the research objectives outlined in Chapter 1, Section 1.3, and are designed to offer practical remedies to address the identified research gaps.

- **DM assessment:** To address the first question, a tentative adaptive EA-driven design is proposed to assess DM with a set of DM levels across adaptive EA layers and its underpinning elements.
- **Digital EA performance assessment factors:** To answer the second research question, a set of digitalisation PIs based on the existing knowledge, the results, and the determinants framework across adaptive EA layers and its underpinning elements are identified.
- **Integrating DM assessment and digital PIs:** To answer the third research question, this stage integrates DM and performance across adaptive EA layers and its underpinning elements to capture the link between DM and an organisation’s performance outcomes.

The purpose, tasks and outputs of this step are visualised in Figure 3-1

3.4.3 Development

The development step involves further elaboration, requiring a creative effort to transform the tentative design into a complete design (Vaishnavi and Kuechler, 2007). The DEAMP assessment framework is systematically developed and evaluated through iterative cycles. The primary aim of this iterative approach in constructing and evaluating the DEAMP assessment framework is to support the gradual refinement of the design, transitioning from its initial alpha version to the final gamma version as each component advanced through several iterations. The development process comprises three main phases, each with several increments for iterative development. The first phase target is to develop an assessment model to integrate DM and performance (alpha version), which is accomplished in two increments. The second phase results from the first evaluation process, refining the alpha version to develop the DEAMP model (beta). However, the beta version underwent the second evaluation stage to refine the model and develop the DEAMP process (gamma version), which was accomplished in three increments. The framework development is discussed in detail in Chapter 5.

The purpose, tasks and outputs of this step are visualised in Figure 3-1

3.4.4 Evaluation

In the evaluation step, the proposed framework is evaluated by adopting the DSR evaluation methodology (Peffer *et al.*, 2012), the aim being to evaluate the artefact against the evaluation criteria adopted from (de Bruin *et al.*, 2005; Prat, Comyn-Wattiau and Akoka, 2014) (Table 3-4) and iteratively update and refine the framework. The evaluation process involves three stages of continuous evaluation with illustrative scenarios and expert evaluation via an industry field survey. This evaluation aims to achieve rigour by ensuring that observed improvements are solely due to the artefact's efficacy while operating within resource constraints and ethics by maintaining ethical considerations throughout the process (Peffer *et al.*, 2012). Accordingly, the developed framework is assessed through two evaluation methods: an illustrative scenario and an expert survey; for more details, refer to section 3.5.

Table 3-4 illustrates the evaluation criteria applied to evaluate the artefact, along with the evaluation methods.

Table 3-4 Evaluation criteria based on (de Bruin *et al.*, 2005; Prat, Comyn-Wattiau and Akoka, 2014)

Criteria	Description	Evaluation methods
Generalisability	the DEAMP model and its components are generic enough to support different contexts to guide the improvement of DM for the desired performance across EA layers.	Expert survey Illustrative scenarios
Understandability	The DEAMP model and its components are easy to read and understand.	Expert survey
Applicability	The DEAMP model and its components can be used to guide the improvement of DM for the desired performance across EA layers.	Expert survey Illustrative scenarios
Comprehensiveness	The DEAMP model and its components contain all the necessary elements to improve DM for performance gains across EA layers.	Expert survey

The first evaluation of the proposed framework (alpha) involved demonstrating the illustrative scenario to practitioners to assess the framework's practical applicability (as detailed in Chapter 5) by internal reviewers and external reviewers (peer-reviewed publication (Alsufyani and Gill, 2023)), which produced the beta version of the proposed framework. The beta version was evaluated in the second evaluation by adopting the expert evaluation method to evaluate this version against the evaluation criteria (Table 3-4). The experts' recommendations, the result of that evaluation, were used to refine and update the framework with more concepts and components to produce the final version of the framework (Gamma) and recognise the future directions. The gamma version was demonstrated via two illustrative scenarios as the final evaluation step. The last version of the DEAMP assessment framework (gamma) is covered in Chapter 4. The purpose, tasks and outputs of this step are visualised in Figure 3-1

3.4.5 Outcome

The final effort of this thesis is the DEAMP assessment framework, which offers both the assessment model (identifying what to assess) and its implementation process (detailing how to assess). It is designed to capture the interdependencies between DM levels and their corresponding performance outcomes, facilitating the recognition and enhancement of DM to achieve the desired performance across EA layers. The assessment process is structured

to provide a systematic, step-by-step approach for customising and applying the DEAMP model. Also, several academic publications have been published, which have made an important contribution to academia and industry. This step's purpose, tasks, and outputs are visualised in Figure 3-1.

The previous section covers a discussion of the applied DRS process. The next section covers a detailed discussion of the evaluation methods adopted in this research.

3.5 Evaluation methods

This section describes the evaluation methods selected for this study, including illustrative scenarios and expert reviews (Peffer *et al.*, 2012). Each evaluation method was designed and refined iteratively, involving instrument designing techniques, pilot tests, and internal and external reviews to refine the instruments.

- Illustrative scenario: a scenario is developed based on relevant existing research. These scenarios measure the practical applicability of the initial framework and framework refinement. In other words, they help ensure that the initial integrated framework covers the concepts in those scenarios relevant to the domain. Then, they are used as an illustration tool for the final version of the framework (physical model).
- Expert Survey: an administrative survey is conducted with DT, business architecture, and the EA field experts. This method aims to measure the proposed solution's generalisability, understandability, comprehensiveness, and applicability. Also, it seeks to extract applicable suggested improvements to refine and improve the DEAMP model and define future research directions.

3.5.1 Illustrative scenario

The illustrative scenario in the context of this research is fictitious test data to create instances of real-world examples as indicative proof of concept validation to test the practical applicability to drive refinements and illustration. The purpose of these fictional business scenarios is to illustrate the practical applicability of the DEAMP framework. It helps identify and comprehend business requirements, thus enabling the derivation of the necessary concepts that the framework must address in a specific context. This, then, will drive the improvement and refinement of the proposed framework. Also, this serves as the

DEAMP physical model, which provides concrete examples to enhance usability and clarify the operational aspects of the framework.

The illustrative scenario in the DSR context can be described as a synthetic or real-world narrative or story that portrays the utility of a proposed artefact or solution that would be used in a practical setting (Peppers *et al.*, 2012). In other words, it describes a hypothetical or real-world situation in which the artefact is applied to address a specific problem or achieve a particular goal. The scenario typically includes the users, their goals and the context in which the artefact is used, and the expected outcomes or benefits (Leite, Hadad and Horacio, 2000). The illustrative scenario helps researchers and stakeholders better understand the proposed solution's potential value and implications of how the artefact would function in real-world use (Blevins and Lambert, 2022). However, constructing a scenario involves several steps to portray the intended utilisation of the proposed framework within a practical context. TOGAF® Series Guide to Business Scenarios was adopted to guide this scenario development (Blevins and Lambert, 2022). This process comprises three phases: formulate, verify, and refine. The first phase involves two steps. Initially, the focus is on identifying the problem to establish the elements of the scenario. Subsequently, scenarios are generated to align with the research objectives and illustrated in spreadsheets. In the verification phase, the generated scenarios are assessed to validate the understanding of the problem context and the relevant elements that require addressing. The verification process includes internal review sessions with the research team and scenario evaluations by external domain experts. In the third phase, the developed scenarios undergo refinement grounded on the received feedback (see Figure 3-2).

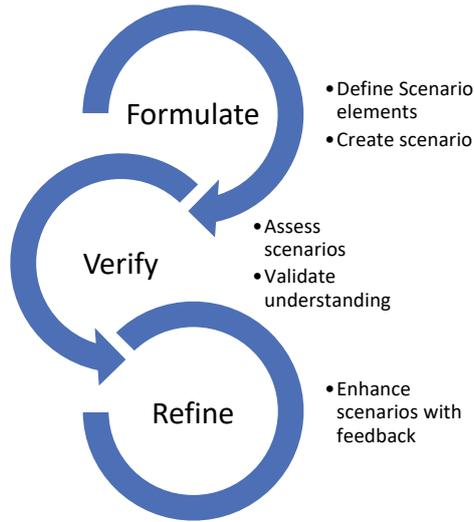


Figure 3-2 Illustrative scenario development process

The outcome of the previous process is summarised as Business Scenarios to be used as illustrative scenarios showcasing the practical application of the DEAMP framework, as detailed in Table 3-5.

Table 3-5 Business scenarios to illustrate the practical applicability of the DEAMP framework

Scenario	Problem description	Business environment	Outcome
Scenario 1: Marketing ABC company specialising in digital marketing and technology-driven campaigns. It operates in a competitive market where DT and continuous improvement are vital for achieving performance gains and delivering exceptional client results.	This company recognises the need to assess its DM and optimise its digital capabilities to stay ahead of the competition. The agency aims to leverage the EA design to evaluate its current digital landscape, identify areas of improvement, and implement targeted initiatives to enhance DM for improved organisational performance.	Digital marketing process maturity assessment, campaign performance metrics	Enhance the effectiveness of current digital marketing capabilities, tools, and technologies.
Scenario 2: Construction company, AB Build Co. specialising in commercial building projects. AB Build Co.	AB Build Co. has recently secured a contract to construct a multi-storey office building for a high-profile client. The	Stakeholder management and overall project success.	Managing communication and coordination

Scenario	Problem description	Business environment	Outcome
co-operates in a competitive market, focusing on mid-sized projects in urban areas.	project has tight deadlines, complex architectural design requirements, and a limited budget. Build Co's reputation is at stake and successful project completion is crucial for future business prospects.		among multiple subcontractors. Balancing cost-saving measures while maintaining quality standards.
Scenario 3: XYZ Mining Co. is a leading global mining company engaged in extracting and processing minerals, primarily in the iron ore and copper sectors. It complies with the highest international standards of corporate governance and continues to build the company operations on a strong foundation of sustainable practices.	XYZ Mining Co. is aiming to be the #1 choice of employees to attract top talents in the market, plus it needs to improve the employee experience to retain its current talents by capitalising on its technology investments and its recent ERP cloud migration and increase the efficiency of the facilities by introducing computer-aided facility management.	HR processes, training, and performance evaluation.	Increased talent pool and improved talent retention. Enhanced employee satisfaction and engagement.

3.5.2 The expert survey

The expert survey is the second stage of evaluation conducted in this thesis. The survey gathers specific data from specialised, targeted groups (Sjøberg *et al.*, 2005; Runeson and Höst, 2009). It was distributed online to a group of domestic and international industry experts. The survey instrument was designed using a standardised methodology (Hyndman, 2008). It is conducted to articulate the models' generalisability, understandability, applicability and comprehensiveness adopted from (de Bruin *et al.*, 2005; Prat, Comyn-Wattiau and Akoka, 2014) (see Table 3-4). It is also conducted to extract applicable suggested improvements to refine and improve the DEAMP model and define future research directions.

Table 3-6 provides a summarised overview of the survey design method stages that were adopted from (Hyndman, 2008).

Table 3-6 Survey design method based on (Hyndman, 2008)

Stage	Description
Survey planning	<p>Objective: Gather insights and assessments from experts on DEAMP models.</p> <p>Method: Designed a survey to collect qualitative and quantitative data.</p> <p>Analysis: Quantitatively assess and validate models against evaluation criteria (Table 3-4). Utilised qualitative feedback for model enhancement.</p>
Recruitment strategy	<p>Method: Participants contacted via LinkedIn based on expertise in DT, EA, and/or business architecture.</p> <p>Location: Global, including Australia, US, UK, Saudi Arabia, and Emirates.</p> <p>Contact: Initiated via LinkedIn with formal invitation letter approved by UTS ethics committee (Appendix E).</p> <p>Content: Outlined research scope, motivation, risks, privacy, advantages, and participant rights. The survey is included in the invitation. No personal data was collected. The survey ran from February - October 2023, with 30 planned and 32 completions.</p>
Questionnaire design	<p>Purpose: Assess generalisability, understandability, applicability, and comprehensiveness of models with feedback and comments.</p> <p>Structure: Sets of questions for each model covering evaluation criteria with open-ended questions for feedback and comments, clustered as shown in Table 3-8 to Table 3-12.</p>
Data collection	<p>Organisation: Data categorised based on evaluation criteria (Table 3-4).</p> <p>Types: Quantitative data from ratings under generalisability, understandability, applicability, and comprehensiveness categories. Qualitative data from participant comments and feedback.</p>
Data analysis	<p>Process: Quantitative evaluation converted categorical ratings to ordinal data for statistical analysis (Table 3-7, Equations 3.1–3.3).</p> <p>The qualitative evaluation used a hypothesis confirmation technique based on artefact evaluation criteria (Table 3-4).</p> <p>Results: Industry feedback is systematically presented in the tables, highlighting instances of evaluation criteria within the text.</p>

For a more detailed view of the survey design methods following a commonly used structure (Hyndman, 2008), the method stages are detailed as follows:

A. Planning the survey

The objective is to gather insights and assessments from experts regarding the DEAMP models. The survey is designed to collect both qualitative and quantitative data from participants. The analysis of this data pursues to quantitatively assess and validate whether the models meet the evaluation criteria (as outlined in Table 3-4). Qualitative participant replies to survey questions were converted into numerical values, as detailed in Table 3-7, to enable quantitative analyses. These numerical values represent the degree of agreement or disagreement with the stated items. Subsequently, qualitative feedback from experts is utilised to reinforce and enhance the models.

Table 3-7 Survey ratings

Qualitative Ratings	Quantitative Ratings	Description
Strongly agree	5	Strongly agree: Participants strongly endorsed the statement.
Agree	4	Agree: Participants expressed agreement with the statement.
Average	3	Average: Participants somewhat agreed with the statement.
Disagree	2	Disagree: Participants disagreed with the statement.
Strongly disagree	1	Strongly disagree: Participants strongly opposed the statement.

B. Recruitment and sample strategy

Participants were contacted via LinkedIn. They were chosen for their DT, EA, and/or business architecture expertise. Participants were located in Australia, the US, the UK, Saudi Arabia, and the Emirates. Initial contact with the participants occurred through LinkedIn, utilising a formal invitation letter approved by the UTS ethics committee under ETH21 5790 (refer to Appendix E). The invitation letter included information regarding the purpose and scope of the research, along with the rationale for selecting specific individuals to participate. It also addressed the potential risks to participants, privacy considerations, benefits of participation, and their rights. The online survey was included in the invitation letter. Consistent with the ethics approval outlined in Appendix D, no personal information was gathered about the participants in the survey. The survey was published in February 2023 and

closed in October 2023. A total of 32 individuals successfully participated in and completed the online survey.

C. Developing the questionnaire

The questionnaire was developed to articulate the models' generalisability, understandability, applicability and comprehensiveness. Each model has a set of questions to cover the evaluation criteria (Table 3-4) with open-ended questions for feedback and comments, and is clustered, as detailed in Table 3-8 to Table 3-12. The aim of these questions is to validate each of the models against the evaluation criteria. A preliminary test involving three participants was conducted to assess the survey questionnaire's clarity, reliability, and relevance. The feedback from this pilot study led to further modifications of the questionnaire.

Table 3-8 Performance model questions

Question	Description	Category
Q1	Is the performance model generic enough to support different contexts to assess performance outcomes across EA layers?	Generalisability
Q2	Are the performance model and its components easy to read? Are the performance model and its components easy to understand?	Understandability
Q3	Can the performance model be used to assess the current and target performance outcomes across EA layers?	Applicability
Q4	Do you agree that the performance model provides enough components to assess the current and target performance outcomes across EA layers?	Comprehensiveness
Q5	Do you agree that the 51 performance indicators provide enough indicators for assessing current and target performance across EA layers?	Comprehensiveness
Q6	Do you suggest any modifications or improvements to the model and its indicators including addition or deletion or any additional feedback? If so, please also give the reasons.	Comments and feedback

Table 3-9 DM model questions

Question	Description	Category
Q1	Is the DM model generic enough to support different contexts to assess DM across EA layers?	Generalisability

Question	Description	Category
Q2	Are the DM model and its components easy to read? Are the DM model and its components easy to understand?	Understandability
Q3	Can the DM model from the DEAMP framework be used to assess current and target DM across EA layers?	Applicability
Q4	Do you agree that the six DM levels provide enough levels for assessing current and target DM levels across EA layers?	Comprehensiveness
Q5	Do you agree that the DM model contains all the necessary elements to assess the current and target DM levels across EA layers?	Comprehensiveness
Q6	Do you suggest any modifications or improvements to the model and levels, including addition or deletion, or any additional feedback? If so, please give the reasons.	Comments and feedback

Table 3-10 Action model questions

Question	Description	Category
Q1	Is the action model suitable for different industries to define actions and roadmaps to improve maturity for the desired performance across EA layers?	Generalisability
Q2	Are the action model and its components easy to read? Are the action model and its components easy to understand?	Understandability
Q3	Can the integrated DM and performance models be used to inform, decide and define actions and roadmaps to improve maturity for the desired performance across EA layers?	Applicability
Q4	Do you agree that the integrated DM and performance models provide enough components for deciding and defining actions and roadmaps to improve maturity for the desired performance across EA layers?	Comprehensiveness
Q5	Do you suggest any modifications or improvements, including addition or deletion or any additional feedback? If so, please give the reasons.	Comments and feedback

Table 3-11 Benefits model questions

Question	Description	Category
Q1	Is the benefits model generic enough to support different contexts to monitor the actual DM and performance outcomes as a result of roadmap actions?	Generalisability
Q2	Are the benefits model and its components easy to read? Are the benefits model and its components easy to understand?	Understandability
Q3	Can the benefits model be used to monitor the actual DM and performance outcomes as a result of roadmap actions?	Applicability
Q4	Do you agree that the benefits model provides enough components for monitoring the actual DM and performance outcomes as a result of roadmap actions?	Comprehensiveness
Q5	Do you suggest any modifications or improvements, including addition or deletion or any additional feedback? If so, please give the reasons.	Comments and feedback

Table 3-12 DEAMP model questions

Question	Description	Category
Q1	Is the DEAMP framework generic enough to support different contexts to integrate DM and performance assessment across EA layers?	Generalisability
Q2	Are the DEAMP framework and its components easy to read? Are the DEAMP framework and its components easy to understand?	Understandability
Q3	Can the DEAMP framework and its components be used to guide the improvement of maturity for the desired performance across EA layers?	Applicability
Q4	Do you agree that the DEAMP framework's overall architecture contains all the necessary elements to improve maturity by addressing pain points for performance gains across EA layers?	Comprehensiveness
Q5	Do you suggest any modifications or improvements, including addition or deletion or any additional feedback? If so, please give the reasons.	Comments and feedback

D. Collecting the data

The collected data was categorised based on the survey evaluation criteria (see Table 3-4). The data gathered through the survey can be classified into two categories: quantitative and qualitative. The quantitative data stems from the ratings obtained through the sets of survey questionnaires under the generalisability, understandability, applicability and comprehensiveness categories. The qualitative data, on the other hand, stems from the comments and feedback category.

E. Data analysis

The survey analysis involves two key stages:

- **Quantitative evaluation:** The initial categorical ratings provided by participants were transformed into numerical ordinal data by applying the survey ratings outlined in Table 3-7. These ordinal data were then utilised in statistical formulas to analyse the survey results, as adopted from (Bou Ghantous and Gill, 2021) and as detailed in Equation 1, Equation 2, and Equation 3.

Equation 1 Chi2 statistical formula

Chi2 Statistical Formula
$\chi^2 \text{ or } X^2 = \sum \frac{(O-E)^2}{E} \text{ (O = frequency and E = expected value) (p-value} < 0.05)$
$E = \frac{\sum O}{N} \text{ (O = frequency and N = total number of observations)}$
The p-value determines if the null hypothesis H0 is accepted or rejected based on a critical value $\alpha = 0.05$
If p-value $< \alpha$, then H0 is rejected and H1 is accepted, and there is a positive association between the test variables (DEAMP_models) and the evaluation criteria (see Table 3.4).
[If p-value $< 0.000\epsilon$ (ϵ is a small number), then p is mathematically corrected to p < 0.001]
H0 (null hypothesis): there is no association between the test variables and the evaluation criteria
H1 (alternative hypothesis): test variables and the evaluation criteria are positively associated

Equation 2 Average and above frequency (AAF) formula

AAF Formula
$AAF = \sum \text{Frequency (Ratings } \geq 3)$ <p>AAF is the sum of all participants' responses [Average (3) + Agree (4) + Strongly Agree (5)]</p> $AAF = \sum \text{Frequency (Ratings } \geq 3)$ <p>AAF is the sum of all participants' responses [Average (3) + Agree (4) + Strongly Agree (5)]</p>

Equation 3 Average and above percentage (AAP) formula

AAP Formula
$AAP = \sum \text{Percentage (ratings } \geq 3)$ <p>AAP is the sum of all percentages of responses [Average (3) + Agree (4) + Strongly Agree (5)]</p>

- Qualitative evaluation:** Participants' comments were analysed by adopting the hypothesis confirmation general technique described by Runeson and Höst (Runeson and Höst, 2009). The hypotheses were based on the artefact evaluation criteria established by (De Bruin *et al.*, 2005; Prat, Comyn-Wattiau and Akoka, 2014) (refer to Table 3-4). The comments were methodically reviewed to identify instances of these criteria within the responses, as adopted from (Bou Ghantous and Gill, 2021). This expert's views are systematically structured and presented in tables to extract applicable suggested improvements to refine and improve the artefact in Chapter 5.

Qualitative Analysis Purpose	Description
DEAMP feedback analysis	Feedback was analysed using the cross-examination method between the participants' feedback and the combined evaluation criteria. This analysis aims to connect or relate the hypotheses (evaluation criteria) to the experts' feedback.
DEAMP improvements	A combination of suggestions and improvements feedback was gathered and categorised. This analysis aims to extract applicable suggested improvements to refine and improve the DEAMP model and define future research directions.

The previous section covers a detailed discussion of this research's evaluation methods. The next section covers the research ethics.

3.6 Research ethics

The research adhered to ethical standards, receiving formal approval from the UTS Research Ethics Committee following the University of Technology Sydney's research ethics policies. The approval documentation is available under Appendix D. No ethical concerns were raised during the research. Initial contact with the participants occurred through LinkedIn, utilising a formal invitation letter approved by the UTS ethics committee under ETH21 5790 (refer to Appendix E). The invitation letter included information regarding the purpose and scope of the research, along with the rationale for selecting specific individuals to participate. It also addressed the potential risks to participants, privacy considerations, benefits of participation, and their rights. The online survey link was included in the invitation letter. Consistent with the ethics approval outlined in Appendix D, no individual information was collected about the participants in the survey.

3.7 Research validity and limitations

The validity of the DSR and qualitative research methodologies is a fundamental consideration, as it is seen as a contingent concept rooted in the chosen research methodology processes and purposes (Golafshani, 2003). It signifies that the study's findings credibility and trustworthiness are grounded in the specific processes and implications of the chosen research methodology. Thus, diverse terminology such as quality, rigour, and trustworthiness has emerged to capture this concept (Golafshani, 2003). Gregor and Hevner (2013) also outlined that the selection of the design, build, and evaluation methodologies is grounded in the pursuit of rigorous research, which is essential to establish the credibility and trustworthiness of the findings.

To ensure the validity of this research, the implemented research methodology is a rigorous and well-established DSR methodology that aligns with the research objectives to establish methodological trustworthiness. It was also selected for its structured approach to problem identification and iterative development and evaluation. This approach began with two SLRs covering two separate fields, the DM model and digitalisation performance, within the theoretical and practical domains (Chapter 3). This perspective provided a solid foundation for problem identification to ensure the incorporation of insights from both theoretical and practical domains. Also, kernel theories and practical framework techniques were integrated with the DSR process to further strengthen the research credibility. This approach provides

a robust foundation for solution development, which facilitates the synthesis of the SLR findings and the iterative framework development.

The solution's validity was enhanced through iterative evaluation. The initial solution validation was achieved by demonstrating the solution's application with an illustrative scenario, followed by discussions with experienced practitioners internally and externally through conference publication. Subsequently, the DEAMP assessment framework was evaluated through an online survey targeting both academic researchers and industry practitioners to gather feedback on the proposed framework. The findings from this evaluation were instrumental in identifying areas for improvement within the framework and its components. By incorporating these expert-driven recommendations, the framework was iteratively refined to align more closely with the evolving needs and challenges in the field.

A comprehensive review process was undertaken to confirm the rigour and relevance of the research instruments, illustrative scenarios and the field survey. Both internal (supervisory) and external (academic and industry experts) feedback was sought. The insights gained from this review process were used to refine and improve the research instruments accordingly.

This research faces methodological limitations related to the survey. One limitation is the use of closed-ended questions with fixed choices, which may restrict participants to existing selections and aspects of the framework, possibly overlooking further perceptions. However, to overcome this limitation, five open-ended questions were included to enable participants to offer individual feedback and recommendations beyond the fixed choices for each component of the model and the overall model. This dual approach aimed to gather data and feedback to assess and refine the framework. Additionally, qualitative and quantitative data analyses were employed to understand the survey findings thoroughly.

The participant sample size was constrained to 32 due to the research project scope. However, the literature indicates that this sample size is adequate for evaluating the artefact (Almaliki *et al.*, 2014; Albladi and Weir, 2018). However, to mitigate the potential sample size limitations and ensure the robustness of the quantitative analysis, participants' feedback was collected and analysed qualitatively by the cross-examination method and extracted applicable suggested improvements to refine and improve the artefact. Also,

illustrative scenarios enriched the survey findings and offered supplementary evaluation and insights. These scenarios applied the framework to fictitious situations, facilitating analysis and refinement of the framework based on the outcomes. These combined approaches were instrumental in pinpointing areas for improvement in the framework (refer to Chapter 5).

3.8 Summary

This research focuses on developing the DEAMP assessment framework to establish a link between DM and performance assessment, enabling the identification of necessary actions and the development of roadmaps. Following established DSR guidelines (Vaishnavi and Kuechler, 2007), this chapter outlines the research method. Illustrative scenarios were provided to assess the framework's generalisability, applicability, understandability, and comprehensiveness, and expert feedback was collected through an online field survey. A detailed discussion of the DEAMP assessment framework's final iteration is presented in Chapter 4.

4 Chapter 4 The DEAMP Assessment Framework

This chapter discusses the DEAMP assessment framework, which is the primary contribution of this research. The proposed framework provides a practical approach to addressing the research questions outlined in Chapter 1. The DEAMP assessment framework consists of two components: the DEAMP model and the DEAMP process. Developed using the recognised DSR methodology detailed in Chapter 3, this chapter provides the final gamma version of the DEAMP framework. The purpose of this chapter is to describe the final version of the framework structure and components in detail. The theoretical discussion of the development and evaluation of this framework is covered in Chapter 5.

4.1 The DEAMP assessment framework overview

The developed DEAMP assessment framework will allow organisations to define whether to initiate a digitalisation activity or not to meet the intended performance outcomes. It is a planning tool that will enable organisations to self-assess their DM to get the best fit-for-purpose level of digitalisation for their intended performance outcomes. Ultimately, the DEAMP assessment framework provides decision makers with valuable insights to make informed decisions and guide the enhancement of DM for the desired performance across the EA layers. This can be accomplished by a framework process to guide organisations on what to do to assess their DM for performance gain using the framework models.

The DEAMP assessment framework provides both the assessment model (what to assess) and its implementation process (how to assess). The DEAMP model captures the interconnectivity between DM levels and their associated performance outcomes to recognise and guide the improvement of DM for the desired performance across EA layers. The assessment process is developed to provide a stages-wise approach to tailor and apply the DEAMP model.

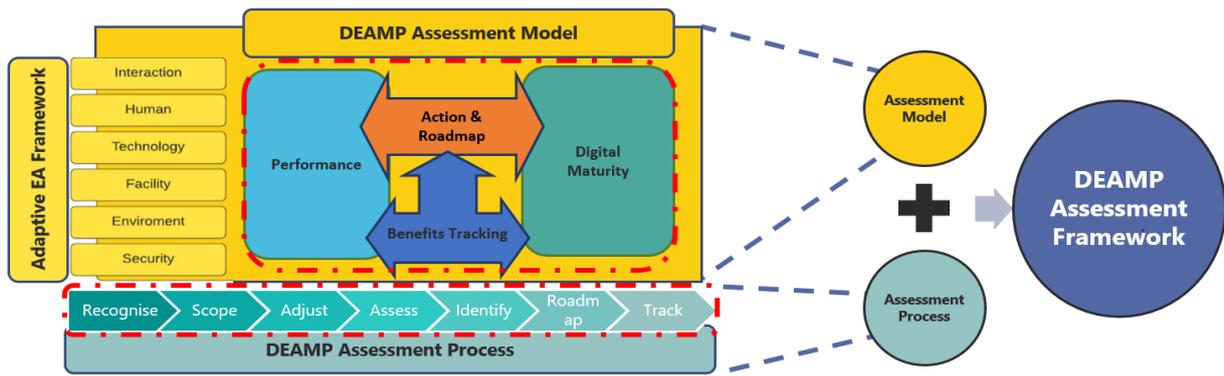


Figure 4-1 High-level contextual view of the DEAMP assessment framework

The design of this model is illustrated on different levels of detail. To do this, this model was designed following the architectural technique of TOGAF Standard 10 (*The TOGAF® Standard, 10th Edition, 2022*) (see Chapter 3). The design of this model comprises three levels as follows:

- **DEAMP conceptual model** focuses on high-level abstraction, emphasising essential concepts and relationships. It helps stakeholders define requirements, identify key entities, and understand the structure of what the model does.
- **DEAMP logical model** translates the conceptual model into a more detailed representation, specifying the concepts and their relationships. The logical model refines high-level ideas into a structured format, detailing how the concepts are defined and how they interrelate.
- **DEAMP physical model** is the instantiation or implementation of the logical model with the DEAMP process for a particular scenario or case, as discussed in Chapter 5 throughout the evaluation process.

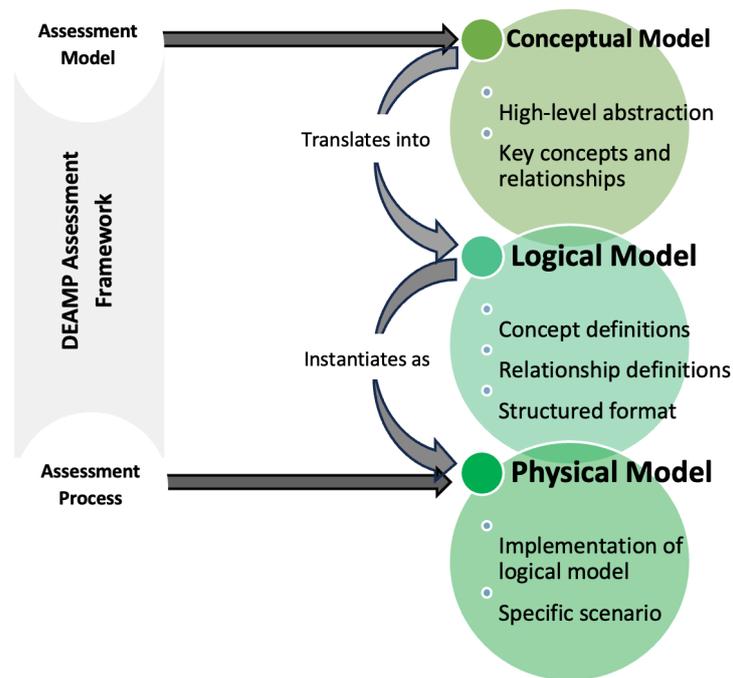


Figure 4-2 The 3 levels of the DEAMP model

This chapter mainly discusses the conceptual and logical models, and the physical model is discussed in Chapter 5.

The next section covers the DEAMP assessment model from conceptual and logical perspectives.

4.2 The DEAMP assessment model

The DEAMP assessment model provides an integrated assessment model capturing the relationships between DM levels and performance outcomes, which helps recognise the necessary DM enhancement for the desired performance across EA layers (Alsufyani and Gill, 2023). It integrates four models: performance, DM, action, and benefits models across various layers of the EA. This model establishes a link between DM and performance assessment to identify actions and develop roadmaps. These roadmaps can be monitored and tracked through benefits tracking across different EA layers. The DEAMP assessment model is an EA-driven approach (based on Adaptive EA layers by Gill 2015 - 2022) to link DM and performance assessment across different layers of the EA and define actions that can be monitored and tracked by benefits tracking. EA layers offer a structured approach and components for designing and developing digitally enabled organisations. These EA layers provide a holistic illustration of the organisation's architecture design: interaction, human,

technology, environment, facility, and security. Thus, this framework can be used mainly to help decision makers make well-informed decisions by utilising data and information to guide the improvement of DM for the desired performance across EA layers. Also, it allows the effectiveness of the implemented actions to be measured and evaluated by comparing them to the target DM and performance.

The following sections discuss the conceptual and the logical model in detail.

4.2.1 DEAMP conceptual model

The DEAMP model (Alsufyani and Gill, 2023), as a whole, provides a consolidated view of the integrated DM model and performance model. This framework can help in assessing DM and performance outcomes across adaptive EA layers and their underpinning elements. The model is structured into four key components: performance, DM, actions, and benefits. Performance assessment aims to identify performance gaps in relation to organisational goals and objectives. Simultaneously, a DM assessment can be conducted to pinpoint DM gaps based on underlying pain points across the EA design. Given that current and target DM levels influence current and target performance, these assessments can be used to guide the initiation of actions to address performance and maturity gaps to enhance DM for improved performance. These actions can be incorporated into a roadmap to chart the path towards target DM and performance levels. Lastly, the benefits component can be used to monitor the actual DM and performance outcomes post-implementing the action roadmap. It tracks resolved pain points, seized opportunities, and achieved goals and objectives following the desired target DM and performance.

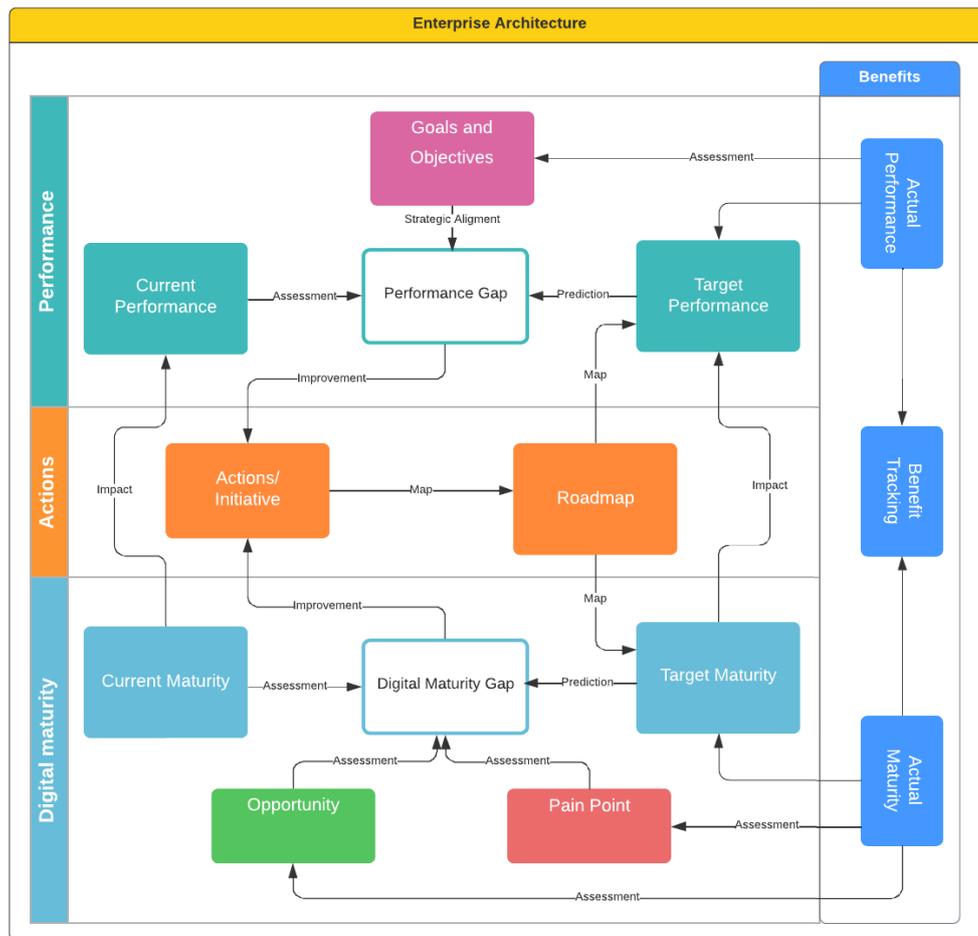


Figure 4-3 The DEAMP model – a conceptual model (updated after (Alsufyani and Gill, 2023))

The conceptual model of the DEAMP illustrates the four main components of the model across the EA layers figure. Each component of the DEAMP model serves as a model with concepts and relationships that have direct relationships to the other components. These models include:

- Performance model
- DM model
- Actions model
- Benefits model

As previously discussed, the DEAMP model includes the concepts to assess and comprehend the linkage between DM levels and their resultant performance outcomes. This understanding aids in identifying and directing enhancement actions to improve DM and achieve the desired performance outcomes across the EA layers.

The following four sections discuss each component of the conceptual DEAMP model.

4.2.1.1 Performance model

The first component of the DEAMP conceptual model is the performance model, enabling organisations to assess performance outcomes across the adaptive EA(Gill, 2015) layers. The aim is to capture the organisations’s current and target performance outcomes for each EA layer and its underpinning elements. This will help outline the performance gap by aligning related goals and objectives. This model proposes a direct and indirect DM level impact on the performance outcome of the EA layers and underpinning elements, as illustrated in Figure 4-4.

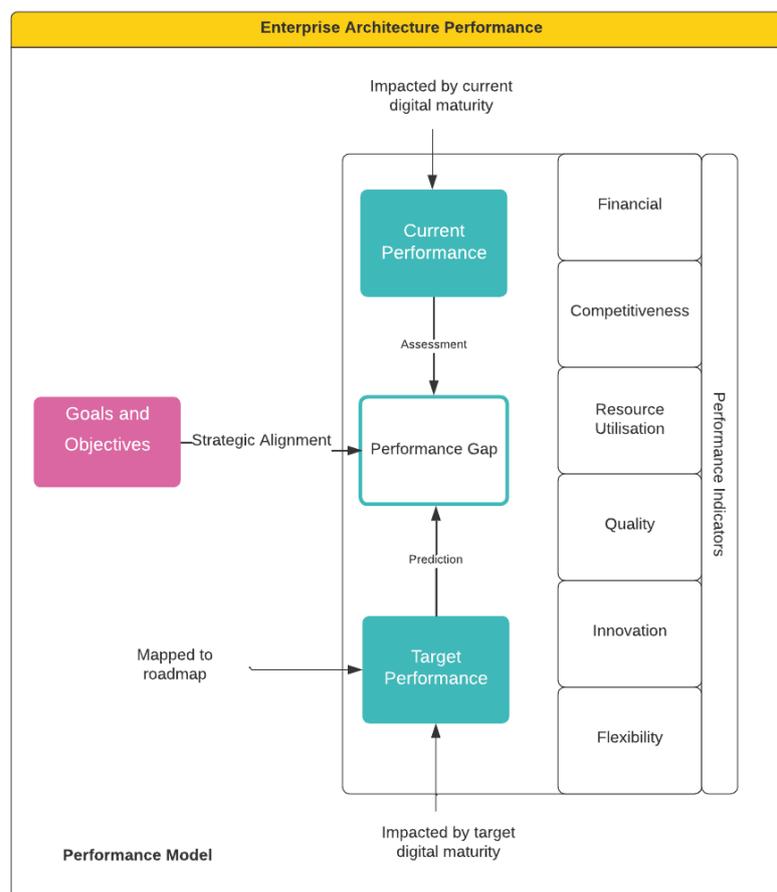


Figure 4-4 Performance model

These current and target performance outcomes can be captured by a set of potential PIs across six generic dimensions (PI type) for performance measurement: competitiveness, financial, quality, flexibility, resource utilisation and innovation. These dimensions can measure profitability, market value, cost-effectiveness, market share, sales, customer base, product attractiveness, efficiency, productivity, satisfaction, responsiveness, availability, reliability, innovation, and flexibility performance, as reported in this study (Alsufyani and Gill, 2022). However, this study detailed 51 potential digitalisation PIs, their measures,

scales, and metrics. Also, 11 new PIs were added as they emerged from the experts' feedback.

Table 4-1 outlines six different PI types, each accompanied by a set of potential measures that can be utilised to assess various PIs and their description.

Table 4-1 PIs across six generic dimensions for performance measurement (updated after (Alsufyani and Gill, 2022))

#	PI Type	Measure	PI	Description
1	Competitiveness	Market share	Market share	Market share compared to its competitors.
2			Internationalisation performance	Expanding market by selling services abroad
3		Sales growth	Sales growth	The increase in sales revenue over a specific period compared to its competitors
4		Customer base	Customer acquisition	Acquisition of new customers compared to its competitors
5		Degree of attractiveness	Sales per customer	Sales per customer compared to its competitors
6		Degree of excellence	Product/Customer/Operational excellence*	Product/Customer/Operational excellence compared to its competitors
7	Financial	Cost efficiency	Enterprise efficiency ratio	The ratio of non-interest expenses to total net income OR operating expenses to operating income
8			Operating cost	Operating expenses
9			Sales cost	The cost to make and sell a product
10		Cost	IT investment - infrastructure	The amount they spend on IT infrastructure
11		Growth prediction market valuations	Enterprise stock market measures	Price-to-book-value and annual equity returns
12		Market value	Enterprise market value	12 months' stock return adjusted by the risk-free rate
13		Profitability	Income	The total revenue or earnings a company generates from its business activities
14			Operating margin	Gross pre-tax operating profits divided by revenue

#	PI Type	Measure	PI	Description
15			Operating return on assets	The ratio of operating income to assets
16			Return on asset	Net income divided by total assets
17			Return on investment	Evaluating the efficiency of an investment or comparing the efficiency of a number of different investments.
18			Revenue	Total sales or income received from selling goods or services over a given period of time.
19			Turnover	Fixed asset turnover in previous years
20			Profit	The gain a company achieves after deducting all expenses from its total revenue.
21	Flexibility	Degree of agility speed	Enterprise agility	Capability of process flexibility and flexible strategy, customer responsiveness
22		Degree of flexibility	HR flexibility	EX: (HR flexibility) job rotation, multi-skilling and adoption of flexible working hours or operational performance - process flexibility
23	Innovation	Degree of encouragement	Talent management performance	Boost creativity and talent
24		Degree of innovation efficiency	Enterprise innovation efficiency	The ratio of the number of patents granted to the total number of inventors involved in their creation digitises a firm's innovation portfolio
25		Degree of innovation effectiveness	Enterprise innovative effectiveness	Renewing competitive offers by developing and selling new services/products (% of new services sales)
26	Quality	Satisfaction	Demand rationalisation	Ability to bundle the requests from internal customers into frame agreements
27			Purchase quality	Acquire goods and services that satisfy the needs of the internal clients.
28			Customer satisfaction	How well products or services meet or exceed customer expectations.
29			Customer/User Experience (CX/UX)*	How well interactions with products/services meet or exceed customer expectations throughout the customer journey.

#	PI Type	Measure	PI	Description	
30		Availability	Service coverage (availability of services)*	The availability and reach of services.	
31		Reliability	Awareness	The degree of awareness of a brand/product/service	
32			Brand associations	The perceptions consumers associate with a brand which influence their attitudes, preferences, and purchasing decisions.	
33		Responsiveness	Consumer attitudes	The degree of the consumer-responsive toward the product or the service	
34			Service coverage (service response time)*	The average time taken to respond	
35		Interoperability	Interoperability*	The extent to which different systems, devices, or applications can effectively communicate, exchange data, and operate together seamlessly	
36		Scalability	Customer coverage and segment*	The percentage of the target market reached or the geographic distribution of customers.	
37		Security	Security of products/services /processes*	How well products/services/processes are protected against threats and vulnerabilities	
38		Resource utilisation	Efficiency	Customer retention	The ability to keep existing customers over a specified period
39				Customer acquisition rate*	The rate at which new customers are gained over a specified period
40	Change management - adoption rates*			Commitment employees show to organisational changes.	
41	Change management - employee engagement*			The rate at which users fully utilise a new system, process, or technology post-implementation.	
42	Change management -			The degree of opposition or struggle employees exhibit against organisational change.	

#	PI Type	Measure	PI	Description
			resistance to change*	
43			Ecotourism performance	Number of visitors via “knowledge sharing related to ecotourism, tourist attractions, and digital management system and ICT”
44			Enterprise in ecosystem connectivity	Collaborative process in the ecosystem
45			HR development performance	Knowledge/ skills/ professional development
46			Business flexibility	How IT has helped the business respond to internal and external
47			Cost-effective use of IT	The extent, efficiency, and value of IT used in the business
48			IT for asset utilisation	How successfully IT has used knowledge-based assets in an organisation
49			IT for growth	How effective IT is in learning, being innovative, gaining competitive advantage, and changing and improving
50			Labor-capital ratio	Employee over assets
51			Market value capture	Leveraging knowledge about competitors for pricing
52			Market value creation	Leveraging knowledge about customers for offering development
53			Operational performance	Production lead time, process uptime and/or production cost per unit
54			Procurement savings	Acquire goods and services at convenient prices, lower or in line with those budgeted
55			Environmental performance	Reduction of air emission, reduction of wastewater, reduction of solid wastes and improvement of the firm’s environmental situation
56			HR efficiency	Increase in overtime hours, part-time workers and temporary workers
57		Efficiency/ Integration	Process digitisation	Automated processes

#	PI Type	Measure	PI	Description
58			Platforms, Technologies, or Systems choice*	How well a selected platform, technology, or system performs its intended functions relative to the resources it consumes
59		Productivity	Work performance	Boost productivity/ value of work/responsiveness and adaptation
60			Employee job performance	(1) Task performance, (2) contextual performance, (3) counterproductive behaviour
61			Information visualisation	The ability to display data/information visually
62			Degree of autonomy	Business unit IT autonomy

* New PIs emerging from the experts' evaluation

4.2.1.2 DM model

The second component of the DEAMP conceptual model is the DM model, enabling organisations to assess the level of DM across different EA layers (e.g. interaction, human, technology, and facility) (Alsufyani and Gill, 2023). It aims at capturing the current and target organisation's level of DM for each EA layer and its underpinning elements. This will help determine the DM gaps by considering the related pain points and opportunities.

The main components of this model are the EA element, DM levels' current maturity, target maturity DM gap, pain points and opportunity. Each component plays a different role within the model. The EA layer and underpinning elements (EA element) specify a particular area of EA that will be assessed to determine both its current level of DM (current maturity) and the desired future level (target maturity) in comparison to predefined DM levels. Possible opportunities and pain points related to the assessed EA element are captured to determine the assessment result (DM gap). It must be noted that seizing a possible opportunity is a concept that emerged from the experts' feedback.

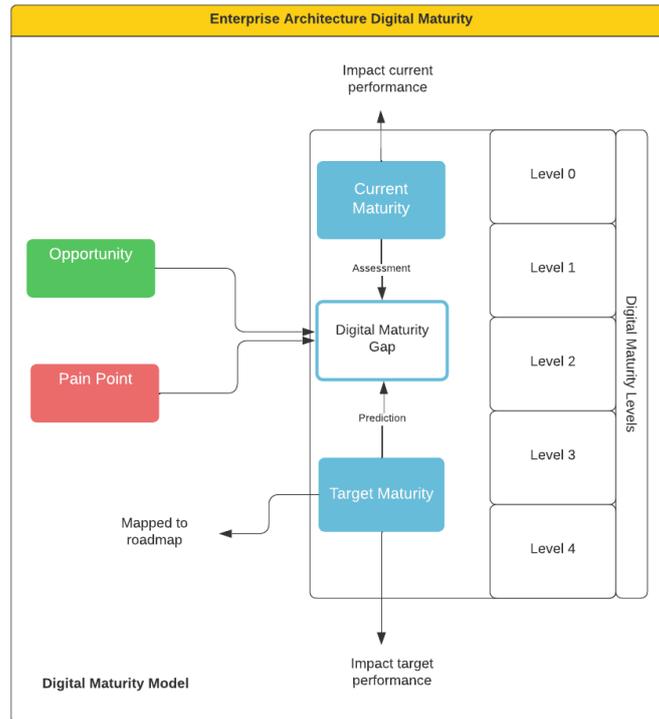


Figure 4-5 DM model

The following set of DM levels is categorised from a low level of DM (level 0) to a high level (level 4). The DM levels can be used to assess the current maturity level across the EA layers. This will then provide baseline information to set the target maturity level. In other words, the DM levels are a normative outline of the levels at which organisations can tailor their specific definitions of the DM levels to their consideration of maturity levels. It is important to note here that one may only focus on a particular EA layer or layers when using the DM levels as appropriate for the scope of their assessment project. These levels are summarised and tailored to the EA layer (e.g. the human layer) and underpinning elements (e.g. business capability) (Table 4-2). Details can be found in a previous work (Alsufyani and Gill, 2021).

Table 4-2 DM levels

Level	Name	Description	EA Layer
Level 0	None	Either the absence of digitalisation or basic digitisation as no or limited digital processes running in silos.	Each level can be tailored to the EA layer (e.g. the human layer) and underpinning
Level 1	Beginner/ Learner	Digitally aware or ad-hoc digitalisation (adopting some digital practices), as some or ad-hoc moves towards defining digital capabilities processes or breaking down internal silos and the digital collaborative practices created.	

Level	Name	Description	EA Layer
Level 2	Intermediate	Consistent, defined, integrated and digitally enabled such as business practices and processes are being identified and developed digitally.	elements (e.g. business capability).
Level 3	Advanced	Completely developed and data driven as fully developed and integrated into organisational plans and the business review cycle for regularly audited and improved.	
Level 4	Expert	Innovative, predictable, proactive and adaptable, such as constantly monitored, improved and refined to anticipate and adaptably respond to new technologies and digital innovation.	

4.2.1.3 Action model

The third component of the DEAMP conceptual model is the action model. Once the current and target DM levels and performance outcomes are determined, these insights can be used to guide the initiation of actions to address performance and maturity gaps. These actions aim to improve DM and enhance performance across the EA layers. Also, these actions can be included in a roadmap to provide a strategic plan to achieve the target DM and performance outcomes. The roadmap arranges actions with the consideration of several factors, but not limited to timelines, priorities, strategic alignment, critical path, urgency, and feasibility. It may also incorporate the potential risks associated with each action, considering factors such as complexity, dependencies, and other external influences.

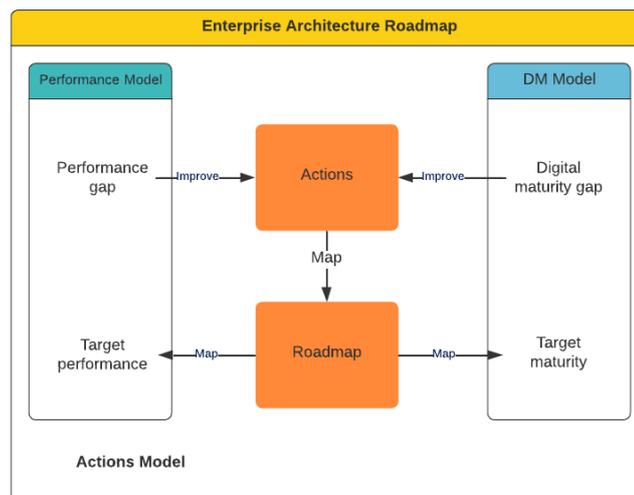


Figure 4-6 Action model

4.2.1.4 Benefits model

The fourth component of the DEAMP conceptual model is the benefits model. This component is implemented during or post the project's implementation phase to monitor the DM and performance achieved from the previous assessment results (DM and performance gaps). The benefits model tracks the resolution of pain points, seized opportunities, and achieved goals and objectives, which can be achieved by aligning them with the desired target maturity levels and performance outcomes. It serves as a means to measure and evaluate the effectiveness of the implemented actions by comparing them to the target DM and performance.

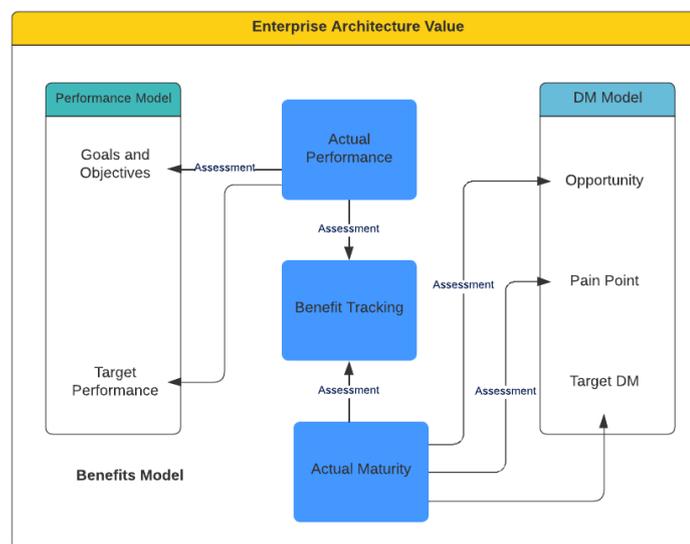


Figure 4-7 Benefits model

The previous section covers the conceptual model of the DEAMP assessment model. The next section covers the logical model of the DEAMP assessment model.

4.2.2 DEAMP logical model

The logical model of the DEAMP expands the conceptual model in Figure 4-3 by incorporating subclass concepts of the main concepts covered in section 4.2.1. To ensure a consistent understanding of the DEAMP model and its components, the DEAMP conceptual model was expanded into a structured informal ontology. As discussed in Chapter 2, Section 2.1.5, this ontology includes the concepts identification and relationships related to the domain (Uschold & Grüninger 1996), which is expected to enhance communication when assessing and improving DM for the desired performance outcomes. The ontology facilitates communication and knowledge sharing between individuals and organisations, within and

across organisations by providing a common understanding of terms and concepts and their relationships (Uschold, 1996).

First, the key concepts and definitions were identified to capture the ontology aspect of the DEAMP conceptual model (Table 4-3). Additional subclass concepts were introduced to capture the nuances of key concepts, such as classes and attributes. For instance, to identify the performance gap of a specific element, the PI gap utilises a set of current and target PIs measures (CPI and TPI, respectively). The same principle applies to DM, with current and target DM levels (CDM and TDM). The CPI and TPI reflect the influence of CDM and TDM.

Furthermore, an action considers the PI gap, DM gap, goal, opportunities, and pain points of a particular architecture element and is linked to a roadmap. Additionally, five concepts encompass a set of sub-concepts that can be further elaborated to derive more detailed sub-concepts. For example, the architecture domain includes business, information, and other domains, such as technology and security, which can also be considered. The architecture elements include people, process, capability, and information. Also, the roadmap can include priority (timeline, strategic alignment, critical impact and feasibility) and risk (complexity and dependency). Equally, five levels of DM were established as attributes for the DM level class. For example, level 0 signifies the absence of digitalisation or basic digitisation, while advanced level 4 represents innovative, data-driven, and adaptable aspects. These levels are elaborated further in Table 4-2. The PI type encompasses six dimensions: financial, quality, and resource utilisation. These dimensions can be further segmented into more specific and detailed PIs within each PI type, as outlined in Table 4-1.

Table 4-3 displays the class label, concepts and their definitions.

Table 4-3 DEAMP concepts and their definitions

Class Label	Concept	Definition	Reference
DM_Gap	DM gap	A level of DM that represents a gap in the DM	(Alsufyani and Gill, 2021)
CDM	Current DM	A level of DM that represents the current level of the DM	(Rosemann and de Bruin, 2005)
TDM	Target DM	A level of DM that represents the target level of the DM	(Rosemann and de Bruin, 2005)

Class Label	Concept	Definition	Reference
DM_Level	DM level	It represents the six levels of the DM	(Alsufyani and Gill, 2021)
Level_00	Level 0	None - Absence of digitalisation or basic digitisation	(Alsufyani and Gill, 2021)
Level_01	Level 1	Beginner/ Learner - Digitally aware or ad-hoc digitalisation or adopted some digital practices	(Alsufyani and Gill, 2021)
Level_02	Level 2	Intermediate - Consistent, defined, integrated and digitally enabled	(Alsufyani and Gill, 2021)
Level_03	Level 3	Advanced - Completely developed and data-driven	(Alsufyani and Gill, 2021)
Level_04	Level 4	Expert - Innovative, predictable, proactive and adaptable	(Alsufyani and Gill, 2021)
PI_Gap	Performance gap	A set of PIs that represents a gap in performance outcomes	(Alsufyani and Gill, 2022)
CPI	Current PI	A set of PIs that represents current performance outcomes	(Rosemann and de Bruin, 2005)
TPI	Target PI	A set of PIs that represents target performance outcomes	(Rosemann and de Bruin, 2005)
PIType	PI Type	Represent the six types of PI	(Alsufyani and Gill, 2022)
Financial	Financial	Represent the financial PIs	(Alsufyani and Gill, 2022)
Competitiveness	Competitiveness	Represent the competitiveness PIs	(Alsufyani and Gill, 2022)
Resource_Utilisation	Resource Utilisation	Represent the resource utilisation PIs	(Alsufyani and Gill, 2022)
Quality	Quality	Represent the quality PIs	(Alsufyani and Gill, 2022)
Innovation	Innovation	Represent the innovation PIs	(Alsufyani and Gill, 2022)
Flexibility	Flexibility	Represent the flexibility of PIs	(Alsufyani and Gill, 2022)
Architecture	Architecture	A business area in the EA design	(Gill, 2015)
Architecture_Domain	Architecture domain	A domain of the EA design within a business area (business or information of the human layer)	(Gill, 2015)
Architecture_Element	Architecture element	An element of the architecture domain (People, Capability, Process or Information)	(Gill, 2015)
Goal	Goal	A description (statement) of what the organisation wants to achieve	(Kaplan and Norton, 2010)
Objective	Objective	A scalable description of a goal	(Kaplan and Norton, 2010)

Class Label	Concept	Definition	Reference
Pain_point	Pain point	A problem or solution of an issue that was unfinalised	(Yu and Madiraju, 2014; Gill, 2015)
Opportunity	Seizing opportunity *	An opportunity to enhance or improve digitally	New
Action	Action	Initiatives defined by the organisation to improve DM level for the desired performance gains.	(Kaplan and Norton, 2010)
Roadmap	Roadmap	A sequence of actions based on several factors	(Gill, 2015; Parviainen <i>et al.</i> , 2017)
Timeline	Timeline	A period of time needed to implement an action	(Gill, 2015)
Dependency	Dependency	Represent the dependency between actions	(Gill, 2015)
Priority	Priority*	The priority of an action	(Gill, 2015)
Strategic_A	Strategic Alignment*	The strategic alignment of an action	New
Critical_I	Critical impact on business processes *	The critical impact of an action on business processes	New
Urgency	Urgency*	The urgency to implement an action	New
Feasibility	Feasibility*	The feasibility of an actions	New
Risk	Risk*	Represent the potential risks associated with each action roadmap.	New
Complexity	Complexity*	The complexity of an action to implement	New
Benefit	Benefit	Gain or value realisation via implementing the roadmap	(Serra and Kunc, 2015)
Actual_M	Actual Maturity	A level of DM that represents the actual DM level after or while implementing the roadmap	(Serra and Kunc, 2015; Alsufyani and Gill, 2021)
Actual_P	Actual Performance	A set of PIs that represent the actual performance after or while implementing the roadmap	(Serra and Kunc, 2015; Alsufyani and Gill, 2021)

*A new concept emerged from the second evaluation stage

Second, based on the conceptual DEAMP model and relevant existing studies as discussed in the iterative development of the model Chapter 5 Section 5.2, a set of relationships

between the concepts was captured. These relationships include DEFINED_BY, IMPACTED-BY, ASSOCIATED_WITH, IMPROVE, MAP, IMPACT and HAS, as shown in the matrix in Figure 4-8. "HAS" indicates that one entity owns, contains, or is connected to another entity within a given context. For instance, an "Architecture" "HAS" an "Architecture_Domain", indicating that the architecture contains a set of architecture domains. In contrast, the "SUBCLASS_OF" indicates a hierarchical or inheritance structure, in which one entity is a more specific type or subclass of another broader entity. For example, "Level_1" "SUBCLASS_OF" "DMLevel" signifies that level 1 is a particular class within the broader category of DM levels that inherits characteristics from the main class. The relationship "SUBCLASS_OF" is used to describe the link between a concept and its sub-concepts for six concepts (DMLevel, PIType, Architecture_Domain, Architecture_Element, Priority and Risk) as detailed in Table 4-4.

Due to the visualisation constraint to show all classes in the matrix, the sup-classes are detailed in Table 4-4, while the rest of the classes are demonstrated in Figure 4-8.

Label	DM_Gap	CDM	TDM	DM_Level	PI_Gap	CPIs	TPIs	PIType	Architecture_Domain	Architecture_Element	Objective	Pain_point	Action	Roadmap	Timeline	Risk	Priority	Benefits	Actual_DM	Actual_P	Opportunity	
DM_Gap		DEFINED_BY	DEFINED_BY										IMPROVED_BY									
CDM				HAS		IMPACT																
TDM				HAS			IMPACT															
PI_Gap						DEFINED_BY	DEFINED_BY						IMPROVED_BY									
CPIs		IMPACTED-BY						HAS														
TPIs			IMPACTED-BY					HAS														
Architecture									HAS													
Architecture_Domain										HAS												
Architecture_Element	ASSOCIATED_WITH				ASSOCIATED_WITH						ASSOCIATED_WITH	ASSOCIATED_WITH	ASSOCIATED_WITH					ASSOCIATED_WITH				ASSOCIATED_WITH
Goal											HAS											
Objective					ASSOCIATED_WITH																	
Pain_point	ASSOCIATED_WITH																					
Action	IMPROVE				IMPROVE									ASSOCIATED_WITH								
Roadmap			MAP				MAP								HAS	HAS	HAS					
Benefits																			DEFINED_BY	DEFINED_BY		
Actual_DM				HAS								ASSOCIATED_WITH										ASSOCIATED_WITH
Actual_P								HAS			ASSOCIATED_WITH											
Opportunity	ASSOCIATED_WITH																					

Figure 4-8 Ontology concepts-relationships matrix _ Gamma

Table 4-4 Ontology base and subclasses - Gamma

Base Class	Sub Class
DMLevel	Level_0, Level_1, Level_2, Level_3 and Level_4
PIType	Financial, Competitiveness, Resource_Utilisation, Quality, Innovation and Flexibility
Architecture_Domain	Business and Information
Architecture_Element	Info, Capability, Process and People
Priority	Strategic_Alignment, Critical_Impact, Urgency, Feasibility
Risk	Complexity, Dependency

Third, the ontology is illustrated using a graph-modelling method. This approach visually represents concepts (Table 4-3) as labelled nodes interconnected by labelled edges (Figure 4-8), demonstrating their relationships (see Figure 4-9, Table 4-3). Due to visual limitations in displaying class labels in Figure 4-9, some node labels may not be completely visible. For a comprehensive view of these labels, please refer to the class label column in Table 4-3.

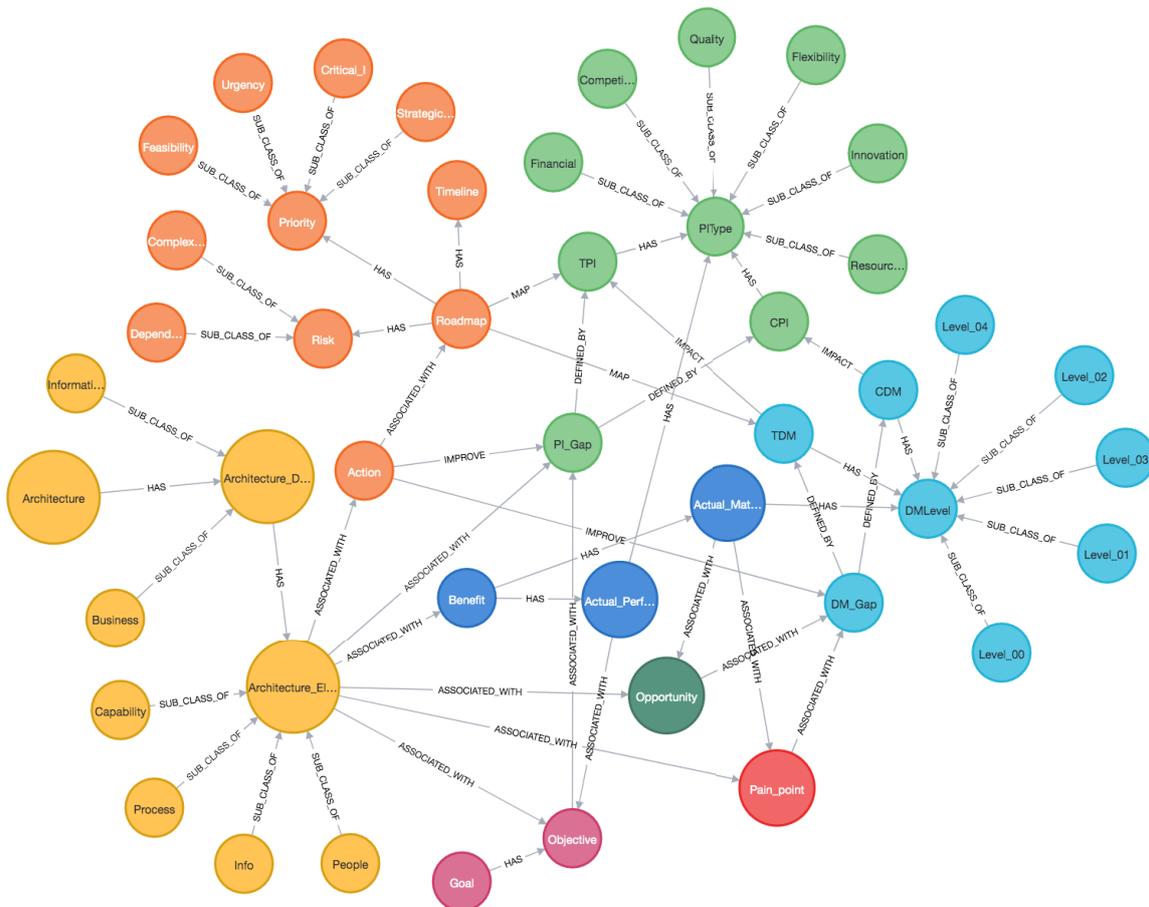


Figure 4-9 Full DEAMP graph-based model

The previous section covers the conceptual and logical model of the DEAMP assessment model. The next section covers the DEAMP assessment process.

4.3 The DEAMP assessment process

The DEAMP assessment process comprises seven stages: recognise, scope, adjust, assess, identify, roadmap and track (Figure 4-10). The first stage is the recognise stage of the assessment process (e.g. when and why there is a need to conduct an assessment). The relevant stakeholders can trigger this stage from a concerned business area of the organisation, which can then be proposed to the senior stakeholders or decision makers as a proposal for assessment. Then, if the proposal is approved, they can initiate an initiative with the assigned assessment owner to assign a relevant group of stakeholders to plan and commence workshops to discuss and define the scope of the assessment, which refers to the second stage of the process (scope). Adjust stage guides the review of the DEAMP model and adjusts it according to the assessment scope. It also defines the key stakeholders involved in the assessment data collection steps (assessors). The rest of the stages in this process are as follows: how to use the DEAMP assessment to collect data, identify gaps and actions, plan the roadmap, and track maturity and performance. If the results of this activity do not match the desired outcomes, then follow-up actions or further improvement actions can be systematically identified and roadmapped in a second loop. This applies learning and adaptability for more robust and reliable outcomes in subsequent iterations. (for more details, see Figure 4-10 and Table 4-6)

Following the structured methodology used in the ADM (The TOGAF® Standard, 10th Edition, 2022), each stage defines specific objectives, inputs, steps, and outputs (Table 4-6). To ensure a comprehensive and structured methodology for establishing and conducting the assessment, roadmapping and tracking enhancements are undertaken (refer to Chapter 3 Table 3-3).

Before diving into a detailed discussion of the assessment process, the stakeholders of this assessment can be identified during the first three stages as this assessment process is conducted. After the initiators' proposal recognises the need for the assessment to be approved, the assessment owner and the audience must be selected for the second step. Then, the assessment owner, with the audience and initiators, can choose the assessors to contribute to the assessment step effort (see Table 4-5). Each stakeholder has different

roles and responsibilities. Initiators are responsible for recognising the need for the assessment. The assessment owner oversees the implementation of the entire assessment process. The audience, typically comprising senior decision makers, contributes information to refine the process and make decisions. Assessors provide information about the selected factors necessary for data collection. Together, these stakeholders ensure a comprehensive and effective assessment process.

Figure 4-10 displays the assessment process stages.

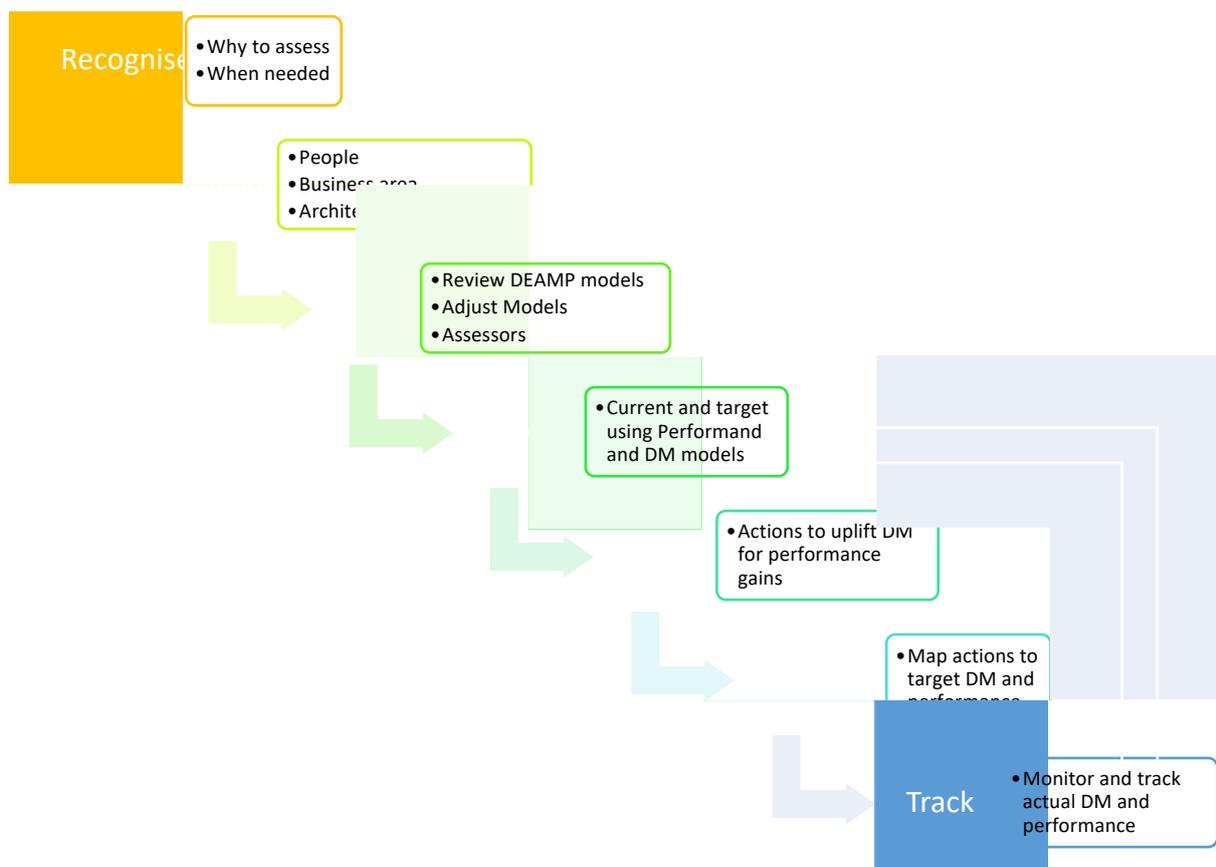


Figure 4-10 The DEAMP assessment process

Table 4-5 The four main groups involved in the assessment

Assessment owner	Responsible for the implementation of the assessment process
Assessors	Contribute information about the selected factors to data collection.

4.3.1 The DEAMP assessment process stages

4.3.1.1 Recognise

The objective of that stage is to understand why and when the assessment is required. This involves defining the reasons for the assessment. The objectives of this stage can be derived from identifying the desired outcomes by considering business events, issues, or opportunities. The output of this stage is an assessment brief that outlines the reasons and outcomes needed to conduct the assessment and the timeframe.

4.3.1.2 Scope

The objective of the scope stage is to select the EA layer/element for the assessment (What should be assessed). It includes several steps such as assigning an assessment owner, determining the audience, and conducting workshops with the audience and initiators. These workshops aim to choose the business area and relevant architecture layers and elements first, then prioritise business areas for DM assessment and performance improvement. The outcome of this stage is an assessment scope that defines the nominated business areas and relevant groups.

4.3.1.3 Adjust

The adjust stage tailors the DEAMP model to fit the selected EA layers and elements. The objective is to adjust and choose the aligned PIs and DM levels for the defined scope. This stage involves workshops with the audience and initiators to implement the required adjustments and customisations. During these workshops, participants have to accomplish a set of steps as selecting relevant PIs for each chosen layer and its underpinning elements to determine how they can be measured. The DM levels also have to be tailored to fit the organisation's digital needs and context. Strategic goals are aligned with identified pain points. The data sources for the selected PIs must be defined by identifying who can contribute to this process as assessors for the evaluation and the method for how to collect data. The preparation for these assessments could involve a questionnaire-based method for collecting DM and performance-related data, both for financial and non-financial indicators. The inputs of this stage include the assessment scope, business goals, pain points, and business drivers. The outcome of this stage is an assessment guideline that includes the adjusted customised DEAMP model.

4.3.1.4 Assess

The assess stage involves collecting data and evaluating performance and DM to assess DM and performance in alignment with the pain points and strategic goals. This stage includes workshops with the assessors to gather and analyse data to define the current and target states for each selected PI, as well as the current and target DM levels for each chosen layer. This process helps identify gaps in performance and DM. The assessment guideline acts (from the previous stage) as input for this stage. The output of this phase is a set of assessment results.

4.3.1.5 Identify

The identify stage efforts are focused on determining actions that can improve DM and achieve performance gains by addressing identified gaps. This stage includes several steps such as workshops with the audience and initiators to review the assessment results, recognise the need for action, and identify specific actions, as well as review planned and ongoing projects across different layers to ensure coordination of these actions across different layers. Using the DM and related performance gaps, along with analytics that resulted from the previous stage, digital initiatives can be identified. Hence, the inputs for this stage are the assessment results and actions across layers, and the output is an initiative backlog.

4.3.1.6 Roadmap

The roadmap stage defines a sequence of actions to achieve the target DM and performance levels. The objective is to select and prioritise digital initiatives to develop a roadmap and implementation plan. This stage includes workshops with the audience and initiators to organise actions based on their timeline, risk (considering complexity, dependencies, and external influences), and priority (assessing strategic alignment, impact on critical business processes, urgency, and feasibility). The input for this stage is the initiative backlog, and the output is a roadmap for implementation.

4.3.1.7 Track

The track stage involves monitoring and evaluating the DM and performance outcomes after implementing the actions outlined in the roadmap. It includes workshops with the audience, initiators, and assessors, using the previous assessment guidelines and results. These workshops encompass several steps, such as defining the actual DM and performance

outcomes to measure the impact of the implemented actions, comparing these outcomes with previous assessment results, and inspecting the resolved pain points and achieved goals. The workshops also involve documenting any necessary follow-up actions. This stage establishes digital governance to assess the value of the action, identify any remaining issues, and capture lessons learned for future projects in alignment with the pain points, opportunities, and strategic goals. The outputs consist of reporting and governance documentation to ensure alignment with pain points, opportunities, and strategic goals.

Table 4-6 details the steps in each stage, the input objectives and the outputs of the DEAMP assessment process.

Table 4-6 DEAMP assessment process

Stage Name	Steps	Inputs	Objectives	Outputs
Recognise	<p>Recognise why there is a need to conduct this assessment (why to assess and when)</p> <ul style="list-style-type: none"> • Define the reason for conducting this assessment: <ul style="list-style-type: none"> ○ What is the outcome? ○ When is it needed? 	Business events, issues, or opportunities.	Recognise the reasons and the outcomes needed to conduct the assessment and the timeframe.	Assessment brief
Scope	<p>Select the EA scope for this assessment. (What should be assessed?)</p> <ul style="list-style-type: none"> • Assign Assessment owner • Select the audience • Workshop with audience and initiators to <ul style="list-style-type: none"> ○ Select the business area subject to this assessment ○ Select the architecture layers and their elements for the previously selected business area subject to this assessment 	Assessment brief	Select and prioritise business areas in scope for DM assessment and performance improvement and the relevant groups to the selected scope.	Assessment scope
Adjust	<p>Adjust the DEAMP model (PIs and DM Models) to suit the selected EA layers and elements.</p> <ul style="list-style-type: none"> • Workshop with audience and initiators to adjust and tailor the model by: <ul style="list-style-type: none"> ○ Select the PIs related to each selected layer and its underpinning elements and how they can be measured ○ Tailer the DM levels to the organisation ○ Align strategic goals and Pain points ○ Define the source of inputs for the selected indicators and who can contribute to identify 	Assessment scope business goals, pain points and business drivers.	Adjust and select the aligned PIs and DM Levels to the selected scope	Assessment guideline (Adjusted DEAMP model)

Stage Name	Steps	Inputs	Objectives	Outputs
	<ul style="list-style-type: none"> ○ Select the assessors 			
Assess	<p>Collect data and assess the performance and DM</p> <ul style="list-style-type: none"> • Workshops with the assessors to <ul style="list-style-type: none"> ○ Collect the data ○ Analyse the data and define the current and target state of each PI ○ Define the current and target DM level for each selected layer ○ Determine the performance and DM gaps 	Assessment guideline	Apply a systematic approach to assess and improve DM and performance in alignment with the pain point and strategic goals.	Assessment results
Identify	<p>Identify actions to uplift DM (DM gap) for performance gain (performance gap)</p> <ul style="list-style-type: none"> • Workshops with the audience and initiators to <ul style="list-style-type: none"> ○ Review the assessment results and realise the need to take actions ○ Identify actions ○ Coordinate actions across layers* 	Assessment results and initiatives backlog across EA layers	Identify and formulate digital initiatives and coordinate actions across layers.	Initiatives backlog
Roadmap	<p>Define a roadmap to map to target DM and performance, which is a sequence of actions based on several factors.</p> <ul style="list-style-type: none"> • Workshops with the audience and initiators to arrange actions based on the identified timeline, their risk (complexity, dependencies, and external influences) and priority (strategic alignment, impact on critical business processes, urgency, and feasibility). 	Initiatives backlog	Select and prioritise digital initiatives to develop the roadmap and implementation plans.	Roadmap for implementation plan
Track	Monitor and track the actual DM and performance (post-actions roadmap's implementation)	Assessment guideline	Establish digital governance to assess the effectiveness of the action, identify any remaining issues, and capture	Reporting and governance

Stage Name	Steps	Inputs	Objectives	Outputs
	<ul style="list-style-type: none"> • Workshops with the audience, initiators and assessors using the previous assessment guidelines and results to <ul style="list-style-type: none"> ○ Define the actual DM and performance outcomes resulting from implementing the actions roadmap to measure how well the actions uplifted DM and the performance gain ○ Compare actual DM and performance with the previous Assessment results ○ Monitor resolved pain points and realised goals and objectives according to the desired target maturity and performance levels (based on the reporting needs) ○ Document follow-up actions if needed. 	Assessment results	lessons learned for future projects in alignment with the pain points, opportunities and strategic goals.	

4.4 Summary

This chapter discusses the DEAMP framework and the main contribution of this research within the scope of the study. The DEAMP assessment framework enables organisations to determine whether to initiate digitalisation activities to achieve their intended performance outcomes by providing a comprehensive tool for self-assessing DM. It offers both an assessment model and an implementation process, guiding organisations in enhancing DM across EA layers. The DEAMP assessment framework comprises two components: DEAMP model and DEAMP process which captures the interconnectivity between DM levels and performance outcomes, aiding decision-makers with valuable insights for informed decisions. The framework is structured into three levels: the DEAMP conceptual model for high-level abstraction, the DEAMP logical model for detailed representation, and the DEAMP physical model for specific scenario implementation. This chapter focuses on the conceptual and logical models, and the physical model is discussed in Chapter 5.

5 Chapter 5 Development & Evaluation

This chapter focuses on developing and evaluating the framework, while the previous chapter (Chapter 4) presents the final version of the DEAMP assessment framework and its components. This journey was taken to accomplish two different yet interrelated stages of the DSR process. It clarifies the framework formation and the rigorous research evaluation process. The development of the framework journey will be incrementally discussed; then, the evaluation methods will be highlighted to clarify the use of the methods to develop and evaluate the framework iteratively. This chapter is structured as follows:

- 5.1 The DEAMP assessment framework development
- 5.2 Evaluation methods
- 5.3 Evaluation journey

The components of the DEAMP assessment framework were constructed and evaluated iteratively. The main goal of this iterative process in building and evaluating the DEAMP assessment framework was to facilitate the gradual evolution of the design, from its initial alpha version to the ultimate gamma version, as each component progressed through multiple increments. As facilitated in Figure 5-1, the development process underwent six increments, resulting in three different versions. The initial alpha version includes the first two increments. The first increment involves developing the DM model and performance model individually. The second increment focuses on integrating these two models by developing the integration point (the action model). The beta version was the result of the first evaluation process that concluded to add a benefit tracking model to close the loop of the assessment model. Last but not least, the gamma version resulted from the experts' suggested refinements collected from the second round of the evaluation process. This version went through three different increments. One was designated to improve and refine the DEAMP model. The last two increments were to develop and refine the DEAMP process. As such, each version underwent an evaluation process, the details of which are addressed in section 5.3.

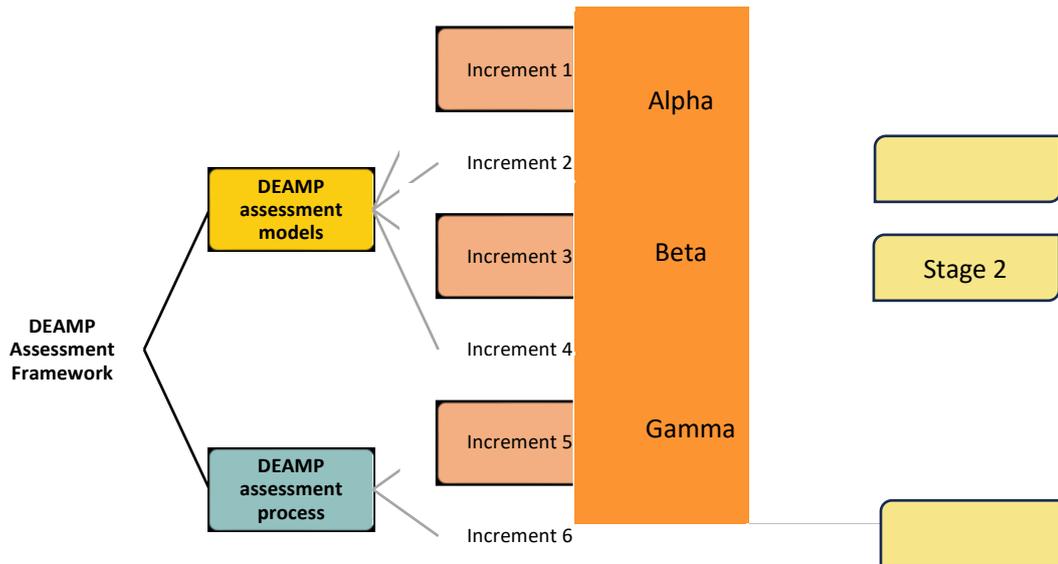


Figure 5-1 Proposed framework development increments & evaluation stages

5.1 The DEAMP assessment framework development

This assessment framework was developed to address the RQ: How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? (see chapter 1). The development process consisted of six increments in alignment with the principles of DSR (see Chapter 3). Parallely, the design of this assessment model was informed by the De Bruin framework as a theoretical lens and foundation (De Bruin *et al.*, 2005), as discussed in Chapter 3. The first increment focused on developing the DM and performance models separately. In the second increment, these two models were integrated by creating an integration point known as the action model. The third increment introduced a benefit tracking model to complete the assessment model. The fourth increment aimed at enhancing and refining the DEAMP model. The final two increments were dedicated to developing and refining the DEAMP process. The actions associated with these increments and their corresponding DEAMP assessment framework components are detailed in Table 5-1.

Table 5-1 Increment actions for DEAMP assessment framework development

Framework Component	Action/Justification
DEAMP Assessment Model	(Adaptive EA and Results and Determinants performance framework) were defined to ground the artefact on both theory and practical frameworks as detailed in Table

Framework Component	Action/Justification
	<p>3-3).To address the first and second RQs (see Chapter 1), existing studies related to DM models were reviewed systemically as reported in an earlier published study (Alsufyani and Gill, 2021) and digitalisation performance in an earlier published study (Alsufyani and Gill, 2022). De Bruin's framework (De Bruin <i>et al.</i>, 2005) was adopted to design the artefact and conceptualise a tentative adaptive EA-driven model defining the performance outcomes and metrics and DM levels separately.</p> <p>Increment 2: To address the third RQ and the main RQ (see Chapter 1), we integrated the isolated DM and performance tentative assessment by developing the action model. This integration was designed into two levels of abstraction (conceptual and logical modelling) following the architectural technique of TOGAF Standard 10 to conceptualise and then identify the three model concepts and their relationships in an ontology to ensure a cohesive understanding of the DEAMP model and its components. The graph-based modelling approach (Pokorný, 2016) was adopted to illustrate the DEAMP (logical model) concepts, properties and their relationships using Noe4j.</p> <p>Increment 3: For the iterative process to evaluate and refine the artefact (in alignment with the principles of DSR and De Bruin's assessment designing framework), the outcome of the first evaluation (illustrative scenario for demonstrating the applicability) is to develop a benefits model to monitor the actual DM and performance outcomes stemming from the implementation of the action roadmap following its execution. Update the logical and conceptual DEAMP models (Beta version) that were published (Alsufyani and Gill, 2023)</p> <p>Increment 4: The beta version was evaluated by an expert survey to test a set of Criteria adopted from (de Bruin <i>et al.</i>, 2005; Prat, Comyn-Wattiau and Akoka, 2014). This resulted in refining and updating the final gamma version of the DEAMP model by including new concepts (opportunities) and adding other refinements (see Table 5-11)</p>
DEAMP Assessment Process	<p>Increment 5: As a result of the expert's survey, a process is needed to help organisations self-assess DM and performance outcomes, using and complementing the DEAMP assessment model to aid in their DT planning. The CCP interpretive framework (Stockdale and Standing, 2006) (as listed in Table 3-3) is adopted to develop an initial framework process to guide organisations on what to do to assess their DM for performance gain using the framework models. The initial process was reviewed internally in a design review meeting within the DigiSAS Lab.</p> <p>Increment 6: The initial process was reviewed internally in a design review meeting in the DigiSAS Lab, which led to refine the process by including an additional stage to</p>

Framework Component	Action/Justification
	emphasise the reasons and the outcomes needed from the assessment, recognise and define stakeholders critical to the assessment process and develop a detailed stages process of each of the 7 steps following the Structured Methodology (<i>The TOGAF® Standard, 10th Edition, 2022</i>). (see Table 3-3)

The following section details the first increment, followed by details of the remaining six increments.

5.1.1 First increment: DM model and performance model

The aim was to create a tentative conceptual model to outline the performance outcomes and metrics for a particular level of DM from an EA perspective by adopting theoretical lenses and frameworks (see Table 3-3). Following the development of the model introduced by de Bruin *et al.* (2005), this increment involved the tentative development of the DM model and performance model individually before integrating them into a cohesive model to align DM levels with performance outcomes. The detailed processes of the development of the DM model and performance model are discussed below.

5.1.1.1 DM model

A comprehensive review of existing DM models was conducted to develop the DM model, as detailed in the first SLR (Alsufyani and Gill, 2021). Thirty models were synthesised using the theoretical lens of adaptive EA (Gill, 2015). This analysis identified five different DM levels, ranging from maturity (level 0) to high maturity (level 5). These levels are summarised in Table 5-2 and are discussed in greater depth in earlier work (Alsufyani and Gill, 2021).

Table 5-2 DM levels

Level	Name	Description	EA Layer
Level 0	None	Either the absence of digitalisation or basic digitisation as no or limited digital processes running in silos	Each level could be tailored to the EA layer (e.g. the human layer) and underpinning elements (e.g.
Level 1	Beginner	Digitally aware or ad-hoc digitalisation, as some or ad-hoc moves towards defining digital capabilities processes	
Level 2	Learner	Adopting digital practices such as breaking down internal silos and digital collaborative practices created	

Level	Name	Description	EA Layer
Level 3	Intermediate	Consistent, defined, integrated and digitally enabled such as business practices and processes are being identified and developed digitally	business capability, information).
Level 4	Advanced	Completely developed, predictable and proactive as fully developed and proactively integrated into organisational plans and the business review cycle for regularly audited and improved	
Level 5	Expert	Innovative, data-driven and adaptable such as constantly monitored, improved and refined to anticipate and adaptably respond to new technologies and digital innovation	

The DM levels can be used to assess the current maturity level across the EA layers. This will then provide baseline information to set the target maturity level. In other words, the DM levels are a normative outline of the levels at which the organisations can tailor their specific definitions of the DM levels to their consideration of maturity levels. Thus, the proposed tentative adaptive EA-driven DM model is to assess DM across adaptive EA layers and its underpinning elements (see Table 5-3).

Table 5-3 Tentative DM model based on adaptive EA (Gill, 2015)

		Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
Interaction	Actors						
	Channels						
	Touchpoint						
	Experience						
Human	Business						
	Information						
	Social						
	Professional						
Technology	Application						



5.1.1.2 Performance model

To develop the performance model, digitalisation performance outcomes were synthesised using two theoretical lenses, namely adaptive EA (Gill, 2015) and the results and

determinants framework (Fitzgerald *et al.*, 1991) in an earlier published study (Alsufyani and Gill, 2022).

Table 5-4 details the proposed set of digitalisation PIs based on the existing knowledge and the results and determinants framework as reported in (Alsufyani and Gill, 2022).

Table 5-4 PIs (Alsufyani and Gill, 2022)

	PI Type	PI	Measure
1	Competitiveness	Market share	Market share
2		Global performance	
3		Sales growth	Sales growth
4		Customer acquisition	Customer base
5		Sales per customer	Degree of attractiveness
6	Financial	Enterprise efficiency ratio	Cost Efficiency
7		Operating cost	
8		Sales cost	
9		IT investment - infrastructure	Cost
10		Enterprise stock-market measures	Growth Prediction Market Valuations
11		Enterprise value /market value	Value Market
12		Income	Profitability
13		Operating Margin	
14		Operating return on assets	
15		Return on asset	
16		Return on investment	
17		Revenue	
18		Turnover	
19	Profit		
20	Flexibility	Enterprise agility	Degree of agility speed
21		HR flexibility	Degree of flexibility
22	Innovation	Talent management performance	Degree of encouragement
23		Enterprise - Innovation Efficiency	Increase innovation efficiency
24		Enterprise - Innovative Effectiveness	Increase innovation Effectiveness
25	Quality	Demand rationalisation	Satisfaction
26		Purchases quality	
27		Customer satisfaction	
28		Availability	availability

	PI Type	PI	Measure	
29		Awareness	Reliability	
30		Brand associations		
31		Consumer attitudes	Responsiveness	
32	Resource utilisation	Customer retention	Efficiency	
33		Ecotourism performance		
34		Enterprise in Ecosystem - connectivity		
35		HR development performance		
36		IT governance performance – business flexibility		
37		IT governance performance - Cost-effective use of IT		
38		IT governance performance - IT for asset utilisation		
39		IT governance performance - IT for growth		
40		Labor-capital ratio		
41		Market Value capture		
42		Market Value creation		
43		Operational performance		
44		Procurement Savings		
45		Environmental performance		
46		HR Efficiency		
47		Process digitisation		Efficiency/ integration
48		Work performance		Productivity
49		Employee - job performance		
50	Integrated enterprise data/info - visualisation			
51		Business unit IT autonomy/	Degree of autonomy	

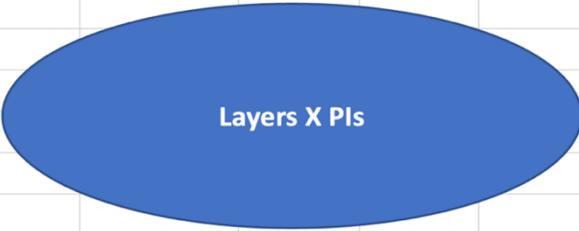
The aim is to capture the organisation’s performance outcomes for each EA layer and its underpinning elements. These performance outcomes can be captured by a set of PIs across six generic dimensions for performance measurement: competitiveness, financial, quality, flexibility, resource utilisation and innovation. These dimensions can measure profitability, market value, cost-effectiveness, market share, sales, customer base, product attractiveness, efficiency, productivity, satisfaction, responsiveness, availability, reliability, innovation, and flexibility performance, as reported in this SLR study (Alsufyani and Gill, 2022). Based on this SLR, a questionnaire-based method appears to be the preferred approach for collecting performance-related data, both for financial and non-financial

indicators. However, it can be extracted objectively from the financial report or the ratio calculation of non-financial indicators. This preference is due to the method's suitability for subjective measurements, its data collection efficiency, and its confidentiality.

Table 5-5 details the PIs' dimensions, the EA layers, and their underpinning elements to visualise the tentative design of the performance model.

Table 5-5 Tentative performance assessment model based on adaptive EA (Gill, 2015), results and determinants framework (Fitzgerald et al., 1991)

		Financial	Competitiveness	Resource Utilisation	Quality	Innovation	Flexibility
Interaction	Actors						
	Channels						
	Touchpoint						
	Experience						
Human	Business						
	Information						
	Social						
	Professional						
Technology	Application						



The previous increment introduces the tentative DM and performance assessment models. The next increment introduces the integrated DM and performance assessment model (alpha version).

5.1.2 Second increment: Integrate DM and performance model - Alpha

The result of the first increment formulated the main elements of EA-driven DM and performance tentative assessment models separately (see Table 5-6 and Table 5-7). This increment aims to integrate the isolated DM and performance tentative assessment elements to address the third RQ3: How to link DM levels and the performance of an organisation and the main RQ (refer to Chapter 1). Following the De Bruin framework (2005), the defined boundaries and scope of the design elements were followed while executing the model's development process. This increment has two main steps: conceptual and logical modelling. This approach was adopted from the architectural technique of TOGAF Standard 10 (*The TOGAF® Standard, 10th Edition, 2022*) (see Chapter 3 – Table 3-3).

5.1.2.1 Conceptual modelling

Conceptual modelling focuses on high-level abstraction to highlight fundamental concepts and relationships. It aids in defining requirements, key entities, and the model's structure and functionality. This involves conceptualising an integrated EA-driven model that can assess DM and performance separately but in a connected manner by aligning digital advancements with the desired performance outcomes. These conceptualising answers the main research question (see Chapter 1) on how to help organisations self-assess and navigate their current and intended DM levels and performance outcomes to enable the development of a roadmap to drive digitalisation improvement for enhanced performance gains. To accomplish this, the main concepts and relationships were extracted from our previous studies (Alsufyani and Gill, 2021, 2022) and relevant literature (Rosemann and de Bruin, 2005; Kaplan and Norton, 2010; Yu and Madiraju, 2014; Gill, 2015; Parviainen *et al.*, 2017). The EA-driven DEAMP can be used to assess DM and performance outcomes across adaptive EA layers and their underpinning elements (Figure 5-2).

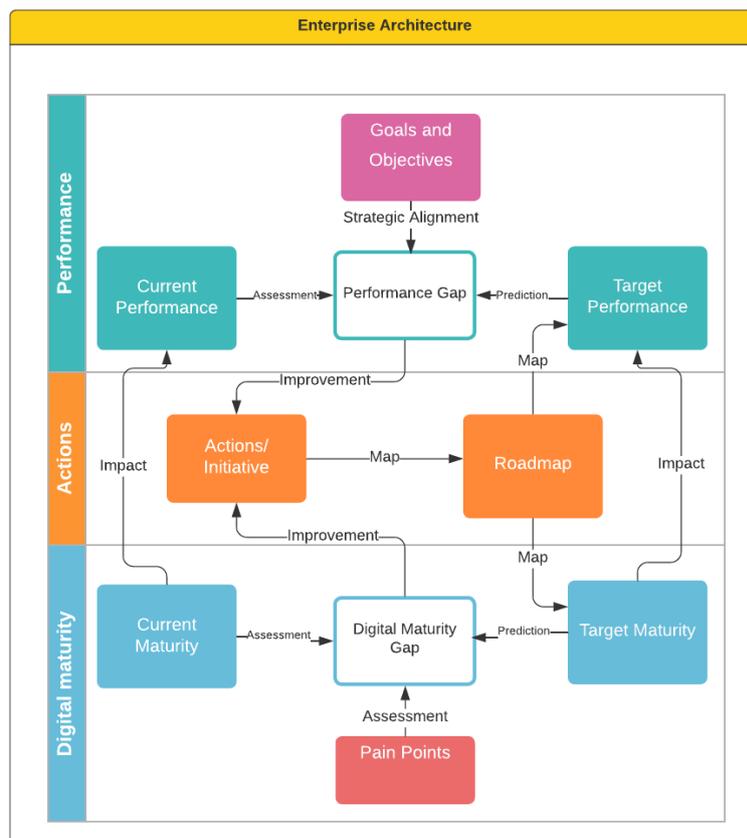


Figure 5-2 Integrated DM and performance conceptual model - Alpha

The DEAMP framework is structured into three key areas: performance, DM, and actions. Performance assessment aims to identify performance gaps in relation to organisational goals and objectives. Similarly, a DM assessment can be conducted to determine DM gaps based on underlying pain points across the EA. Since the current and target DM levels influence current and target performance, these assessments can guide the initiation of actions to address integrated performance and maturity gaps to enhance DM for improved performance. These actions can be incorporated into a roadmap to chart the path towards target DM and performance levels.

5.1.2.2 Logical modelling

Logical modelling translates the conceptual model into a more detailed representation suitable for implementation in an ontology. The ontology adopted to introduce the logical model is “an explicit account or representation of some part of a conceptualisation” (Guarino and Garetta, 1995). Since this model involves human-centric knowledge sharing to ensure a consistent understanding of the DEAMP model and its components to reduce ambiguity, this was expanded into a structured informal ontology. A structured informal ontology provides a flexible framework for defining and organising concepts and relationships without the rigid constraints of fully formalised ontologies (Uschold, 1996). This approach prioritises human comprehensibility while maintaining a basic organisational structure. This ontology includes identifying concepts and relationships relevant to the field (Uschold & Gruninger 1996). It aims to improve communication during assessments and enhancements of DM for the desired performance outcomes. Ontology can also be considered a formal abstract specification of a shared conceptualisation that allows semantic knowledge modelling as a KG (Ehrlinger and Wöß, 2016). KG illustrates concepts as labelled nodes and their relationships by labelled edges (Pokorný, 2016). Thus, using graph modelling to illustrate the ontology can provide a connection-oriented and flexible structure to highlight the relationships between concepts. The ontology development framework by Uschold and Gruninger (1996) was implemented to develop the ontology in three stages: identify the concepts and their definition, identify the relationships between those concepts and implement those concepts and their relations in a graph-based modelling approach (Pokorný, 2016).

First, concepts and their definitions were identified to capture the ontology aspect for each DM, performance model, and then the integrated model DEAMP (Table 5-6, Table 5-7 and Table 5-8). For example, to identify the performance gap, the PI gap utilises a set of current and target performance measures (CPI and TPI, respectively). The same principle applies to DM, with current and target levels (CDM and TDM). The CPI and TPI can reveal the impact of CDM and TDM. Furthermore, an action considers a specific element's PI gap, DM gap, goal, and pain point and is associated with a roadmap. Additionally, five concepts include a set of sub-concepts that can be further elaborated to derive more detailed sub-concepts. For illustration, the architecture domain includes business and information, but other domains, such as technology and security, could also be considered. On the other hand, six levels of DM were defined as sub-concepts for the DM level concept. These levels are elaborated further in Table 5-2. Also, the PI type encompasses six distinct dimensions: financial, quality, and resource utilisation. These dimensions can be further subdivided into more specific and detailed PIs within each PI type, as outlined in Table 5-4.

Table 5-6, Table 5-7 and Table 5-8 detail concepts and their definitions of DM, performance and integration model. The class label is included to show the label used for each concept in the graph-based model.

Table 5-6 DM model concepts

Class Label	Concept	Definition	Reference
DM_Gap	DM gap	A level of DM that represents a gap in the DM	(Alsufyani and Gill, 2021)
CDM	Current DM	A level of DM that represents the current level of the DM	(Rosemann and de Bruin, 2005)
TDM	Target DM	A level of DM that represents the target level of the DM	(Rosemann and de Bruin, 2005)
DM_Level	DM level	Represents the six levels of the DM	(Alsufyani and Gill, 2021)
Level_00	Level 0	None - Absence of digitalisation or basic digitalisation	(Alsufyani and Gill, 2021)
Level_01	Level 1	Beginner - Digitally aware or ad-hoc digitalisation	(Alsufyani and Gill, 2021)
Level_02	Level 2	Learner - adopting digital practices	(Alsufyani and Gill, 2021)
Level_03	Level 3	Intermediate - Consistent, defined, integrated and digitally enabled	(Alsufyani and Gill, 2021)

Class Label	Concept	Definition	Reference
Level_04	Level 4	Advanced - Completely developed, predictable and proactive	(Alsufyani and Gill, 2021)
Level_05	Level 5	Expert - Innovative, data-driven and adaptable	(Alsufyani and Gill, 2021)

Table 5-7 Performance model concepts

Class Label	Concept	Definition	Reference
PI_Gap	Performance gap	A set of PIs that represents a gap in performance outcomes	(Alsufyani and Gill, 2022)
CPI	Current PI	A set of PIs that represents current performance outcomes	(Rosemann and de Bruin, 2005)
TPI	Target PI	A set of PIs that represents target performance outcomes	(Rosemann and de Bruin, 2005)
PIType	PI Type	Represents the six types of PI	(Alsufyani and Gill, 2022)
Financial	Financial	Represents the financial PIs	(Alsufyani and Gill, 2022)
Competitiveness	Competitiveness	Represents the competitiveness PIs	(Alsufyani and Gill, 2022)
Resource Utilisation	Resource Utilisation	Represents the resource utilisation PIs	(Alsufyani and Gill, 2022)
Quality	Quality	Represents the quality PIs	(Alsufyani and Gill, 2022)
Innovation	Innovation	Represents the innovation PIs	(Alsufyani and Gill, 2022)
Flexibility	Flexibility	Represents the flexibility PIs	(Alsufyani and Gill, 2022)

Table 5-8 Integration concepts

Class Label	Concept	Definition	Reference
Architecture	Architecture	A business area in the EA design	(Gill, 2015)
Architecture_Domain	Architecture domain	A domain of the EA design within a business area (business or information of the human layer)	(Gill, 2015)
Architecture_Element	Architecture element	An element of the architecture domain (people, capability, process or information)	(Gill, 2015)
Goal	Goal	A description (statement) of what the organisation wants to achieve	(Kaplan and Norton, 2010)
Objective	Objective	A scalable description of a goal	(Kaplan and Norton, 2010)

Class Label	Concept	Definition	Reference
Pain_point	Pain point	A problem or solution of an issue that was unfinalised	(Yu and Madiraju, 2014; Gill, 2015)
Action	Action	An initiative defined by the organisation to improve DM level for the desired performance gain	(Kaplan and Norton, 2010)
Roadmap	Roadmap	A sequence of actions based on several factors	(Gill, 2015; Parviainen <i>et al.</i> , 2017)
Timeline	Timeline	A period of time needed to implement an action	(Gill, 2015)
Dependency	Dependency	Represents the dependency between actions	(Gill, 2015)
Priority	Priority	The priority of an action	(Gill, 2015)

Second, a set of relationships between the concepts was captured based on the conceptual model and relevant existing studies. These relationships include DEFINED_BY, IMPACTED-BY, ASSOCIATED_WITH, IMPROVE, MAP, IMPACT and HAS, as shown in the matrix in Figure 5-3. “HAS” as a relationship represents a direct association that owns, contains, or is connected to another entity within a given context. For instance, an “Architecture” “HAS” an “Architecture_Domain”, indicating that the architecture contains a set of architecture domains. In contrast, the “SUBCLASS_OF” indicates a hierarchical or inheritance structure, in which one entity is a more specific type or subclass of another broader entity. For example, “Level_1” “SUBCLASS_OF” “DMLevel” signifies that level 1 is a particular class within the broader category of DM levels that inherits characteristics from the main class. The relationship "SUBCLASS_OF" is used to describe the link between a concept and its sub-concepts for four concepts (DMLevel, PIType, Architecture_Domain, Architecture_Element), as detailed in Table 5-9. Due to the visualisation constraint to show all classes in the matrix, the sup-classes are detailed in Table 5-9, while the rest of the classes are demonstrated in Figure 5-3.

Figure 5-3 visualises the ontology concepts in their relationships in a matrix.

Label	DM_Gap	CDM	TDM	DM_Level	PI_Gap	CPIs	TPIs	PIType	Architecture_Domain	Architecture_Element	Objective	Pain_point	Action	Roadmap	Timeline	Dependency	Priority
DM_Gap		DEFINED_BY	DEFINED_BY										IMPROVED_BY				
CDM				HAS		IMPACT											
TDM							IMPACT										
PI_Gap						DEFINED_BY	DEFINED_BY						IMPROVED_BY				
CPIs		IMPACTED_BY						HAS									
TPIs			IMPACTED_BY					HAS									
Architecture									HAS								
Architecture_Domain										HAS							
Architecture_Element	ASSOCIATED_WITH				ASSOCIATED_WITH						ASSOCIATED_WITH	ASSOCIATED_WITH	ASSOCIATED_WITH				
Goal											HAS						
Objective					ASSOCIATED_WITH												
Pain_point	ASSOCIATED_WITH																
Action	IMPROVE				IMPROVE											ASSOCIATED_WITH	
Roadmap			MAP				MAP								HAS	HAS	HAS

Figure 5-3 Ontology concepts-relationships matrix - Alpha

Table 5-9 Ontology base and subclasses - Alpha

Base Class	Sub Class
DMLevel	Level_0, Level_1, Level_2, Level_3, Level_4 and Level_5
PIType	Financial, Competitiveness, Resource_Utilisation, Quality, Innovation and Flexibility
Architecture_Domain	Business and Information
Architecture_Element	Info, Capability, Process and People

Third, a graph-based modelling approach (Pokorný, 2016) was employed to illustrate the DEAMP concepts and their interconnections. To demonstrate the applicability of the proposed work, the DEAMP graph was implemented using the Neo4j graph database as an initial step (Figure 5-4). It was selected due to its scalability, robustness, and open-source nature as a native graph database (Pokorný, 2015). In Neo4j, data is stored as nodes and edges to demonstrate entities and relationships.

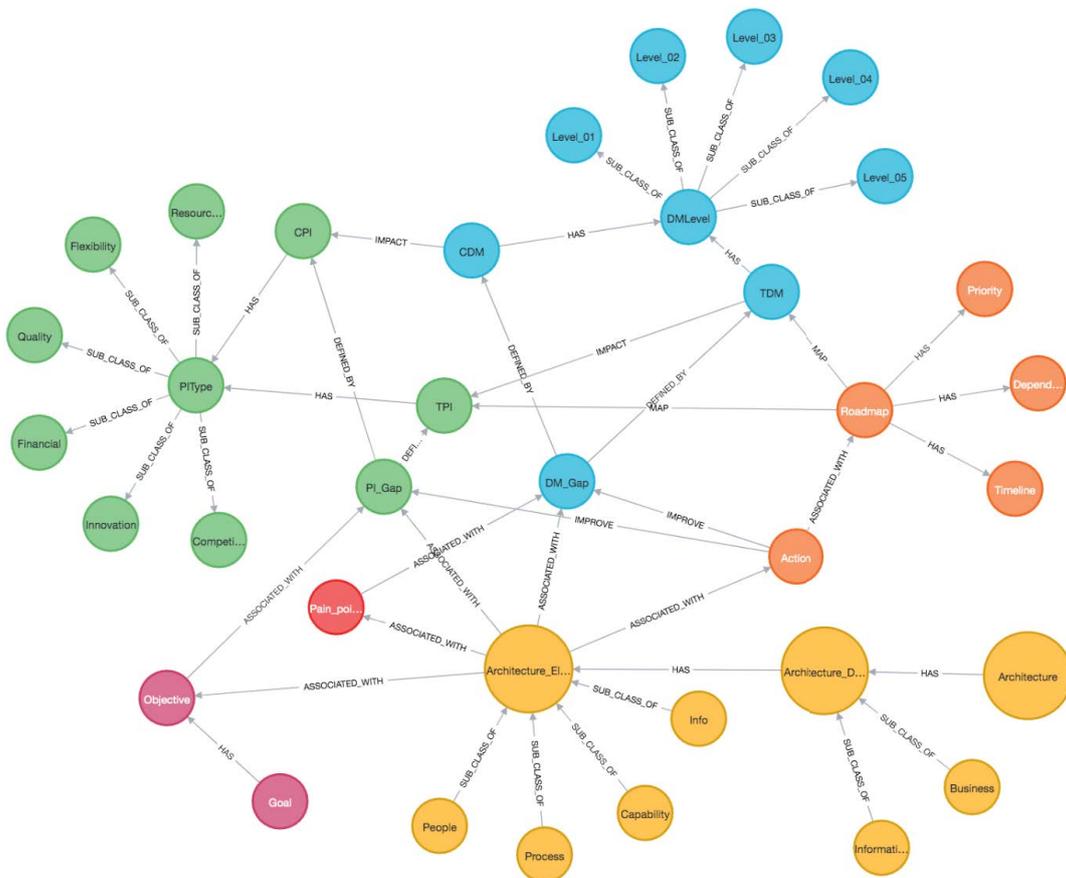


Figure 5-4 DEAMP graph-based model - Alpha

The previous increment introduces the integrated DM and performance assessment model (alpha version). The next increment introduces the DEAMP assessment model (beta version).

5.1.3 Third increment: DEAMP model - Beta as reported in (Alsufyani and Gill, 2023)

The result of the previous (second) increment formulated the integration of the isolated DM and performance in conceptual and logical modelling. This increment aims to adopt the applicable refinements that resulted from the first evaluation stage. According to the De Bruin framework evaluation step (De Bruin *et al.*, 2005), ongoing testing and refinement based on feedback and results are essential in the evaluation process. Thus, as a result of the first evaluation stage, which involved demonstrating the illustrative scenario to practitioners to assess the framework's applicability, it became evident that a benefits-tracking component needs to be established. This component is essential to ensure alignment with identified pain points and strategic objectives. Consequently, a benefits model is developed. This model monitors the actual DM and performance outcomes resulting from the implementation of the action roadmap. It can track resolved pain points and achieved goals and objectives according to the desired target maturity and performance levels. Thus, the conceptual and logical models were updated with the benefits model, as illustrated in Figure 5-5, Figure 5-7 and Table 5-10. This work was published and refined based on peer-review feedback (Alsufyani and Gill, 2023).

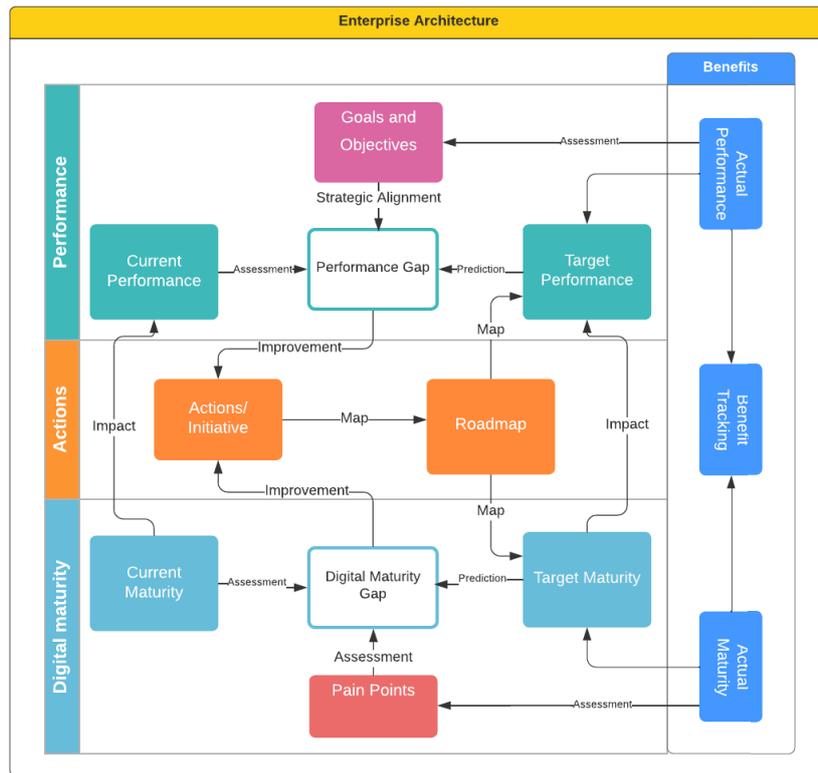


Figure 5-5 DEAMP conceptual model - Beta (Alsufyani and Gill, 2023)

As previously discussed in this increment, the aim is to update the DEAMP model with the benefits model. Thus, the newly emerged main concepts of the benefits model and their definitions were identified to update the logical model following the ontology development framework (Uschold & Grüninger 1996). These concepts are detailed in Table 5-10.

Table 5-10 Benefits model concepts

Class Label	Concept	Definition	Reference
Benefit	Benefit	A gain or value realisation via implementing the roadmap	(Serra and Kunc, 2015)
Actual_M	Actual Maturity	A level of DM that represents the actual DM level after or while implementing the roadmap	(Serra and Kunc, 2015; Alsufyani and Gill, 2021)
Actual_P	Actual Performance	A set of PIs that represent the actual performance after or while implementing the roadmap	(Serra and Kunc, 2015; Alsufyani and Gill, 2021)

Second, the relationships between the newly added concepts and the previous ones are identified, as highlighted in Figure 5-6.

Label	DM_Gap	CDM	TDM	DM_Level	PI_Gap	CPIs	TPIs	PIType	Architecture_Domain	Architecture_Element	Objective	Pain_point	Action	Roadmap	Timeline	Priority	Priority	Benefits	Actual_DM	Actual_P
DM_Gap		DEFINED_BY	DEFINED_BY										IMPROVED_BY							
CDM				HAS		IMPACT														
TDM				HAS			IMPACT													
PI_Gap						DEFINED_BY	DEFINED_BY						IMPROVED_BY							
CPIs		IMPACTED-BY						HAS												
TPIs			IMPACTED-BY					HAS												
Architecture									HAS											
Architecture_Domain										HAS										
Architecture_Element	ASSOCIATED_WITH				ASSOCIATED_WITH						ASSOCIATED_WITH	ASSOCIATED_WITH	ASSOCIATED_WITH					ASSOCIATED_WITH		
Goal											HAS									
Objective					ASSOCIATED_WITH															
Pain_point	ASSOCIATED_WITH																			
Action	IMPROVE				IMPROVE									ASSOCIATED_WITH						
Roadmap			MAP				MAP								HAS	HAS	HAS			
Benefits																			DEFINED_BY	DEFINED_BY
Actual_DM				HAS								ASSOCIATED_WITH								
Actual_P								HAS			ASSOCIATED_WITH									

Figure 5-6 Ontology concepts-relationships matrix - Beta

In the third step, the graph-based model was updated to represent the updated DEAMP concepts and their relationship to the benefits model (see Figure 5-7).

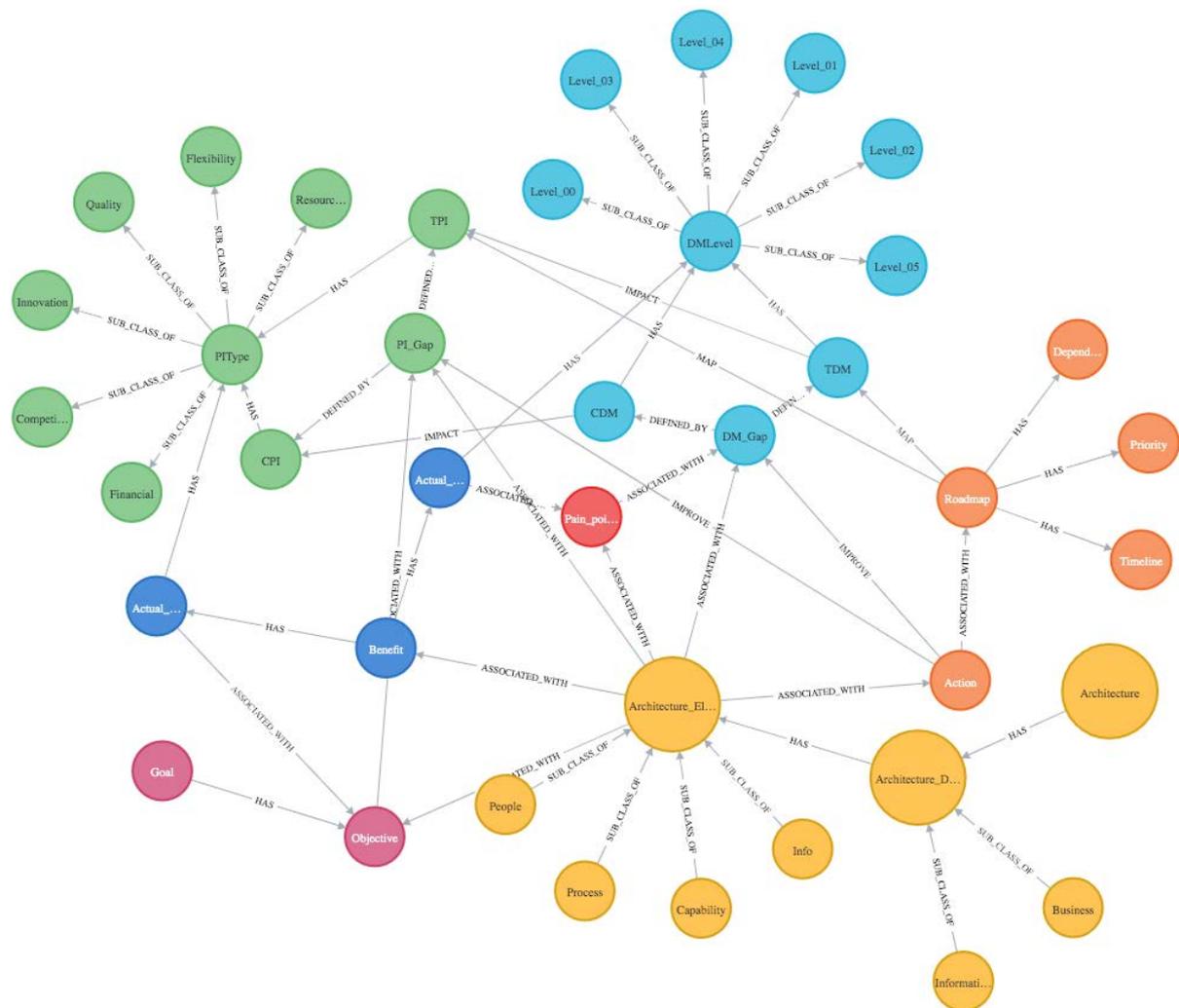


Figure 5-7 Full DEAMP graph-based model - Beta (Alsufyani and Gill, 2023)

The previous increment introduces the DEAMP assessment model (beta version). The next increment introduces the DEAMP assessment model (gamma version).

5.1.4 Fourth increment: DEAMP model - Gamma

The result of the previous (third) increment formulated the gamma version of the DEAMP model in conceptual and logical modelling. This increment aims to adopt the applicable refinements that resulted from the second evaluation stage. As a part of the iterative approach that this DSR study has adopted to conduct that research and the De Bruin

framework for assessment model development and evaluation (De Bruin *et al.*, 2005), the experts' suggested refinements are collected from the second round of the evaluation process (see section 5.3.2). In this increment, the applicable improvements were incorporated to refine and add components to the DEAMP model design derived from the experts' survey qualitative analysis in section 5.3.2.2. This is the final version of the model proposed under the scope of this research (see Chapter 4). However, to address this study's RQ to help organisations use these models to self-assess, two more increments were added to develop a stage-by-stage process on how to use these models (refer to sections 5.1.5 and 5.1.6).

Each DEAMP component model has been addressed with several proposed improvements, as detailed in Table 5-11. These improvements have been incorporated into the conceptual and logical gamma version, as detailed in Chapter 4. It is also illustrated as a physical model in the last evaluation stage in Section 5.3.3.

Table 5-11 The DEAMP model adopted refinements

DEAMP models	Experts' suggested refinements	The adopted refinements
Performance model	<p>Suggestions to refine and expand PIs, including specific areas like customer experience, customer & service coverage and segment, change management metrics, platform choice evaluation, and incorporate quality measures like interoperability, scalability, and security. The emphasis is on assessing competitive position within product, customer, and operational excellence, suggesting these as pivotal contexts for evaluation.</p>	<p>This has been adopted as PIs</p> <ul style="list-style-type: none"> • The satisfaction of the customer/user experience (CX/UX) as a quality measurement • Service coverage can be measured by the availability and responsiveness of the service as quality PIs • Change management PIs (adoption rates, employee engagement or resistance to change) • Platform choice under the efficiency of resource utilisation • Quality measures like interoperability, scalability, and security • Competitive PIs to measure product, customer, and operational excellence

DEAMP models	Experts' suggested refinements	The adopted refinements
DM model	Suggestions to advocate a data-driven approach at levels 3 or 4, as they are deemed more practical and impactful compared to level 5. Moreover, the nuances between certain levels, like Beginner/Learner and Expert/Advanced, might not significantly influence day-to-day decision-making, implying a need for simplification.	This has been adopted to refine the DM levels to make them simpler and reduce confusion by: <ul style="list-style-type: none"> merging the levels Beginner/Learner, which reduces the levels to 5 instead of 6 prioritising and adopting a data-driven approach for level 3 as suggested
	A suggestion to add seizing the opportunity as a concept to consider with the pain points.	Adopting the suggestion to seize the opportunity as a new concept to the model when evaluating the need to overcome the DM gap, if found.
Action model	A suggestion to prioritise and sequence actions within the roadmap by considering factors such as strategic alignment, impact on critical business processes, urgency, and feasibility.	This has been adopted to add more to factors that will help in prioritisation and sequencing actions such as strategic alignment, impact on critical business processes, urgency, and feasibility as
	Suggestion to incorporate risk identification of the potential risks associated with each action, considering factors such as complexity, dependencies, and external influences.	Risk identification of potential roadmap risks has been adopted as a new concept to the model to be considered when evaluating the roadmap of the proposed actions
Benefit model	Suggestion to provide example/illustrative actions in the context of each of the various EA layers.	Since this study focuses on the human layer, an illustrative scenario with actions will be provided in the last stage of the evaluation

The previous increment introduces the DEAMP assessment model (gamma version). The next increment introduces the initial DEAMP assessment process.

5.1.5 Fifth increment: Initial DEAMP assessment process

This increment aims to initiate the assessment process that resulted also from the second stage of the evaluation. Considering the experts' survey qualitative analysis detailed in

section 5.3.2.2, a primary need was identified to provide a step-by-step process on how to use these models. This process assists with the self-assessment of DM levels and performance outcomes, which includes essential information to drive strategic decision making regarding the future or target state DM and performance levels for performance gains. In summary, it complements the DEAMP assessment model to help organisations assess and plan their DT journey. Thus, the fifth increment provides an initial assessment process to guide organisations on what to do to assess their DM for performance gain using the framework models. The development of the process had two iterations. The initial process was developed using the CCP interpretive framework adopted from Stockdale and Standing (2006) and was reviewed internally during a design review meeting in the Digisas Lab. The DEAMP assessment process is a six-stage process that starts by selecting which business area and architecture layer will be subject to this assessment to track the improvements after implementation, as illustrated in Figure 5-8.

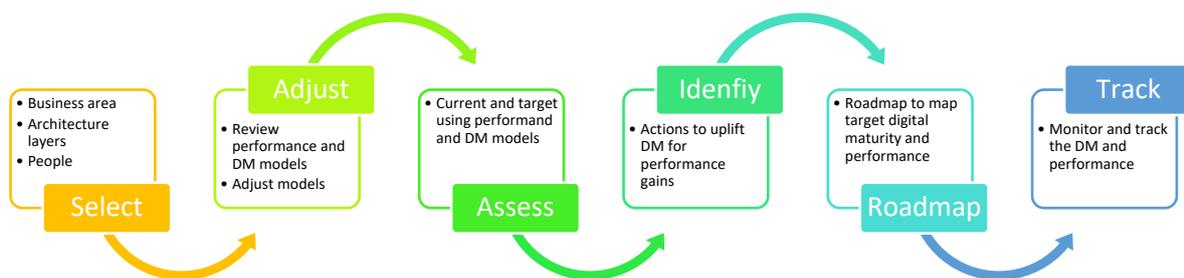


Figure 5-8 Initial assessment process

The previous increment introduces the initial DEAMP assessment process. The next increment introduces the initial DEAMP assessment process (gamma version).

5.1.6 Sixth increment: DEAMP assessment process - Gamma

This increment aims to develop a detailed stage process for each step after an internal design review meeting. This initial review highlighted the need to consider recognising and defining different stakeholders critical to the assessment process (see Chapter 4). This also highlighted the need to include a stage (e.g. when and why there is a need to conduct an assessment), which refers to the first step of the assessment process (Recognise). The relevant stakeholders could trigger this step from a concerned business area of the organisation, which could then be proposed to the senior stakeholders or decision makers

as a proposal for assessment. Then, if the proposal is approved, they can initiate an initiative with the assigned assessment owner to assign a relevant group of stakeholders to plan and commence workshops to discuss and define the scope of the assessment. This also includes reviewing the DEAMP model to adjust it according to the assessment scope. It also represents the key stakeholders involved in the assessment data collection steps (assessors). The rest of these process steps are: how to perform this DEAMP assessment to collect data, identify gaps and actions, plan the roadmap, and track the maturity and performance. Following the structure of (*The TOGAF® Standard, 10th Edition, 2022*), each stage defines specific objectives, inputs, steps, and outputs.

The final process version is discussed in Chapter 4, Section 4.3. Also, this final version has been addressed as the physical model in section 5.3.3 of this chapter.

Previous sections cover the increments in developing the framework. The next section provides a brief overview of the evaluation methods used to evaluate the framework.

5.2 Evaluation methods

The evaluation involves evaluating the developed framework by implementing DSR evaluation methods (Peffer *et al.*, 2012). The purpose of this evaluation is to measure the artefact against the evaluation criteria that were introduced by De Bruin *et al.* (2005) and Prat, Comyn-Wattiau and Akoka (2014) (see Table 3-4), along with iteratively updating and refine the framework. Therefore, the developed framework was evaluated using two evaluation methods.

The following section covers a brief overview of the two evaluation methods. For a detailed discussion of the evaluation methods, refer to Chapter 3 Section 3.5.

5.2.1 Illustrative scenario

Fictitious test data is generated to create instances of real-world examples as indicative proof of concept validation. Three hypothetical business scenarios were created using the proposed scenario documentation methodology adopted from TOGAF® Series Guide to Business (Blevins and Lambert, 2022) (refer to Figure 3-2, Chapter 3). The purpose of these fictional business scenarios is to illustrate the practical applicability of the DEAMP assessment framework. The study aims to evaluate how the framework can provide insights

into an organisation's digital capabilities, identify areas for improvement, and drive strategic decision making to enhance DM for performance gain.

Table 5-12 summarises the three phases involved in the scenario development process and the corresponding activities for each phase.

Table 5-12 Scenario development process

Phase	Step activities
Formulate	1. Identify the problem to establish the elements of the scenario.
	2. Craft scenarios to align with the research objectives.
Verify	1. Assess generated scenarios to validate and/or enhance understanding of the actual problem context.
	2. Evaluate scenarios through walkthrough review sessions with the research team and reviews by external experts.
Refine	1. Refine the developed scenarios grounded on feedback gathered.

The previous section briefly views the illustrative scenario as an evaluation method. The following section briefly summarises the second evaluation method (expert survey).

5.2.2 The expert survey

The expert survey is the second stage of evaluation conducted in this thesis. The survey gathered targeted information from specialised and specific populations (Sjøberg *et al.*, 2005; Runeson and Höst, 2009). It was administered online to domestic and international industry experts and was developed using a standard survey design approach (Hyndman, 2008). It was conducted to articulate the models' generalisability, understandability, applicability, and comprehensiveness (quantitative analysis), as detailed in Table 5-13.

Table 5-13 The expert survey criteria adopted from (De Bruin *et al.*, 2005; Prat, Comyn-Wattiau and Akoka, 2014)

Criteria	Description
Generalisability	The DEAMP model and its components are generic enough to support different contexts to guide the improvement of DM for the desired performance across EA layers.
Understandability	The DEAMP model and its components are easy to read and understand.
Applicability	The DEAMP model and its components can be used to guide the improvement of DM for the desired performance across EA layers.

Criteria	Description
Comprehensiveness	The DEAMP model and its components contain all the necessary elements to improve DM for performance gains across EA layers.

The following presents the steps to construct the survey using a common survey design by Hyndman (2008): planning the survey, recruitment and sample strategy, developing the questionnaire, collecting and analysing the data. The survey analysis involves two primary techniques, as summarised in Table 5-14. For more details, please refer to Chapter 3 Section 3.5.2.

Table 5-14 Evaluation methods and processes

Evaluation Type	Process
Quantitative evaluation	The initial categorical ratings provided by participants were transformed into numerical ordinal data by applying the survey ratings outlined in Chapter 3 Table 3-7. These ordinal data were then utilised in statistical formulas to analyse the survey results, as adopted from (Bou Ghantous and Gill, 2021) and as detailed in Chapter 3 (Equation 1, Equation 2, and Equation 3).
Qualitative evaluation	Participants' comments were analysed adopting the hypothesis confirmation general technique described by Runeson and Höst (2009). The hypotheses were based on the artefact evaluation criteria adopted from (De Bruin <i>et al.</i> , 2005; Prat, Comyn-Wattiau and Akoka, 2014) (refer to Table 5-13). The comment was methodically reviewed to identify instances of these criteria within the responses as adopted from (Bou Ghantous and Gill, 2021). This expert feedback is systematically prepared and presented in tables to extract applicable suggested improvements to refine and improve the artefact (see Section 5.3.2.2.)

The previous section provides a brief overview of the evaluation methods that were implemented to evaluate the developed framework. The next section covers the three stages of the evaluation process.

5.3 Evaluation journey

The components of DEAMP were constructed and assessed iteratively. The main objective of this iterative approach in developing and evaluating the DEAMP assessment framework was to facilitate the gradual evolution of the design, progressing from the alpha version to

the final gamma version, with each component advancing through iterations of illustrative business scenarios and expert survey evaluations. The artefact underwent three design and evaluation stages, as illustrated in Figure 5-9.

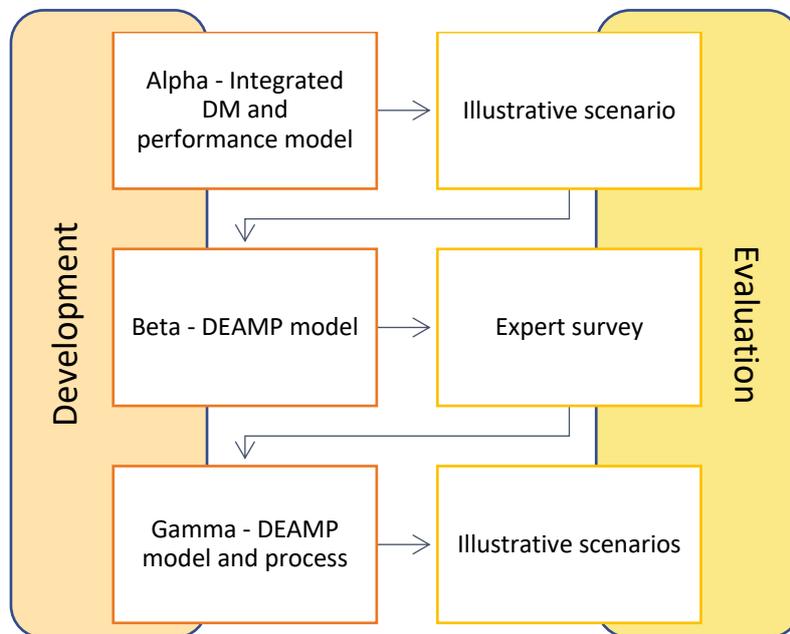


Figure 5-9 DEAMP evaluation journey

The next sections cover the three stages of the evaluation process in detail.

5.3.1 Evaluation stage 1 - Alpha - Integrated DM and performance model

The first evaluation stage was conducted on the Alpha version of the DEAMP model, as detailed in increment 2 (section 5.1.2). In this stage, the illustrative instrument was used to evaluate the alpha version to illustrate the practical applicability as the indicative proof of concept validation and the introduction of refinements.

The following section covers a detailed illustration of the illustrative scenario's application using the model's alpha version and the output of this evaluation stage.

5.3.1.1 Illustrative scenario 1

The scenario involves a hypothetical marketing company called ABC, which has initiated a DT project to enhance overall performance by evaluating and upgrading its DM. The company's primary objective is to assess and improve its marketing business domain to boost the efficacy of its current digital marketing capabilities, tools, and technologies (as outlined in Table 5-15). To achieve this, the company selected the business architecture

layer from EA to gain a comprehensive understanding of the marketing domain's business capabilities. Within this context, the marketing business domain encompasses various business capabilities. This includes, but is not limited to, advertising and customer relationship management.

Table 5-15 Illustrative scenario 1

Context	Description
Scenario	Marketing ABC company specialising in digital marketing and technology-driven campaigns. It operates in a competitive market where DT and continuous improvement are vital for achieving performance gains and delivering exceptional client results.
Problem	This company recognises the need to assess its DM and optimise its digital capabilities to stay ahead of the competition. The agency aims to leverage the EA design to evaluate its current digital landscape, identify areas of improvement, and implement targeted initiatives to enhance DM for improved organisational performance.
Business Environment	Digital marketing process maturity assessment, campaign performance metrics.
Outcome	Enhance the effectiveness of current digital marketing capabilities, tools, and technologies.

This example concentrates on the capability of "manage customer relationships" to capture current and target DM levels, goals, pain points, and current and target PIs. The related current and target PIs and their gaps are defined in alignment with the company's goals and objectives. Table 5-16 and Figure 5-10 illustrate the instance of this example scenario by applying the DEAMP framework (Alpa version). The "manage customer relationships" capability (an architecture element) shows a gap of one level between its current and target DM states due to duplicate accounts in the Customer Relationship Management (CRM) system, which is identified as a pain point. One of the PIs associated with this capability is income, which requires a 15% increase based on the difference between current and target income figures (linked to the company's profit/income objective). To address these issues and improve performance, the proposed action is to enhance the performance management process by implementing a new dynamic online CRM system. This action is expected to elevate the DM level and increase income (the desired performance outcome). Implementing this action is anticipated or assumed to take 100 days and is assigned high priority on the DT roadmap.

Table 5-16 illustrates the model instantiation of the illustrative scenario 1.

Table 5-16 DEAMP instantiation (Illustrative scenario 1)

Class Label		Instances	Instances Details
Architecture		Marketing	
Architecture_Domain		Business	
Architecture_Element		Cap01	Capability 01: Manage Customer Relationships
CDM		L01	Level 01
DM_Gap		1 Level	1 level difference between the current and target DM
TDM		L02	Level 02
CPI		F01	Financial Indicator 01: Income
PI_Gap		+15%	15% increase to up lift current income to target income
TPI		F01	Financial Indicator 01: Income
Pain_Point		PP01	Pain Point 01: Duplicate accounts in the CRM systems
Goal		G01	Goal 01: Improve Productivity
Objective		Obj01	Objective 01: Increase Company Profits/Income (15%)
Action		Ac01	Action 01: Implement a new dynamic online CRM system
Roadmap	Timeline	100 days	
	Dependency	N/A	
	Priority	High	

Figure 5-10 illustrates the instance of the beta version graph-based model with the illustrative scenario 1.

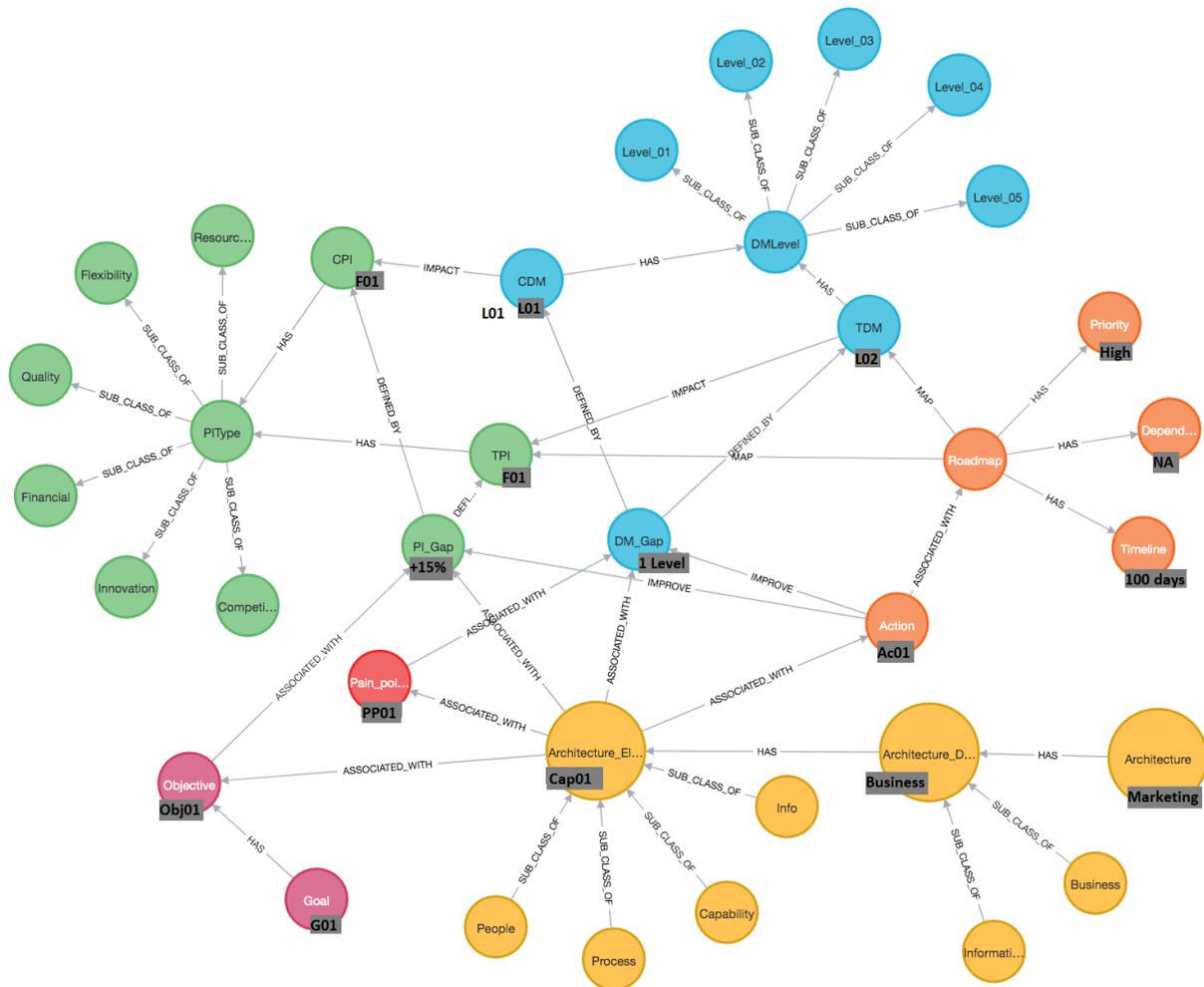


Figure 5-10 The instance of the DEAMP graph-based model with illustrative scenario 1

Outputs:

Following the initial evaluation phase, which involved demonstrating the illustrative scenario to practitioners to assess the model’s applicability, it became evident that there is a need to establish digital benefits tracking. Thus, the benefits tracking model has been added to the DEAMP model. This will help ensure alignment with the identified pain points and strategic objectives. The benefits tracking mechanism monitors the actual DM and performance outcomes that resulted from implementing the action roadmap, particularly after its implementation. It tracks resolved pain points and achieved goals and objectives according to the desired target maturity and performance levels. The emerged model has concepts and their definitions, as shown in Table 5-17. Adopting these refinements is discussed in the third increment of development, detailed in Section 5.1.3 and reported in a published study (Alsufyani and Gill, 2023).

Table 5-17 The emerged benefits model's concepts

Emerged Concept	Definition	Reference
Benefit	A gain or value realisation via implementing the roadmap	(Serra and Kunc, 2015)
Actual Maturity	A level of DM that represents the actual DM level after or while implementing the roadmap	(Serra and Kunc, 2015; Alsufyani and Gill, 2021)
Actual Performance	A set of PIs that represent the actual performance after or while implementing the roadmap	(Serra and Kunc, 2015; Alsufyani and Gill, 2021)

The previous section covers the first stage of the evaluation to assess the model’s applicability, which results in the refinements of the model (beta version). The next section covers the second round to evaluate the beta version with different evaluation instruments.

5.3.2 Evaluation stage 2 - Beta - DEAMP model

The second evaluation stage has been conducted on the beta version of the DEAMP model, as detailed in increment 3 (section 5.1.3). In this stage, the expert survey instrument (see Chapter 3, Section 3.5.2) was used to conduct quantitative and qualitative analysis separately, as discussed in Sections 5.3.2.1 and 5.3.2.2.

The survey was published in February 2023 and closed in October 2023. A total of 32 individuals successfully participated in and completed the online survey. Details about the participants, such as their expertise and years of experience in a related field, are presented in Table 5-18. Most participants' years of experience were 10 years or more. This could suggest that participants will likely offer more insightful feedback and comments, drawing on their extensive knowledge and expertise in DT, EA and/or business architecture.

Table 5-18 Participants’ demographic data

#	Area of experience.	Years of experience
1	Business Architecture	More than 10 years
2	EA: Business Strategy, Enterprise Security Architecture, Cybersecurity	More than 10 years
3	EA	Less than 5 years
4	Business Architect	Between 5 and 10 years
5	DT	More than 10 years
6	Business Architecture	Between 5 and 10 years
7	DT: Software solution architecture	More than 10 years

#	Area of experience.	Years of experience
8	EA	More than 10 years
9	EA	More than 10 years
10	Business Architecture, Strategy and EA	Between 5 and 10 years
11	DT with a focus on emerging technologies.	Between 5 and 10 years
12	EA: Specialising in Information Architecture and solutions architecture.	More than 10 years
13	Business and EA	Between 5 and 10 years
14	I have hands-on experience and held positions in all four areas above	More than 10 years
15	Business Architecture: business and digital-centric engagements.	Between 5 and 10 years
16	DT: Project/program/portfolio delivery	More than 10 years
17	EA	More than 10 years
18	EA: Governance	Less than 5 years
19	Solution and EA	Between 5 and 10 years
20	EA	More than 10 years
21	EA: Application and Technology layers	More than 10 years
22	Business architecture and Transformation in Financial Service.	More than 10 years
23	EA	More than 10 years
24	EA	More than 10 years
25	EA	More than 10 years
26	DT	Between 5 and 10 years
27	EA	More than 10 years
28	Business and EA	Between 5 and 10 years
29	Business Architecture	Between 5 and 10 years
30	EA: Exploration, Mining, Metal, Fertilizers, Construction and Engineering, Safety, Environmental, Health	More than 10 years
31	Business Architecture	Between 5 and 10 years
32	EA	More than 10 years

5.3.2.1 Quantitative evaluation

The quantitative data was recorded separately according to each component of the DEAMP model (performance, DM, action and benefits model) and the overall DEAMP model. The initial categorical ratings provided by the participants were translated into numerical ordinal data by applying the survey ratings outlined in Chapter 3, Table 3-7. These ordinal data were

then utilised in statistical formulas to analyse the survey results, as adopted from Bou Ghantous and Gill (2021) and as detailed in Chapter 3 (Equation 1, Equation 2, and Equation 3). As such, each recorded data point is processed by a set of steps, as detailed in Table 5-19.

Table 5-19 Quantitative evaluation process

Step	Description
Collect and organise data	Gather and document the survey ratings in tables labelled as (Survey Rating - the name of the model) SR-[n]. Categorise the ordinal data from these rating tables into grouped category rating tables labelled (Survey Group Data - name of the model) SG-[n], organised according to the questionnaire sets (see Table 5-20 - Table 5-29).
Visual representation	Plot the SR-[n] tables into a bar graph representation of the data labelled (Rating Graph - the name of the model) RG-[n].
Statistical calculations	Compute the AAP and AAF statistical values for all SR-[n] tables. Additionally, calculate goodness-of-fit Chi2 for all SG-[n] (see Equation 3.1-3.3). The objective of these calculations is to assess whether the DEAMP models satisfy the evaluation criteria in a positive manner (refer to Table 5-13): <ul style="list-style-type: none"> • AAF determines the frequency of participants agreeing or strongly agreeing that the DEAMP models meet the evaluation criteria positively. • AAP determines the percentage of participants agreeing or strongly agreeing that the DEAMP models meet the evaluation criteria positively. • Goodness-of-fit Chi2, and p-value for each of the SG-[n] tables.
Hypothesis Testing	H0 (null hypothesis): There is no link among the DEAMP models and the evaluation criteria. H1 (alternative hypothesis): The DEAMP models meet the evaluation criteria positively.
Decision Rule	If $p\text{-value} < \alpha=0.5$, then H0 is rejected and H1 is accepted, and the DEAMP models meet the evaluation criteria positively (generalisability, applicability, understandability, comprehensiveness). [If $p\text{-value} < 0.000^{\beta}$ (β is a small number), then p is corrected to $p < 0.001$].

The following sections discuss the quantitative data analysis and outcomes according to the analysis process in Table 5-19 for each component of the DEAMP model (performance, DM, action and benefits model) and the overall DEAMP model separately.

a) Performance model (PM)

The results of processing the quantitative data recorded for the performance model are as follows across five survey questions, which use a 5-point scale, indicating overall positive results, as detailed in Table 5-20.

Table 5-20 Performance survey rating (SR-PM)

	Q1	Q2	Q3	Q4	Q5	Total	%
Strongly agree	4	5	2	2	2	15	9.375
Agree	13	13	17	13	15	71	44.38
Average	12	11	10	13	12	58	36.25
Disagree	3	3	3	4	3	16	10
Strongly disagree	0	0	0	0	0	0	0
Total	32	32	32	32	32	160	100

AAF = 144 AAP = 90.00%

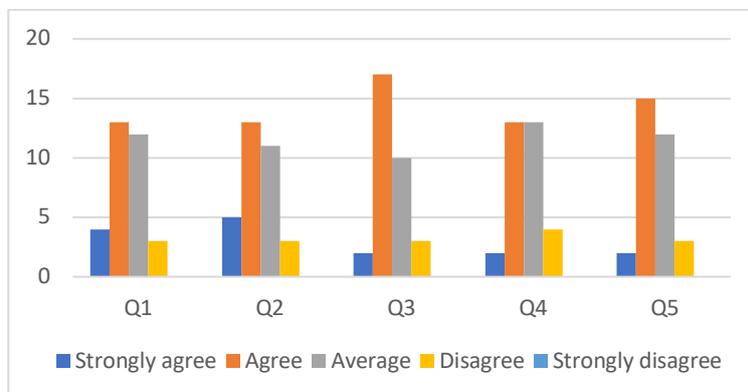


Figure 5-11 Performance survey rating graph (RG-PM)

Table 5-21 Performance survey group data (SG-PM)

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4, Q5)	
	O	E	O	E	O	E	O	E
Strongly agree	4	6.4	5	6.4	2	6.4	4	12.8
Agree	13	6.4	13	6.4	17	6.4	28	12.8

Average	12	6.4	11	6.4	10	6.4	25	12.8
Disagree	3	6.4	3	6.4	3	6.4	7	12.8
Strongly disagree	0	6.4	0	6.4	0	6.4	0	12.8
H0 is rejected for $p < 0.5$	Chi ² = 20.813	P<0.001	Chi ² = 18.625	P<0.001	Chi ² = 30.813	P<0.001	Chi ² = 51.156	P<0.001

Outcomes:

The ordinal data extracted from Table 5-20 (**SR-PM**) and Table 5-21 (**SG-PM**) generated key statistical metrics based on the participants' responses. The evaluation outcomes of the performance model can be explained as follows:

AAF: Of the 160 responses, 144 affirm the alignment of the performance model with positive criteria for generalisability, applicability, understandability, and comprehensiveness evaluation, signifying widespread agreement among participants.

- AAP: With a percentage of 90.00%, a substantial majority of participants express agreement with the positive assessment of the performance model concerning the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.
- Regarding the p-values for the test variables:
 - All evaluation criteria (generalisability, applicability, understandability, and comprehensiveness), where the p-value is set at $0.001 < \alpha = 0.5$, indicate the rejection of (H0) and the acceptance of (H1). This confirms that the performance model satisfies the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.

In summary, the statistical findings suggest that participants perceive the performance model as generic enough to support different contexts, easy to understand, applicable, and providing enough components to assess the current and

target performance outcomes across EA layers. Figure 5-11 visually represents participants' response frequencies to offer additional insight into the results.

b) DM model (DMM)

The results of processing the quantitative data recorded for the DM model are as follows across five survey questions at a 5-point scale, indicating overall positive results, as detailed in Table 5-22.

Table 5-22 DM survey rating (SR-DMM)

	Q1	Q2	Q3	Q4	Q5	Total	%
Strongly agree	5	7	7	5	6	30	18.75
Agree	14	13	9	9	10	55	34.38
Average	11	12	11	10	11	55	34.38
Disagree	2	0	4	8	4	18	11.25
Strongly disagree	0	0	1	0	1	2	1.25
Total	32	32	32	32	32	160	100

AAF = 140 AAP = 87.50%

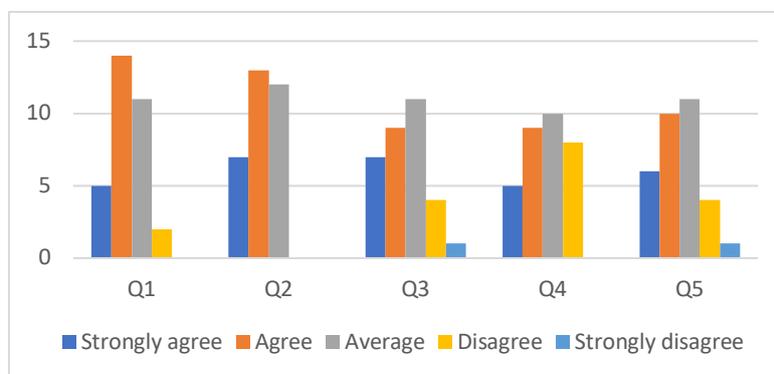


Figure 5-12 DM survey rating graph (RG-DMM)

Table 5-23 DM survey group data (SG-DMM)

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4, Q5)	
	O	E	O	E	O	E	O	E
Strongly agree	5	6.4	7	6.4	7	6.4	11	12.8
Agree	14	6.4	13	6.4	9	6.4	19	12.8

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4, Q5)	
	O	E	O	E	O	E	O	E
Average	11	6.4	12	6.4	11	6.4	21	12.8
Disagree	2	6.4	0	6.4	4	6.4	12	12.8
Strongly disagree	0	6.4	0	6.4	1	6.4	1	12.8
H0 is rejected for $p < 0.5$	Chi ² = 22.063	P<0.001	Chi ² = 24.563	P<0.001	Chi ² = 9.875	P=0.04	Chi ² = 19.438	P<0.001

Outcomes:

The ordinal data extracted from Table 5-22 (**SR-DMM**) and Table 5-23 (**SG-DMM**) generated key statistical metrics based on the participants' responses. The evaluation outcomes of the DM model can be explained as follows:

- AAF: Of the 160 responses, 140 affirm the alignment of the DM model with positive criteria for generalisability, applicability, understandability, and comprehensiveness evaluation, signifying widespread agreement among participants.
- AAP: With a percentage of 90.00%, a substantial majority of participants express agreement with the positive assessment of the DM model concerning the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.
- Regarding the p-values for the test variables:
 - For generalisability, understandability, and comprehensiveness evaluation criteria, where the p-value is set at $0.001-0.04 < \alpha=0.5$, indicate the rejection of (H0) and acceptance of (H1). This confirms that the DM model satisfies the generalisability, understandability, applicability, and comprehensiveness evaluation criteria.

In summary, the statistical findings suggest that participants perceive the DM model as generic enough to support different contexts, easy to understand, applicable and provides necessary elements to assess the current and target DM levels across EA layers. Figure 5-12

visually represents the participants' response frequencies to offer additional insight into the results.

c) Action model (AM)

The results of processing the quantitative data recorded for the action model are as follows across four survey questions at a 5-point scale, indicating overall positive results as detailed in Table 5-24.

Table 5-24 Action survey rating (SR-AM)

	Q1	Q2	Q3	Q4	Total	%
Strongly agree	3	6	5	2	16	12.5
Agree	13	14	11	13	51	39.84375
Average	13	11	12	10	46	35.9375
Disagree	3	1	3	5	12	9.375
Strongly disagree	0	0	1	2	3	2.34375
Total	32	32	32	32	128	100

AAF = 113 AAP = 88.28%

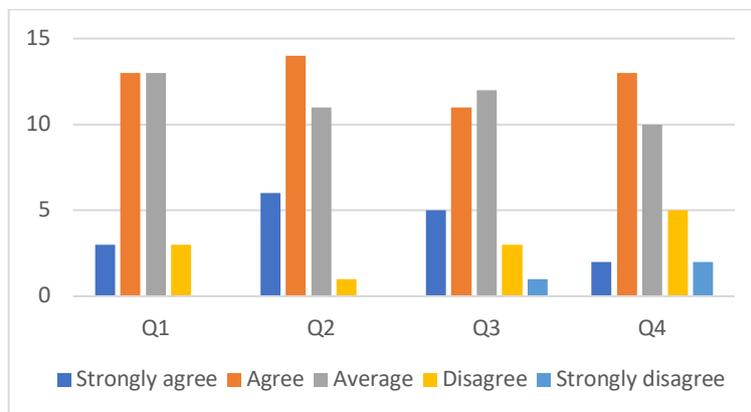


Figure 5-13 Action survey rating graph (RG-AM)

Table 5-25 Action survey group data (SG-AM)

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4)	
	O	E	O	E	O	E	O	E
Strongly agree	3	6.4	6	6.4	5	6.4	2	6.4
Agree	13	6.4	14	6.4	11	6.4	13	6.4
Average	13	6.4	11	6.4	12	6.4	10	6.4

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4)	
	O	E	O	E	O	E	O	E
Disagree	3	6.4	1	6.4	3	6.4	5	6.4
Strongly disagree	0	6.4	0	6.4	1	6.4	2	6.4
H0 is rejected for $p < 0.5$	Chi ² = 23.625	P<0.001	Chi ² = 23.313	P<0.001	Chi ² = 14.875	P=0.004	Chi ² = 15.188	P=0.004

Outcomes:

The ordinal data extracted from Table 5-24 (**SR-AM**) and Table 5-25 (**SG-AM**) generated key statistical metrics based on the participants' responses. The evaluation outcomes of the action model can be explained as follows:

- AAF: Of the 128 responses, 113 affirm the alignment of the action model with the positive criteria for generalisability, applicability, understandability, and comprehensiveness evaluation, signifying widespread agreement among participants.
- AAP: With a percentage of 88.28%, a substantial majority of participants express agreement with the positive assessment of the action model concerning generalisability, applicability, understandability, and comprehensiveness evaluation criteria.
- Regarding the p-values for the test variables:
 - All evaluation criteria (generalisability, applicability, understandability, and comprehensiveness), where the p-value is set at $0.001 < \alpha = 0.5$, indicate the rejection of (H0) and acceptance of (H1). This confirms that the performance model satisfies the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.

In summary, the statistical findings suggest that participants perceive the action model as generic enough to support different contexts, easy to understand, applicable and provides

enough components for deciding and defining actions and roadmaps to improve maturity for the desired performance across EA layers. Figure 5-13 visually represents the participants' response frequencies to offer additional insight into the results.

d) Benefits model (BM)

The results of processing the quantitative data recorded for the benefits model are as follows across five survey questions at a 5-point scale, indicating overall positive results as detailed in Table 5-26.

Table 5-26 BM survey rating (SR-BM)

	Q1	Q2	Q3	Q4	Total	%
Strongly agree	2	3	3	1	9	7.031
Agree	15	11	10	12	48	37.5
Average	11	15	14	15	55	42.97
Disagree	4	3	3	2	12	9.375
Strongly disagree	0	0	2	2	4	3.125
Total	32	32	32	32	128	100

AAF = 112 AAP = 87.50%

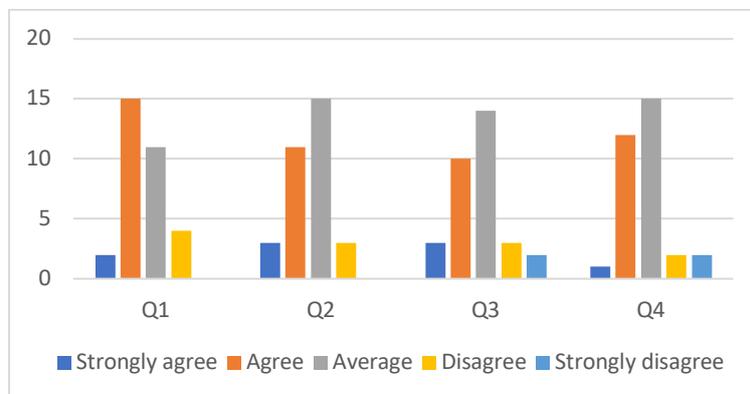


Figure 5-14 BM survey rating graph (RG-BM)

Table 5-27 BM survey group data (SG-BM)

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4)	
	O	E	O	E	O	E	O	E
Strongly agree	2	6.4	3	6.4	3	6.4	1	6.4
Agree	15	6.4	11	6.4	10	6.4	12	6.4

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4)	
	O	E	O	E	O	E	O	E
Average	11	6.4	15	6.4	14	6.4	15	6.4
Disagree	4	6.4	3	6.4	3	6.4	2	6.4
Strongly disagree	0	6.4	0	6.4	2	6.4	2	6.4
H0 is rejected for $p < 0.5$	Chi ² = 25.188	P<0.001	Chi ² = 24.875	P<0.001	Chi ² = 17.688	P=0.001	Chi ² = 27.063	P<0.001

Outcomes:

The ordinal data extracted from Table 5-26 (**SR-BM**) and Table 5-27 (**SG-BM**) generated key statistical metrics based on the participants' responses. The evaluation outcomes of the benefits model can be explained as follows:

- AAF: Of the 128 responses, 112 affirm the alignment of the benefits model with positive criteria for generalisability, applicability, understandability, and comprehensiveness evaluation, signifying widespread agreement among participants.
- AAP: With a percentage of 88.28%, a substantial majority of participants express agreement with the positive assessment of the benefits model concerning the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.
- Regarding the p-values for the test variables:
 - All evaluation criteria (generalisability, applicability, understandability, and comprehensiveness), where the p-value is set at $0.001 < \alpha = 0.5$, indicate the rejection of (H0) and acceptance of (H1). This confirms that the performance model satisfies the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.

In summary, the statistical findings suggest that participants perceive the Benefits Model as generic enough to support different contexts, easy to understand, applicable, and providing

enough components for monitoring the actual DM and performance outcomes resulting from roadmap actions. Figure 5-14 visually represents participants' response frequencies to offer additional insight into the results.

e) DEAMP model

The results of processing the quantitative data recorded for the DEAMP model are as follows across four survey questions at a 5-point scale, indicating overall positive results as detailed in Table 5-28.

Table 5-28 Survey rating (SR-DEAMP)

	Q1	Q2	Q3	Q4	Total	%
Strongly agree	2	3	3	3	11	8.594
Agree	16	15	16	11	58	45.31
Average	10	13	8	11	42	32.81
Disagree	4	1	3	5	13	10.16
Strongly disagree	0	0	2	2	4	3.125
Total	32	32	32	32	128	100

AAF = 111 AAP = 86.72%

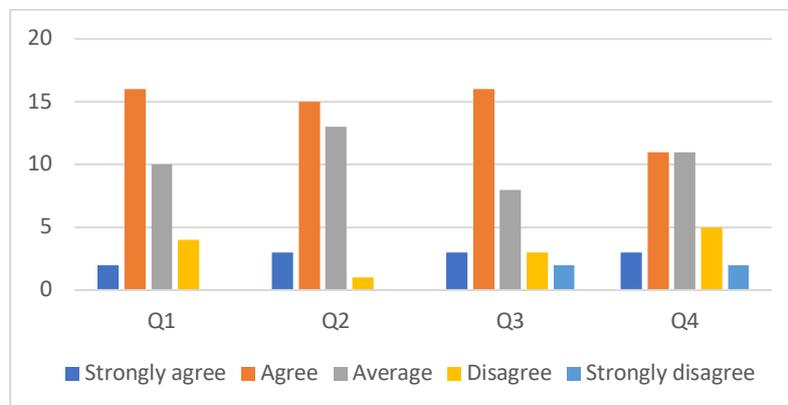


Figure 5-15 DEAMP survey rating graph (RG-DEAMP)

Table 5-29 DEAMP survey group data (SG-DEAMP)

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4)	
	O	E	O	E	O	E	O	E
Strongly agree	2	6.4	3	6.4	3	6.4	3	6.4
Agree	16	6.4	15	6.4	16	6.4	11	6.4

	Generalisability (Q1)		Understandability (Q2)		Applicability (Q3)		Comprehensiveness (Q4)	
Average	10	6.4	13	6.4	8	6.4	11	6.4
Disagree	4	6.4	1	6.4	3	6.4	5	6.4
Strongly disagree	0	6.4	0	6.4	2	6.4	2	6.4
H0 is rejected for $p < 0.5$	Chi ² = 26.750	P<0.001	Chi ² = 31.125	P<0.001	Chi ² = 21.438	P<0.001	Chi ² = 11.750	P=0.019

Outcomes:

The ordinal data extracted from Table 5-28 (**SR-DEAMP**) and Table 5-29 (**SG-DEAMP**) generated key statistical metrics based on the participants' responses. The evaluation outcomes of the DM model can be explained as follows:

- AAF: Of the 128 responses, 111 affirm the alignment of the DEAMP model with the positive criteria for generalisability, applicability, understandability, and comprehensiveness evaluation, signifying widespread agreement among participants.
- AAP: With a percentage of 86.72%, a substantial majority of participants express agreement with the positive assessment of the DEAMP model concerning the generalisability, applicability, understandability, and comprehensiveness evaluation criteria.
- Regarding the p-values for the test variables:
 - For the generalisability, understandability, applicability and comprehensiveness evaluation criteria, where the p-value is set at $0.001 < \alpha < 0.5$, this indicates the rejection of (H0) and acceptance of (H1). This confirms that the DEAMP model satisfies the evaluation criteria for generalisability, understandability, comprehensiveness, and applicability.

In summary, the statistical findings suggest that the participants perceive the DEAMP model as generic enough to support different contexts, easy to understand and provides the

necessary elements to assess the current and target DM levels across EA layers. Figure 5-15 visually represents the participants' response frequencies to offer additional insight into the results.

5.3.2.2 Qualitative evaluation

The expert survey provided five open-ended questions to collect suggestions for modifications or improvements to the model, additions, deletions, or any additional feedback. This allowed the experts to comment on each of the four components of the DEAMP model and the overall DEAMP model. The participants' comments were analysed by adopting the hypothesis confirmation general technique described by Runeson and Höst (2009). The qualitative analysis process involves two different purposes as follows:

Table 5-30 Qualitative evaluation process analysis purposes

Qualitative Analysis Purpose	Description
DEAMP Feedback Analysis	The analysis of feedback utilised a cross-examination approach, comparing participants' responses against the consolidated evaluation criteria. This analytical process aimed to explore the correlation or relationship between the hypotheses (represented by the evaluation criteria) and the insights provided by the experts.
DEAMP improvements	A combination of suggestions and improvements feedback was gathered and categorised. This analysis aims to extract applicable suggested improvements to refine and improve the DEAMP model and define future research directions.

The following sections discuss the qualitative data analysis and outcomes according to the analysis purposes shown in Table 5-30 for each component of the DEAMP model (performance, DM, action and benefits model) and the overall DEAMP model separately, as discussed in Section 5.3.2.2.1 and 5.3.2.2.2.

5.3.2.2.1 DEAMP feedback analysis

The qualitative data in this section was cross-referenced with the evaluation criteria for each component model and the DEAMP model adopted from Anwar (2021) and Alabsi (2023). This analysis aims to explore the relationship between the hypotheses (evaluation criteria) and the experts' feedback by calculating how frequently each criterion appeared in the participants' responses and the percentage of its occurrence. This analysis process went

through several steps as follows:

- Collect the feedback on the four models and the DEAMP model with associated references to the evaluation criteria.
- Analyse the comments in Table 5-31 based on the frequency criteria occurrences in the text using the cross-examination technique.
- Calculate the percentage of recurrence.
- Review the analysis results.

Table 5-31 illustrates the cross-examined selected feedback on the evaluation criteria and the calculated percentage of the recurrence.

Table 5-31 DEAMP feedback cross-examination analysis

	Feedback	Evaluation Criteria			
		Applicability	Comprehensiveness	Understandability	Generalisability
Performance model	However, from what I see, the coverage of the performance model seems to a good starting point.		Y		
	The six dimensions (PI type column) is generic enough for me to use.				Y
	I love the main model addressing the gap analysis.	Y	Y	Y	Y
DM Model	As an assessment tool, yes, it is comprehensive and useful.		Y		
	Reminds me of the CMMI, very nice and useful.	Y	Y		
	I believe this model is solid and comprehensive.	Y	Y	Y	Y
	The maturity levels will work great.	Y	Y		
Action Model	I really like this map. However, I would have liked to see additional detail on what you mean by actions.	Y	Y		

	Feedback	Evaluation Criteria			
		Applicability	Comprehensiveness	Understandability	Generalisability
	I like the linking of organisational performance and digital maturity metrics pointing to actions to be included on a roadmap for an organisation as it links the strategic aspects of the organisation which is often an organization-wide view compared to a digital maturity model which often is used as a performance metric for parts of the organisation, for example ICT.	Y	Y	Y	Y
	As a model for identifying the need(s) for actions to improve overall performance and reduce the gaps) between the current state and desired target state, I think it is a useful tool.	Y	Y	Y	Y
	This is nice and straightforward. It's a good understandable artefact.			Y	
	Good model.	Y	Y	Y	Y
	I believe the model can help me to identify gaps and plan actions/initiatives. I would be looking for a way to prioritise my actions though because it's not feasible or viable to implement all the actions.	Y		Y	Y
Benefits model	It would really come down to how you are defining and tracking the benefits within the organisation. I can imagine a	Y	Y	Y	Y

	Feedback	Evaluation Criteria			
		Applicability	Comprehensiveness	Understandability	Generalisability
	way this could be done using this model.				
	I like the introduction of the concept of 'benefits'. A concept like benefits is very subjective so as a practitioner, I would have liked to have seen additional detail here.	Y			
	I would have liked to have seen some more detail on the benefits realisation model as benefits realisation is a useful component of the model.	Y		Y	Y
	The model looks fine. But its usefulness will depend on the applicability of the performance model.			Y	
	This is a solid model.	Y	Y	Y	Y
	It's logically sound.	Y	Y	Y	Y
DEAMP Model	Overall, I think this framework will be a valuable addition to the literature.		Y	Y	
	It is easy to understand as it is way too high level.			Y	
	The overall DEAMP framework is a good one and one of the better ones I have seen that has been based on sound research.	Y	Y	Y	Y
	The model looks fine. The list of layers is OK, quite similar to the other lists of inputs to capability.	Y	Y	Y	Y
	Wonderful model, very easy to follow and understand. Achieves the goal of enabling	Y	Y	Y	Y

	Feedback	Evaluation Criteria			
		Applicability	Comprehensiveness	Understandability	Generalisability
	decision makers. Nicely simplified for C-suite executives. Most useful at a high level for the communication of benefits and setting directions. - A nice lightweight model that can be easily applied to any industry.				
	Again, this is a good model. Looking forward to diving down further.	Y	Y	Y	Y
	The framework is good.	Y	Y	Y	Y
	Components are good and I agree because I understand them.	Y	Y	Y	Y
	Total	22	21	19	17
	Percentage	81.45%	77.78%	70.38%	62.97%

Review:

The qualitative data in Table 5-31 was cross-examined with the evaluation criteria for each component and DEAMP model. This analysis aims to investigate the connection or relation of the hypotheses (evaluation criteria) to the experts' feedback by calculating the frequency and percentage of the appearance of each criterion in the participants' responses. Of the 32 participants, 26 responded to at least one of the five open-ended questions. As indicated in Table 5-31, the experts' responses have 79 references to the evaluation criteria. The results suggest that participants find the DEAMP model and its components to be applicable (81%), comprehensive (77%), understandable (70%), and general (63%). These findings imply that the DEAMP model and its components are applicable and relevant to the domain. They are valuable in addressing the identified research gaps and questions (see Chapter 1). Additionally, the results show that participants consider the DEAMP model and its

components clear, easy to understand, sufficiently comprehensive, and general enough to apply to other contexts.

Also, the feedback in Table 5-31 appears to recognise the following fundamentals:

- The performance model provides enough coverage of the essential elements, especially the generic PI dimensions and the gap analysis.
- The DM model is comprehensive and valuable.
- The action model enables the connection of organisational performance and DM metrics by addressing both strategic aspects and creating a roadmap for an organisation.
- The action model is useful for identifying the need for actions to enhance overall performance and bridge gaps between the current and desired states for planning initiatives.
- The benefits model provides a crucial component within the overall framework, and its usefulness depends on the practical applicability of the performance model.
- The DEAMP model is enabling for decision makers as a simplification for executives, making it particularly useful at a high level for communicating benefits and setting strategic directions.
- The DEAMP model supports any industry, indicating its versatility and broad applicability across different sectors.
- The DEAMP model is anticipated to be a valuable addition to the existing literature, suggesting a perceived contribution and significance in the field.

5.3.2.2.2 DEAMP improvements

The qualitative data was explored to extract applicable suggested improvements to refine and enhance the DEAMP model and to identify future research directions. This analysis process went through several steps as follows:

- Collect experts' feedback about suggestions/improvements recorded for each model.
- Categorise the suggested improvements into areas for potential improvement.
- Analyse the comments based on applicable improvement, previously addressed and out of the scope (future improvement) for each component of the DEAMP model.
- Respond to the experts' feedback.

- Summarise the main applicable improvements derived from the feedback.

Table 5-32 to Table 5-36 (pages 165-176) present potential areas of improvement based on the participants' feedback. Each table focuses on a different component of the DEAMP model. The last column in each table categorises the feedback into three decision types:

- **Applicable improvement:** Suggestions that can be immediately implemented.
- **Previously addressed:** Feedback on issues that have already been resolved.
- **Out of scope (future improvement):** Suggestions beyond the current scope may be considered for future enhancements.

These categorisations respond directly to the experts' feedback (for a clear and actionable path if the decision is applicable improvement) for each component of the DEAMP model. Then, the main applicable improvements are summarised from the feedback at the end of each table.

Table 5-32 to Table 5-36 illustrate the participants' feedback for each model component, grouped based on areas of improvement with a response to the experts' feedback and feedback action type.

Table 5-32 Performance model participants' feedback

Area of improvement	Participants' feedback	Response
Public and non-profit sector PIs	<p>“The competitiveness and financial aspects only relate to for-profit organizations. Has consideration been given to how this might translate to a non-profit or government context - or are you limiting the model to for-profit organizations?”</p> <p>“Performance Model - Competitiveness PI does not cover the public sector entities.”</p>	<p>Decision: Out of the scope (future improvement)</p> <p>In the model, potential PIs are suggested which organisations can tailor to their context. Thus, public and non-profit organisations can adopt PIs types other than financial PIs. Also, they can adopt other PIs frameworks fit to their industry and sector.</p>
Other potential KPIs	<p>“I am a bit hesitant when it comes to the PI categories and measures. There are hundreds of potential KPIs and narrowing them down to just these 51 is very impressive; however, I would be interested in an updated version that maybe finds a better way to incorporate them.”</p> <p>“I'm on the fence about whether you should add more or simplify but this is a minor thought.”</p>	<p>Decision: Out of the scope (future improvement)</p> <p>Suggestion to consider enhancing and expanding the KPIs, however, organisation can adopt PIs frameworks fit to their industry and sector.</p>
Suggested applicable PIs	<p>“Some of the important and potentially missing PI's are</p> <ol style="list-style-type: none"> 1. Customer/User experience 2. Change management 3. Platform choice” <p>“CX can be as PI, Customer & Service coverage and segment can be added.”</p>	<p>Decision: Applicable improvement</p> <p>Suggestions to expand potential PIs, including specific areas like customer experience, customer & service coverage and segment, change management metrics, platform choice evaluation, and incorporating quality aspects as interoperability, scalability, and security. Also, it is</p>

Area of improvement	Participants' feedback	Response
	<p>“Regarding the quality, I was wondering if other quality factors such as interoperability, scalability, or security could be added to the framework. This concern is also true for other elements of this model such as innovation and so on.”</p> <p>“A key concept in digital transformation is how competitive walls come down and a need to revisit what capabilities you compete with and what you turn to others for. Also, I like viewing competitive position in the context of product excellence, customer excellence, and operational excellence. It’s a balance but one will dominate how the brand is perceived.”</p>	<p>suggesting to address the competitive position within product, customer, and operational excellence.</p> <p>Action: Applied to the gamma version</p>
Other performance frameworks adoption	<p>“PI competitiveness - Maybe consider some of the Porter 5 Forces with a technology lens?</p> <p>Under-resource utilisation - consider alignment to a roles- based framework e.g. SAFIA? include project / stakeholder engagement; project allocation; supplier engagement etc.”</p> <p>“I would recommend reviewing the PMI's Disciplined Agile Framework and browser to see how they incorporate decision trees. Might be a useful tactic for developing your KPIs”</p>	<p>Decision: Out of the scope (future improvement)</p> <p>Suggestion to adopt Porter 5 Forces to review PI competitiveness through a technology lens and resource utilisation can be enhanced with a SAFIA roles-based framework.</p> <p>Suggestion to incorporate decision trees to develop KPIs within the model by leveraging methodologies like (Project Management Institute) PMI's Disciplined Agile Framework.</p>
Other EA frameworks adoption	<p>“Reference to TOGAF and other EA frameworks, how does this framework link in and co-exist with other EA frameworks, i.e., can you have TOGAF, ZACHMAN and DEAMP all co-existing?”</p>	<p>Decision: Out of the scope (future improvement)</p>

Area of improvement	Participants' feedback	Response
	<p>“You may wish to compare it to the APQC Process Classification Framework (apqc.org/process-frameworks), which has done a good job at process modelling a standard enterprise function. And using this model to cross reference your performance model.”</p>	<p>The DEAMP used the adaptive EA as a systematic approach to facilitate these models for the organisation EA. Thus, DEAMP can be aligned or coexist with frameworks like TOGAF.</p> <p>The proposed framework is an assessment model using the EA approach, not an enterprise model. Thus, APQC could be incorporated to evaluate the current and target performance if applicable, to evaluate the performance of the organisation EA.</p>
Pls definition refining	<p>“The PI column is more specific and requires more time and knowledge to understand. My suggestion is to consider including non-redundant definitions. For example and for the purpose of this model, market share is defined as 'the percentage of an industry's sales that a particular company owns'. A redundant definition might look like this: market share is the share of the market a company owns.”</p>	<p>Decision: Applicable improvement</p> <p>Suggestion to generalise or refine definitions for clearer understanding.</p> <p>Action: Applied to the gamma version</p>
Performance metrics	<p>“I would add a focus on performance metrics. I realize this is difficult. I think the areas of focus are all very solid. Metrics would be an additional vehicle for measurement.”</p>	<p>Decision: Previously addressed</p> <p>Suggestion to add metrics for PIs, which are detailed in Appendix C</p>
Risk management	<p>“The management of risk is becoming quite important at the executive layer and does not seem to be represented here. Also, I think culture is an important factor, especially in alignment with innovation.”</p>	<p>Decision: Out of the scope (future improvement)</p>

Area of improvement	Participants' feedback	Response
	<p>"It's not an obviously mutually exclusive and collectively exhaustive list. Risk, control, resilience and compliance are key aspects of performance in Financial Services."</p> <p>"I think Governance should also be the part of the PI"</p>	<p>Suggestion to incorporate risk management with performance assessment results, such as risk, control, resilience, and compliance which could be potential PIs in the governance dimension.</p>
Capability improvements	<p>"I also think one of the PI should also focus on the capability improvements in each layer of the EA."</p>	<p>Decision: Previously addressed</p> <p>The capability improvement could be addressed and highlighted as a pain point or opportunity indicator that is addressed in the DM model.</p>

Applicable improvement extracted from performance model participants' feedback (Table 5-32):

- Recommendations to expand PIs, including customer experience, change management metrics, platform choice evaluation, and incorporate quality measures such as interoperability, scalability, and security.
- Emphasis on assessing competitive position within product, customer, and operational excellence.

Table 5-33 DM model participants' feedback

Area of improvement	Participants' feedback	Response
Levels and definitions refining	<p>"Digital maturity is going to be a lot more important in some layers than others. In terms of the maturity levels, I would be aiming to be data-driven at level 3 or 4 rather than level 5."</p>	<p>Decision: Applicable improvement</p>

Area of improvement	Participants' feedback	Response
	<p>“Nuances between Beginner/Learner and Expert/Advanced don't make a lot of difference in day-by-day decision making.”</p> <p>“The distinctions between levels 4, 5 and 6 feel similar. For example, when I read their descriptions by themselves, I didn't know what level they referred to because they all sound equally important or weighted. The other day, we had a client ask us about our maturity levels and definitions. The definitions build upon each other and it helped the client understand the true difference in the levels.”</p>	<p>Suggestions to prioritise a data-driven approach at levels 3 or 4, as they are more appropriate compared to level 5.</p> <p>Also, there is a nuance between Beginner/Learner and Expert/Advanced which justify refinement by creating dependency between levels' definitions.</p> <p>Action: Applied to the gamma version</p>
Context-specific tailoring	<p>“Level-based maturity can imply a linear-based improvement. What is measured at each level is important and what level an organization should aspire to is often contextual to that organization.”</p>	<p>Previously addressed</p> <p>The DM levels can be tailored to its organisational relevance. The tailoring could be refined and scoped by opportunity relevance to the domain and pain point, as the aim is to determine the feasibility of elevating DM within specific elements as capabilities under the human/business layer by establishing correlations between the DM gap and the performance gap.</p>
Layers refining	<p>“Less is more. I think there are too many layers. From a practical standpoint, management wants to know which areas need development and which areas are doing well.”</p>	<p>Decision: Previously Addressed</p> <p>Suggestions to targeting specific layers and their components for assessment as there are concerns about</p>

Area of improvement	Participants' feedback	Response
	<p>"EA layers can be elaborated by including various artefacts of the layers."</p>	<p>having too many layers. However, this model suggested to focus on key layers relevant to organisational goals and performance, This approach allows management to focus on key areas needing development to facilitate effective decision making.</p>
<p>Layer-specific tailoring</p>	<p>"I think that it needs to be framed in the context of the various EA layers and by doing this, the language used to describe each of the maturity levels may change slightly. As it is, the language used to describe the maturity levels is suitably generic but this leaves it open to interpretation during assessment which IMO weakens the objectivity and usefulness of the assessment tool."</p> <p>"What is missing is what is being assessed. There needs to be specific evidence of digital maturity within a domain which should be covered by a set of questions that get to the heart of digital success and ROI with evidence from real-world examples."</p> <p>"I believe the maturity framework can be more comprehensive. Additional detail can be added in the following area (if you haven't done so already): Rationale or criteria an organisation contains for belonging to a specific level. Detailing criteria will provide clarity for when an organisation is currently in L2 but is ready to move to L3 so you can track maturity on a continuous basis."</p>	<p>Decision: Previously addressed</p> <p>Suggestion to consider refining the DM level definition for different layers by incorporating specific questions and real-world examples for assessments, providing additional details on criteria for each DM level, and elaborating on EA layers with associated artefacts. However, one of this study criteria is generalisability, the model is generalised so that organisations can then tailor it to the layers being assessed. On the other hand, the illustrative scenarios incorporate specific definition tailored to the layers under the study.</p>

Area of improvement	Participants' feedback	Response
Seizing opportunities as a driver	"The driver for organisations could be to seize an opportunity (gain). The model above refers only to relieving pain points as an input. Examples include expanding market share, penetrating new markets, leveraging new technology, or being first to market."	<p>Applicable improvement</p> <p>Suggestion to add seizing opportunity as a concept to consider with the pain points.</p> <p>Action: Applied to the gamma version</p>

Applicable improvement extracted from DM model participants' feedback (Table 5-33):

- Recommendation to prioritise a data-driven approach at levels 3 or 4 is more practical than level 5.
- Recognise that nuances between certain levels, such as Beginner/Learner and Expert/Advanced which justify refinement by creating dependency between levels' definitions.
- Suggestion to add seizing opportunity as a concept to consider with the pain points.

Table 5-34 Action model participants' feedback

Area of improvement	Participants' feedback	Response
Action description	"However, I would have liked to see additional detail on what you mean by actions. Currently, I am not clear on what that means and how that fits into the roadmap. Maybe you have this in the detailed description in your report already - if action is a metamodel element or an additional class you are proposing, having additional criteria defined here allows for an	<p>Decision: Previously addressed</p> <p>Actions serve as integration points within the model to utilise information gathered from related DM and performance models.</p> <p>They are initiatives or steps defined by the organisation with the</p>

Area of improvement	Participants' feedback	Response
	understanding of what comprises an action, how it uses maturity and performance gaps and how it maps to a roadmap.”	specific purpose for improving DM levels to achieve the desired performance gains.
Actions prioritisation	<p>“I would be looking for a way to prioritise my actions though because it's not feasible or viable to implement all the actions. A way to prioritise the maturity assessment is important for a practical roadmap.”</p> <p>“Prioritization and Sequencing of Actions: Clearly define the prioritization and sequencing of actions in the roadmap. Consider dependencies and critical paths to ensure that actions are executed in a logical and efficient sequence.”</p> <p>“Not sure if good here but may wish to add a risk component as part mapping the action within the roadmap? (not sure how it would work or if it would distract)”</p>	<p>Decision: Applicable improvement</p> <p>Suggestion to clearly define the actions prioritisation and sequencing in the roadmap by considering factors such as strategic alignment, impact on critical business processes, urgency, and feasibility.</p> <p>Suggestion to Incorporate a risk identification of potential risks associated with each action such as complexity, dependencies, and external influences.</p> <p>Action: Applied to the gamma version.</p>
Illustrative actions	“However, I think it would be improved by providing example/illustrative actions in the context of each of the various EA layers.”	<p>Decision: Applicable improvement</p> <p>Suggestion to provide example/illustrative actions in the context of each of the EA layers. Since this study focuses on the human layer, some actions examples is provided in the last stage of evaluation.</p>

Area of improvement	Participants' feedback	Response
		Applied to the evaluation of the gamma version (illustrative scenario)
Coordination across layers	"Also actions that span EA layers e.g. an action designed to make a coordinated change across two or more EA layers, as these can be hard to identify and track effectively (based on my own experience) and tend to lead to 'splitting' the actions according to the EA layers and this leads to multiple actions that need to be coordinated and often are not."	<p>Decision: Applicable improvement</p> <p>Suggestion for a holistic approach to action identification by considering actions that cut across multiple layers instead of focusing on individual layers.</p> <p>Action: Applied to the DEAMP process gamma version</p>
Cross-functional collaboration	"Cross-Functional Collaboration: Emphasize collaboration across different departments or functions within the organization. Actions often require multidisciplinary efforts, and fostering collaboration ensures a holistic and integrated approach to achieving digital maturity and improved performance."	<p>Decision: Out of the scope (future improvement)</p> <p>Suggestions for cross-functional collaboration, especially across different departments or organisational functions, to implement actions. However, this is out of the scope of this study since the DEAMP model is an assessment model, not an implementation model.</p>
Integration with project management tools	"Integration with Project Management Tools: Explore integration possibilities with project management tools to facilitate seamless execution and monitoring of actions outlined in the roadmap."	<p>Decision: Out of the scope (future improvement)</p> <p>Suggestion to integrating project management tools to facilitate the execution and monitoring of actions outlined in the roadmap.</p>
Actions control validation	"Other action items from the organization actions like the audit or compliance to new regulations may also influence the actions"	Decision: Out of the scope (future improvement)

Area of improvement	Participants' feedback	Response
		Suggestion to add audit or compliance to new regulations as factors which are often integrated into the project planning phase not the roadmap.

Applicable improvement extracted from action model participants' feedback (Table 5-34):

- Consider factors including strategic alignment, impact on critical business processes, urgency, and feasibility to prioritise and sequence actions in the roadmap.
- Include a risk identification process for potential risks associated with each action, such as complexity, dependencies, and external influences.
- Suggestion to provide example/illustrative actions in the context of each of the EA layers (see Section 5.3.3).
- Adopt a holistic approach to action identification by addressing actions that span across multiple layers rather than focusing on individual layers.

Table 5-35 Benefits model participants' feedback

Area of improvement	Participants' feedback	Response
Illustrative scenarios	"I initially got stuck on the pain points but needed to work through a few of my own scenarios for it to make sense. It may make sense to provide a few scenarios such as risk mitigation, low capability delivery, or growth scenario to demonstrate the model in operation to others who may not understand it."	Decision: Applicable improvement Suggestion to provide an example/illustrative scenario to enhance the understandability in the context of the selected scenario context.

Area of improvement	Participants' feedback	Response
		Action: Applied to the evaluation of the gamma version (illustrative scenario).
Frameworks for benefits realisation	“In addition, I suggest layering the benefits through established frameworks such as the value realisation framework or the business value articulation framework.”	Decision: Out of the scope (future improvement) Suggestion to integrate established frameworks for value realisation, such as the value realisation framework or the business value articulation framework. This integration can enhance the tracking of benefits resulting from the implementation of roadmap actions.
Reuse of DM and performance model for tracking benefits	“I would reuse the DMM to conduct a new assessment and help me determine if the target performance/maturity actually realises the benefit. If it doesn't, then that means I've set the wrong target.” “A concept like benefits is very subjective so as a practitioner, I would have liked to have seen additional detail here on what you mean and what type of benefit you are measuring and its linkage to the PI's you listed in the beginning.”	Decision: Previously addressed Suggestion to reuse DM and performance model for tracking benefits which has been proposed by conducting another analysis using the results of the previous DM and performance assessment during or after the implementation of actions.

Applicable improvement extracted from benefits model participants' feedback (Table 5-35):

- Suggestion to provide an example/illustrative scenario in the context of each of the EA layers. Since this study focuses on the human layer, some actions will be provided in the last evaluation stage.

Table 5-36 DEAMP model participants' feedback

Area of improvement	Participants' feedback	Response
Guidance to apply the DEAMP model	<p>"I think the effectiveness always comes down to the actual use/implementation of the framework and I believe that the 'how to use' knowledge has to be baked into the framework otherwise it's just another framework that people can use the wrong way."</p>	<p>Decision: Applicable improvement</p> <p>Suggestion to include detailed instructions and guidance on how to use DEAMP model properly to ensure the framework's effectiveness.</p> <p>Action: Applied as a process in the gamma version</p>
About EA framework	<p>"Not sure about the difference between facilities and environment. I wonder if technology as a single layer makes sense in an EA sense. There is usually a very different experience of technology at the end-user level versus infrastructure/network. Security is also something that will exist across all levels - personnel security, physical security, information security etc."</p> <p>"Would need to be paired with other frameworks to be truly useful for practical EA use. Reminds me of the Zachman framework; useful for understanding EA but not as prescriptive for EA initiatives."</p> <p>"I am unable to understand how facility can play a role in transformation."</p>	<p>Decision: Out of the scope</p> <p>Suggestion to integrate other EA frameworks as a lens, also some feedback about the adaptive EA framework, which is out of the scope of the study as the purpose of adopting EA is to provide a lens to systemise the facilitation of the assessment.</p>

Area of improvement	Participants' feedback	Response
	<p>"Typically, the business transformations are focused on the people, process, and technology layer in context to the EA layers (i.e. horizontal layers). However, there are vertical layers as well such as security that you have covered, but governance seems to be missing."</p>	
<p>The integration of other frameworks</p>	<p>"In general, my comments are about simplicity, layering, and the use of established frameworks for benefit realisation."</p> <p>"Have you considered adding priority or risk models? May help to deepen decision making."</p>	<p>Decision: Out of the scope</p> <p>Suggestion to integrate other well-known practical frameworks that are relevant to the organisation's industry to help optimise decision-making effectiveness.</p>

Applicable improvement extracted from DEAMP model participants' feedback (Table 5-36):

- Suggest the need for detailed instructions on how to use the DEAMP model correctly, as the framework's effectiveness relies heavily on how it is implemented.

Review:

The qualitative data in this section was analysed as detailed in Table 5-32 to Table 5-36 (pages 165-176) to extract applicable suggested improvements to refine and enhance the DEAMP model and to identify future research directions. As a result, the areas of improvement based on the participants' feedback analysis are summarised in Table 5-37.

Table 5-37 The areas of improvement based on participants' feedback

DEAMP models	Experts' applicable suggestions
Performance	<ul style="list-style-type: none"> • Suggestions to expand PIs, including specific areas like customer experience, customer and service coverage and segment, change management metrics, platform choice evaluation, and incorporate quality measures like interoperability, scalability, and security. • Suggestion to add competitive position within product, customer, and operational excellence
DM	<ul style="list-style-type: none"> • Suggestions to prioritise a data-driven at levels 3 or 4, as they are more appropriate compared to level 5. Moreover, the nuances between certain levels, like Beginner/Learner and Expert/Advanced which justify refinement by creating dependency between levels' definitions. • Suggestion to add seizing opportunity as a concept to be consider with the pain points.
Action	<ul style="list-style-type: none"> • Suggestion to prioritise and sequence actions within the roadmap by multiple factors such as strategic alignment, impact on critical business processes, urgency, and feasibility. • Suggestion to incorporate a risk identification of potential risks associated with each action, such as complexity, dependencies, and external influences. • Suggestion the need to adopt a holistic approach to action identification to recognise actions that span across multiple layers rather than focusing on individual layers
Benefit	<ul style="list-style-type: none"> • Suggestion the need for an example/illustrative scenario in the context of EA layers.
DEAMP	<ul style="list-style-type: none"> • Suggest the need for detailed instructions on how to use the DEAMP model correctly, as the framework's effectiveness relies heavily on how it is implemented.

The previous section covers the second evaluation stage, which is to evaluate the beta version with the expert survey instrument, resulting in the refinements of the model (gamma version). The next section covers the third round of evaluation to demonstrate the physical model (assessment model and process) with two illustrative scenarios.

5.3.3 Evaluation stage 3 - Gamma - DEAMP model and process

The main goal of the third stage of the evaluation is to illustrate the application of the framework (model and process). Also, it discusses that the proposed DEAMP model and process seem useful, and they can be used to systematically guide organisations to plan and conduct their assessments independently of any digital vendor. Also, this serves as the DEAMP physical model, which provides concrete examples to enhance usability and clarify operational aspects of the framework. This physical level focuses on practically implementing the logical components defined at the logical level by utilising business scenarios and operational processes (*The TOGAF® Standard, 10th Edition, 2022*). These scenarios were constructed following the guidelines outlined in the TOGAF® Series Guide to Business Scenarios (Blevins and Lambert, 2022), specifically for this study, as previously discussed in Chapter 3. The selection of scenarios was based on practical relevance, specifically to incorporate examples from the marketing (in the evaluation stage 1), construction, and mining industries (in the evaluation stage 3). This evaluation discussed one instance of each illustrative scenario, 7 fictitious test data, although those scenarios were organised using spreadsheets and automated by Jalapeno.

The following sections, 5.3.3.1 and 5.3.3.2 discuss the application of two illustrative scenarios.

5.3.3.1 Illustrative scenario 2

In this scenario (Table 5-38), BuildCo, a fictional construction company specialising in commercial building projects, has just signed a contract to construct a multi-story office building for a high-profile client within tight deadlines, complex architectural requirements, and a limited budget. With its reputation at stake, BuildCo must effectively manage project delays, cost overruns, and stakeholder expectations. The company operates in a competitive market by focusing on mid-sized projects in urban areas. BuildCo's executive team, project managers, subcontractors, client representatives, and regulatory bodies are key stakeholders.

Table 5-38 Illustrative scenario 2

Context	Description
Scenario	Construction company, " AB Build Co," specialising in commercial building projects. AB Build Co, operates in a competitive market, focusing on mid-sized projects in urban areas.
Problem	AB Build Co has recently secured a contract to construct a multi-story office building for a high-profile client. The project has tight deadlines, complex architectural design requirements, and a limited budget. BuildCo's reputation is at stake, and successful project completion is crucial for future business prospects.
Business environment	Stakeholder management, and overall project success
Outcome	Managing communication and coordination among multiple subcontractors

To address the scenario-specific, BuildCo must coordinate among multiple subcontractors. By conducting a thorough gap analysis, BuildCo can identify areas for improvement. One of the standard gap analyses in this company is the DEAMP assessment framework, which could be deployed as follows:

5.3.3.1.1 Recognise

The first step is to recognise why there is a need to conduct this assessment (why to assess and when) by defining the reason for conducting this assessment:

- What is the reason? (Assessment motivation)
- What is the outcome? (Assessment outcome)
- When is it needed? (Assessment timeframe)

The project management leads (initiators) recognised a need to assess and improve DM to improve the department's performance outcomes. The outcome needed is to determine if there is DM gap that might impact the new project's progress, and if there is a feasibility of improving DM for improved performance outcomes to define and add these digitalisation efforts into the next budget before starting the new project.

Table 5-39 Assessment brief - Scenario 2

Assessment Brief	
Initiator	Project management leads
Assessment motivation	Recognised the need to effectively manage possible project challenges, including delays, cost overruns, and stakeholder expectations.
Assessment outcome	Determine feasibility and areas for improvement through gap analysis to implement a tailored project management framework.
Assessment timeframe	Before the end of the financial year

5.3.3.1.2 Scope and adjust

After recognising the need and before conducting the assessment, they can initiate pre-assessment activities to define the scope of the assessment and then adjust the DEAMP model according to the assessment scope as follows:

- Assign Assessment owner
- Select the audience
- Workshop with audience and initiators to Select and prioritise business areas in scope
- Workshop with audience and initiators to adjust and tailor the model component and select the assessors

Thus, they decided to initiate a DT initiative that included different stakeholders (board, managers, front-line employees, assessment owner, and subcontractors). The assessment owner held workshops with the stakeholders to select a scope subject for the assessment. Thus, they decided to choose and prioritise the “Project Management Information” domain (the Info. Service), which includes information identification, collection, reporting, and collaboration within the stakeholder management.

In these workshops, they adjusted the DEAMP model for the selected scope. They started by selecting and mapping the PIs/measures/scales and goals/objectives to each chosen element in the scope. For example, one of the PIs related to stakeholder management information services is the quality of operational performance, which needs to be improved (as enhancing stakeholder communication and coordination is a related goal). Also, they

identified that this PI would measure the efficiency of the operational performance of the stakeholder management info services on a 5-point Likert scale.

Additionally, they adjusted and tailored the DM levels to be relevant to the selected scope by redefining those levels for assessors to guide their evaluation to choose the degree/level of DM of each element in the scope of this assessment. At this point, they had no information on the pain points or opportunities associated with the selected scope. Thus, pain points or opportunities have been pushed to the next stage to be identified. By the end of these workshops, they selected and assigned assessors for the next step.

Table 5-40 Assessment scope and criteria - Scenario 2

Item	Item's Details
Architecture	Project management
Architecture domain	Info.
Architecture element	Info. Service - Stakeholder management
Goal/objective	Enhance stakeholder communication and coordination
Pain point/Opportunity	N/A
PI	The efficiency of operational performance on a 5-point Likert scale
DM levels	<ul style="list-style-type: none"> • Level 0 (None) Either the absence of digitalisation or basic digitisation as no or limited digital info. services (information identification, collection, reporting, and collaboration) running in silos • Level 1 (Beginner/ Learner) Digitally aware or ad-hoc digitalisation (Adopting some digital practices), as some or ad-hoc moves towards defining digital info. services or breaking down internal silos and digital collaborative practices created • Level 2 (Intermediate) Consistent, defined, integrated and digitally enabled such as info. services are being identified and developed digitally • Level 3 (Advanced) Completely developed and data-driven as fully developed and integrated into organisational plans and the business review cycle for regularly audited and improved • Level 4 (Expert) Innovative, predictable, proactive and adaptable, such as constantly monitored, improved and refined to anticipate and adaptably respond to new technologies and digital innovation

5.3.3.1.3 Assess

After consensus on the scope and the assessment criteria, the assessment owner initiated workshops with the assessors to collect data about the selected scope against PIs and DM levels. They also analysed the data and defined each PI's current and target state. The main activity of this stage is to organise workshops to

- Collect the data
- Analyse the data and define the current and target state of each PI
- Define the current and target DM level for each selected layer
- Determine the performance and DM gaps

In turn, they defined the current and target DM level for each selected element in the scope and determined the performance and DM gaps. During those workshops, they identified a pain point related to the Information Service. They found out that the project information is scattered across multiple systems. It challenges the efficiency to identify and collect relevant data due to fragmented IS. However, the results of this assessment identified a gap of one level between the current and target DM levels. Also, the efficiency of customer retention scored 2 (low) on a 5-point Likert scale (Table 5-41).

Table 5-41 The assessment result report - Scenario 2

Item	Item Details
Scope subject to assessment	Project Management Information domain (Info. Service - Stakeholder management)
Goal	Enhance stakeholder communication and coordination
Pain point	Project information is scattered across multiple systems Poor Collaboration Tools
Current DM	Level 01
Target DM	Level 02
DM gap	1 level difference between the current and target DM
Current PI	Quality Indicator: operational performance (Low – 2 on a 5-point Likert scale)
Target PI	Quality Indicator: operational performance (Medium – 3-4 on a 5-point Likert scale)
Performance gap	operational performance efficiency needs to be increased to reach the targeted efficiency

5.3.3.1.4 Identify and roadmap

Post the assessment activity, the assessment owner conducted review sessions to review the outcomes of the assessment with the participants' audience and initiators (Table 5-41) to

- Review the assessment results and realise the need to take actions
- Identify actions
- Coordination actions across layers

However, this led to the realisation of the need to take action to uplift the DM level to increase operational performance efficiency and reach the targeted efficiency. As a result, they identify and prioritise those actions for developing the roadmap for implementation plans, such as the sequence of actions based on the identified timeline, their dependency and priority. For example, consolidating data into a single platform by implementing a centralised project management information system (PMIS) is the proposed action that can improve stakeholder management and project transparency. Project and portfolio management (PPM) software provides organisations with powerful tools to manage projects, resources, and portfolios. It is designed to help project managers and teams collaborate effectively, streamline project workflows, and gain real-time insights into project performance. Thus, this action will solve the main pain point recognised during assessment workshops. This action is expected to take 60 days, with a high priority on a DT roadmap (see Table 5-42).

Table 5-42 Action and roadmap - Scenario 2

Item		Action 1 details
Action		Implement a centralised PMIS – PPM software
Priority	Strategic alignment	High
	Impact on critical business processes	High
	Urgency	High
	Feasibility	High
Risk	Complexity	Medium
	Dependencies	IT department for integration
Timeline		60 days

5.3.3.1.5 Track

To track the post-action roadmap, a DT initiative led by the assessment owner can establish workshops with the audience, initiators, and assessors to ensure that the implemented actions achieve their intended outcomes. This systematic approach helps track the achieved DM and performance compared to the previous assessment results. The main agenda for these workshops is to:

- Define the actual DM and performance outcomes resulting from implementing the actions roadmap using the previous assessment guideline and
- Compare it to the previous assessment results to monitor and track the uplifted DM and the performance gain. Also, they
- Monitor resolved pain points and realised goals and objectives according to target maturity and performance levels.
- Identify follow-up actions if needed.

If the results of this activity don't match the desired target maturity and performance levels, then they can identify follow-up actions or further improvements to address any remaining issues. Thus, assessing the actual DM and performance after implementing the proposed action, and comparing it to the assessment results, is instrumental to determine whether this action has enhanced stakeholder communication and coordination and resolved the pain points.

5.3.3.2 Illustrative scenario 3

In the third scenario (Table 5-43), XYZ Mining Co., a leading global mining company specialising in the extraction and processing of iron and copper. They aim to become the top employee choice to attract and retain top talent by enhancing employee experience and retention. Thus, this company plans to leverage its technology investments and recent ERP cloud migration while increasing operational efficiency through computer-aided facility management. Accordingly, they have established a department to lead that DT (Transformation department).

Table 5-43 Illustrative scenario 3

Context	Description
Scenario	Mining company, XYZ Mining Co. is a leading global mining company engaged in extracting and processing minerals, primarily in the iron ore and copper

Context	Description
	sectors. It complies with the highest international standards of corporate governance and continues to build the company operations on a strong foundation of sustainable practices.
Problem	XYZ Mining Co. is aiming to be the number one choice of employee to attract top talents in the market plus it needs to improve the employee experience in order to retain its current talents by capitalising on its technology investments and its recent ERP cloud migration and increase the efficiency of the facilities by introducing the computer-aided facility management.
Business environment	HR processes, training, and performance evaluation.
Outcome	Improved talent retention and enhanced employee satisfaction and engagement.

The transformation department is now assigned to conduct a gap analysis and process fitment to identify areas for improvement and develop a structured approach to implementing solutions tailored to the mining industry and follow the best practices. One of the standard gap analysis frameworks in this company is the DEAMP framework, which could be utilised as follows:

5.3.3.2.1 Recognise

The first stage is to recognise why there is a need to conduct this assessment (why to assess and when) by defining the reason for conducting this assessment:

- What is the reason? (Assessment motivation)
- What is the outcome? (Assessment outcome)
- When is it needed? (Assessment timeframe)

The transformation department (initiators) has been assigned to assess and improve DM to improve employee's performance outcomes. Considering the context of this problem, the reason to conduct the assessment is to leverage technology investments and recent ERP cloud migration to address possible challenges in the HR department. The outcome needed is to determine whether there is a feasibility to improve DM for improved performance outcomes to be defined and add these DT efforts into the next budget.

Table 5-44 Assessment brief

Assessment Brief	
Initiator	Transformation department
Assessment motivation	Address challenges in the HR department by leveraging technology investments and recent ERP cloud migration.
Assessment outcome	Determine the gaps between DM and performance in HR department and the feasibility of leveraging its technology investments and recent ERP cloud migration to increase operational efficiency
Assessment timeframe	Before the next budget cycle

5.3.3.2.2 Scope and adjust

After recognising the need and before conducting the assessment, they can initiate pre-assessment activities to define the scope of the assessment and then adjust the DEAMP model according to the assessment scope as follows:

- Assign assessment owner
- Select the audience
- Workshop with audience and initiators to select and prioritise business areas in scope
- Workshop with the audience and initiators to adjust and tailor the model component and select the assessors

The transformation department then assigned an assessment owner who will be responsible for leading and conducting this assessment. The first step of that is holding workshops with the stakeholders to select a scope for the assessment. The stakeholders were the leads in the HR department and IT (HR director, Talent development lead, Training and Development Managers, and IT representative). This step is to select and prioritise business areas in the scope for DEAMP assessment. Thus, they decided to choose and prioritise the HR business capabilities (more precisely, the Talent development capability). In these workshops, they adjusted and tailored the DEAMP model for the selected scope. They started by selecting and aligning the PIs/measures/scales, tailoring the DM level, and mapping related goals/objectives, opportunities and pain points for each element selected in the scope. For example, one of the PIs related to talent development capability is the resource utilisation of productive work performance, which needs to be improved (as

increasing operational efficiency is a related goal). Also, they identified that the measurement of this PI is the degree of productivity of the talent development capability work performance on a 4-point Likert scale. Additionally, they adjusted and tailored the DM levels to be relevant to the selected scope by redefining these levels to guide evaluation of the degree/level of DM of each element in the scope of this assessment. During these workshops also, they pinpointed ad-hoc systems as training registration systems and manual processes, such as conducting requests matching employees with the training courses by the training centre (contractor). By the end of these workshops, they selected and assigned assessors for the next stage.

Table 5-45 Assessment scope and criteria - Scenario 3

Item	Item's details
Architecture	HR
Architecture domain	Business
Architecture element	Capability – Talent Development
Goal/objective	Increasing operational efficiency
Pain point/Opportunity	Ad-hoc systems and manual process (Pain point) leveraging the recent ERP cloud migration (Opportunity)
PI	The degree of productivity in work performance on a 5-point Likert scale
DM levels	<ul style="list-style-type: none"> • Level 0 (None) Either the absence of digitalisation or basic digitisation as no or limited digital processes running in silos • Level 1 (Beginner/ Learner) Digitally aware or ad-hoc digitalisation (Adopting some digital practices), as some or ad-hoc moves towards defining digital capabilities processes or breaking down internal silos and digital collaborative practices created • Level 2 (Intermediate) Consistent, defined, integrated and digitally enabled such as business practices and processes are being identified and developed digitally • Level 3 (Advanced) Completely developed and data-driven as fully developed and integrated into organisational plans and the business review cycle for regularly audited and improved • Level 4 (Expert) Innovative, predictable, proactive and adaptable, such as constantly monitored, improved and refined to anticipate and adaptably respond to new technologies and digital innovation

5.3.3.2.3 Assess

The assessment owner scheduled and conducted the workshops with the assessors to collect data about the selected scope against designated PIs and DM levels. They also analysed the data and defined each PI's current and target state. The main activity of this stage is to organise workshops to:

- collect the data
- analyse the data and define the current and target state of each PI
- Define the current and target DM level for each selected layer
- determine the performance and DM gaps

As a result of these workshops, they defined the current and target DM levels for each selected element in the scope and determined the performance and DM gaps. They reported that there is a one-level gap between the current and target DM levels. Also, the productivity of work performance scored 2 (low) on a 5-point Likert scale (Table 5-46).

Table 5-46 The assessment result report - Scenario 3

Item	Item Details
Scope subject to assessment	Capability – Talent Development
Goal	increasing operational efficiency
Pain point	ad-hoc systems (Pain point)
Opportunity	Leveraging the recent ERP cloud migration
Current DM	Level 00
Target DM	Level 02
DM gap	2 level difference between the current and target DM
Current PI	Resource Utilisation Indicator: Work Performance (Low – 2 on a 5-point Likert scale of the level of productivity)
Target PI	Resource Utilisation Indicator: Work Performance (Low – 2 on a 5-point Likert scale of the level of productivity)
Performance gap	Work Performance efficiency needs to be increased to reach the targeted efficiency

5.3.3.2.4 Identify

Post the assessment activity, the assessment owner conducted review sessions to review the outcomes of the assessment with the audience and initiators (as detailed in Table 5-46) to:

- Review the assessment results and realise the required action
- Identify required actions
- Coordinate actions across layers

However, during those workshops, it became evident that there is a need to uplift the DM level to enhance work performance and productivity. As a potential action, a new feature released by the recent cloud ERP offers modernised integration and business logic that addresses the pain points of multiple siloed solutions. Therefore, the action utilises these new ERP system features to register the training centre as a service provider and add an employee self-service feature. The newly released feature will enable employees to fulfil the registration process via a configurable workflow. The newly released feature allows employees to complete the registration process through a configurable workflow. The workflow is initiated once the employee selects the required training as per the annual individual training plan to be submitted to the talent team for approval. The talent team will verify and then approve the training plan. The plan will be emailed to the employee and the training centre.

when an employee selects a course from the available options, the request will be automatically directed to the talent team for approval. If approved, the training centre will be notified, and then employees will receive notifications with the training details.

The proposed actions are as follows:

- Assignment of the service provider role to the Training Centre: This integration will allow the training centre to be managed within the ERP system, improving coordination and accessibility.
- Activation of the registration feature in Employee Self-Service: This feature will allow employees to independently browse and register for training courses through the ERP system.

To coordinate the proposed actions with other initiative backlogs, as part of the business rules configuration in the new learning module in the ERP system, an integration is possible

to link the employee progression plan with the learning process to ensure the alignment of the required learning to the employee’s career. This integration was prioritised to be configured as part of the same initiative.

The proposed actions, after coordination with other actions, are as follows:

- Registering the Training Centre as a service provider: This integration will allow the training centre to be managed within the ERP system, improving coordination and accessibility.
- Integrate the employee performance module with the learning module: With this integration, training courses can be automatically assigned to employees based on their career objectives and job roles. Thus, the employees will be notified with an appropriate training that captures their personal development goals and the company’s needs.

5.3.3.2.5 Roadmap

During the workshops, they prioritised the required actions to construct the implementation roadmap high-level plan covering the following aspects: strategic alignment, impact on critical business processes, urgency, feasibility, complexity, dependencies, and timeline. The first deliverable (Registering the Training Centre as a service provider) was identified as a high-priority action with high strategic alignment and feasibility, medium impact, low complexity, and is scheduled to be built and tested in 20 days with no dependencies. In parallel, the second deliverable (Integrate the employee performance module with the learning module) was also prioritised highly due to its significant value for strategic alignment, urgency, feasibility, and impact, with medium complexity. This action was highlighted as an ongoing Employee Performance System project activity, as well, with an expected timeline of 50 days, including a 20-day wait for the prerequisite project to complete. By evaluating and sequencing these actions, the organisation can ensure alignment with strategic goals and efficient implementation (see Table 5-47).

Table 5-47 Implementation roadmap - Scenario 3

Item	Action 1 details	Action 2 details
Action	Registering the Training Centre as a service provider	Integrate the employee performance module with the learning module
□	Strategic alignment	High

Item		Action 1 details	Action 2 details
	Impact on critical business processes	Medium	High
	Urgency	High	High
	Feasibility	High	High
Risk	Complexity	Low	Medium
	Dependencies	NA	Employee Performance System - ongoing project
Timeline		20 days	50 days – wait 20 days

5.3.3.2.6 Track

To track the post-action roadmap, the transformation department will assign an assessment owner who can establish workshops with the audience, initiators, and assessors to ensure that the implemented actions achieve their intended outcomes. This tactic facilitates the tracking of achieved DM and performance compared to the previous assessment results.

The main agenda for these workshops is to:

- Define the actual DM and performance outcomes resulting from implementing the action roadmap.
- Compare it to the previous assessment results to monitor and track the uplifted DM and the performance gain.
- Monitor the resolved pain points and realise the goals and objectives according to the desired target DM and performance levels.
- Identify follow-up actions if needed.

Suppose the results of these workshops don't match the desired DM and performance levels. In that case, they can address that gap by identifying follow-up actions or further improvements for any remaining issues. For example, it is to track whether this action has resolved the ad-hoc systems and increased efficiency. If not, they can then identify follow-up actions such as further system enhancements or additional training requirements.

The previous section discusses the application of two illustrative scenarios. The following section discusses a review of the results of the last evaluation stage.

5.3.3.3 Illustrative scenario 2 and 3 review:

The two illustrative scenarios were deployed to illustrate the framework's application (model and process) in a business context. This evaluation has two purposes. First, it demonstrates the practical applicability of the framework. Second, it provides concrete examples to enhance usability and clarify the framework's operational aspects (DEAMP physical model).

The key learnings from the previous evaluation are centred around collaboration and the operational benefits. Recognising and identifying stakeholders' roles in an assessment process helps structure the responsibilities and ensure effective collaboration. Also, it can influence the quality of the assessment outcome. The stages process (e.g., recognise, scope, adjust, assess, identify, roadmap, track) provides a systematic approach to apply the DEAMP assessment. Each stage is elaborated as goals, steps, inputs and outputs, which ensures the comprehensibility of each stage. In the Identify stage, coordinating actions across layers provides adaptability with existing systems and avoids duplication. Meeting the organisation's needs can be achieved by tailoring the models to the organisation's context, aligning strategic goals, and refining models through iterative processes. Outputs of the assessment, such as assessment briefs and guidelines, provide a practical method to translate theoretical models into actionable steps to improve decision making and performance.

In conclusion, a well-defined, iterative, and collaborative assessment process is important to increase the effectiveness of the assessment. The roles of stakeholders and the customisation of the framework ensure alignment with organisational goals. Following a step-by-step method through various stages enables organisations to effectively translate theoretical models into practical solutions to drive improved decision making and performance.

5.4 Summary

This chapter discusses the iterative process of building and evaluating the DEAMP assessment framework from its initial alpha version to the final gamma version, as each version progressed through multiple increments. The first evaluation process, illustrative scenarios, indicated the practical applicability that was applied to alpha, which produced the beta version (second version). Subsequently, the beta version went through the second

round of the evaluation process, which resulted in the last version (gamma version). The second evaluation round used expert survey techniques, as detailed in this chapter. The survey results indicate that DEAMP was applicable to represent the field at hand and help address the gaps in this research. Finally, two illustrative scenarios are presented in this chapter to indicate the practical applicability and provide examples/illustrative scenarios in the context of the EA layers to demonstrate the DEAMP model in the process of the DEAMP process. It also reflects the positive evaluation of the framework using various complementary methods to ensure the soundness of the proposed work. Alpha and beta are discussed in this chapter, while the last version (gamma) is discussed in Chapter 4. The output of this study, limitations, contributions and future directions for research are detailed in the next chapter (Chapter 6).

6 Chapter 6 Discussion and Conclusion

This chapter discusses the research journey that started in July 2020 and the research problem and solution. It also discusses the final implications and contributions of this work. Also, the limitations and opportunities for future research are discussed, besides providing a summary and conclusion.

This thesis explores DM and its link to organisational performance. A methodical review of the existing literature revealed a gap in assessing and enhancing the often disconnected yet related aspects of digital EA maturity and performance. This led to formulating the main research questions outlined in Chapter 1. To address this issue, this thesis seeks to answer the research question: How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? (see Chapter 1). The research presents the DEAMP assessment framework as a practical solution to the research question. This framework was constructed using DSR methodologies and underwent evaluation through illustrative scenarios and experts survey. This evaluation demonstrated that the framework satisfied the evaluation criteria and effectively addressed the research questions at hand. The DEAMP assessment framework has implications for both practitioners and researchers, as discussed in this chapter. Also, two SLRs and initial work have been communicated and published in peer-reviewed conferences and journals. This loop of communication and external feedback enables continuous contribution to the knowledge base and enhancement to the proposed artefact.

6.1 The research journey

The research journey started in the autumn of 2020 and extended over four years, with the thesis anticipated to be submitted for examination in autumn 2024. The initial phase involved conducting a preliminary review (Chapters 1 and 2) to establish an understanding of the research domain, which helped to highlight the research problem, gaps and questions. The primary research question formulated was: How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? This main research question was further broken down into three sub-questions to

facilitate a more detailed and focused investigation, as detailed in Chapter 1. Once a suitable research methodology is identified to address the research questions and conduct the research (Chapter 3). During the initial phase, two SLRs were conducted consecutively (Chapter 2). Based on the findings from both SLR 1 and 2, the alpha version of the framework was developed by incorporating related theoretical and practical lenses to lead the development activities (see Table 3-3, Chapter 3). The alpha version of the framework then underwent the first evaluation phase to evaluate the practical applicability (see Chapters 3 and 5). The alpha version was revised to create the beta version based on the evaluation outcomes. The beta version then underwent the second evaluation phase (expert survey). As a results, the expert recommendations facilitated the development of the final version of the DEAMP assessment framework, as detailed in Chapter 4. Future research directions were subsequently proposed in Chapter 6.

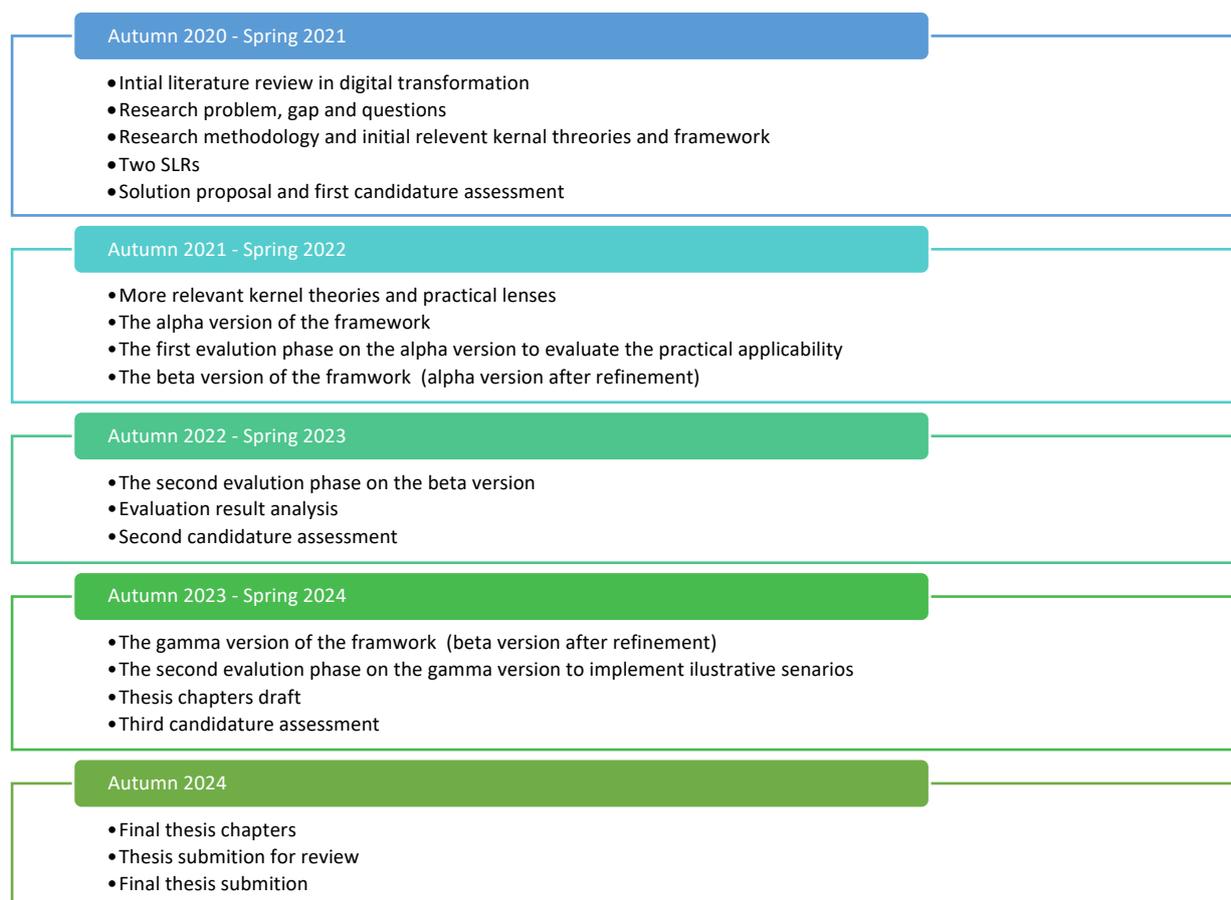


Figure 6-1 Research journey

6.2 Research problem and solution

Digitalisation is becoming increasingly crucial as it offers potential opportunities and mitigates threats. It enables organisations to evolve and thrive in a digitally driven environment. Consequently, many organisations are steering toward pursuing DT. However, they often face uncertainty in determining and understanding their digitalisation capability levels and their link to performance outcomes. This uncertainty places decision makers in a difficult position. It requires them to evaluate the feasibility of digitalisation and its anticipated performance outcomes. Building on this context, the research problem addresses how to navigate DM and performance assessment systematically and link these assessments using additional theoretical lenses. The goal is to establish a much-needed theoretical foundation for these currently ad-hoc and isolated domains. Thus, the research question is as follows:

RQ: How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain?

- RQ 1 How to measure the DM of an organisation?
- RQ 2 How to measure the digitalisation performance of an organisation?
- RQ 3 How to link DM levels and the performance of an organisation?

This research integrates the theoretical foundations of DM, EA, and organisational performance outcomes to address this concern. The objective is to gain insights into EA-driven digitalisation maturity levels, the outcomes of digitalisation, and the relationship between digitalisation maturity levels and performance outcomes to address the research gap at hand, as shown in Figure 1-2.

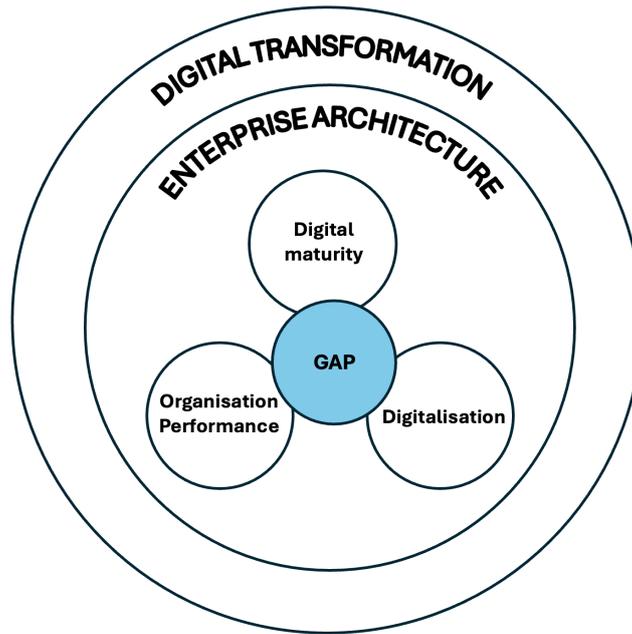


Figure 1-2 Research gap (recalled)

In response to the research questions, the primary aim of this thesis is to develop the DEAMP assessment framework, which covers both the assessment model (what to assess) and its implementation process (how to assess). The DEAMP model captures the interconnectivity between DM levels and their associated performance outcomes to recognise and guide the improvement of DM for the desired performance across EA layers. The assessment process is developed to provide a stages-wise approach to tailor and apply the DEAMP model. The development of the framework was grounded in related existing literature and directed by the implemented theoretical and practical lenses in conjunction with expert comments and observations.

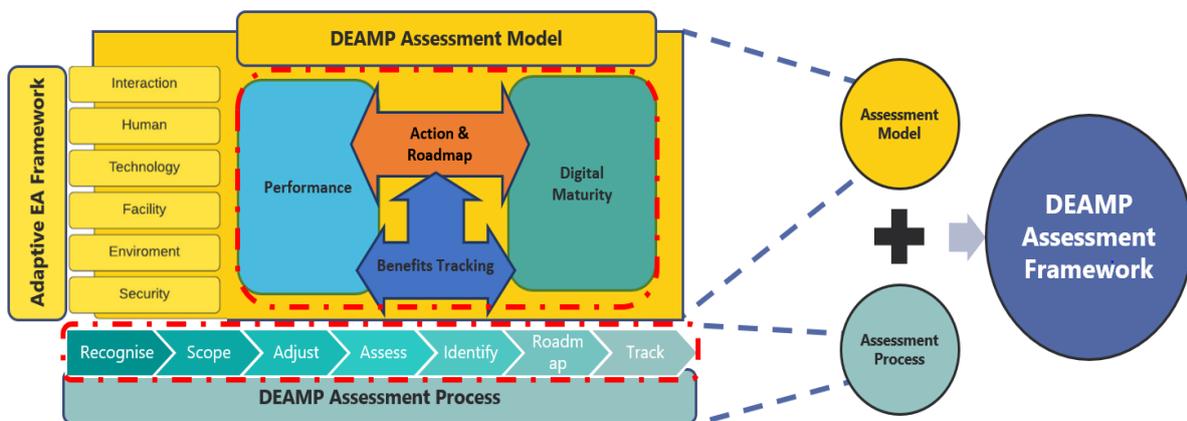


Figure 4-1 High-level contextual view of the DEAMP assessment framework (recalled)

The architectural design of this framework comprises three levels as follows:

- **DEAMP conceptual model** focuses on high-level abstraction, emphasising essential concepts and relationships of the DEAMP assessment model.
- **DEAMP logical model** translates the conceptual model into a more detailed representation that can be implemented in an ontology for the DEAMP assessment model.
- **DEAMP physical model** is the instantiation or implementation of the logical model with the DEAMP process for a particular scenario or case, as discussed in Chapter 5 throughout the evaluation process.

6.2.1 DEAMP assessment model

The first component of the DEAMP assessment framework is the DEAMP assessment model, which is designed to establish a link between DM and performance assessment. It enables action identification and roadmap development. These roadmaps can be monitored and tracked through benefits tracking across different EA layers. This model is introduced to answer the three sub-questions. It provides an understanding of the necessary elements to measure DM and performance across EA layers. It captures the interconnectivity between DM levels and their associated performance outcomes to recognise and guide the improvement of DM for the desired performance across EA layers. This model is designed and represented in a conceptual and logical modelling. The conceptual model ensures adaptability and compatibility with existing systems and processes. It allows organisations to adopt it without disrupting current processes. Also, it offers a flexible structure that enhances organisational efficiency. Additionally, the logical model (ontology) formalises the concepts and relationships to facilitate communication between individuals and organisations. This enables knowledge sharing within and across organisations by providing a common understanding of terms and concepts and their relationships.

Table 6-1 provides a detailed overview of the DEAMP conceptual and logical model, including descriptions and their corresponding locations in the thesis.

Table 6-1 DEAMP assessment model output

Model	Description	Source
DEAMP conceptual model	The conceptual model of the DEAMP illustrates the four main components of the model across the EA layers figure. Each component of the DEAMP model serves as a model with a set of elements that have direct relationships to the other components. These models include the performance model, DM model, action model and benefits model. It includes elements to assess DM levels and performance outcomes across EA layers in order to understand the link between DM levels and their performance outcomes. This understanding aids in identifying and directing enhancements actions to improve DM to achieve the desired performance outcomes across EA layers.	Chapter 4 Section 4.2.1
DEAMP logical model	The DEAMP conceptual model was expanded into a structured informal ontology to ensure a consistent understanding of the DEAMP model and its components. This ontology captures concept and sub-concept definitions and defines the relationships among these elements. It offers insights into how they interact and relate to each other. A graph-based approach is used to illustrate the ontology and is implemented using the Neo4j graph database.	Chapter 4 Section 4.2.2

6.2.2 DEAMP assessment process

The second component of the DEAMP assessment framework model is the DEAMP assessment process, which is designed to provide a stage-wise approach to tailor and apply the DEAMP assessment model. To address the main research question, how to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? The assessment model process was proposed to provide essential guidance to assist organisations in self-assessing using the DEAMP assessment model. This offers organisations a structured approach for using and implementing the DEAMP assessment model. Also, it provides seven seven-stage guide to initiate and deploy the assessment activity. By following this guidance, organisations can enhance their ability to measure and make decisions to optimise performance outcomes systematically.

Table 6-2 provides a detailed overview of the DEAMP assessment process and DEAMP physical model, including descriptions and their corresponding locations within the thesis.

Table 6-2 DEAMP assessment process output

Model	Description	Source
DEAMP assessment process	This process is composed of seven stages: recognise, scope, adjust, assess, identify, roadmap and track. It was introduced to provide a stages-wise approach to tailor and apply the DEAMP model.	Chapter 4 Section 4.3
DEAMP physical model	This model was introduced for the instantiation or implementation of the logical model with the DEAMP process using two illustrative scenarios. It is introduced to provide concrete guidance examples facilitating a clearer understanding and practical application of the framework.	Chapter 5 Section 5.3.3

6.3 Research implications

The proposed DEAMP assessment framework in this research discusses some important RQs highlighted in Chapter 1 (see Table 1-1). In this section, the implications for practice and research of DEAMP are discussed.

6.3.1 Implications for practice

- The framework allows organisations to assess their current level of digitalisation and define a target state, either to resolve current weaknesses or to seize opportunities to enhance digitalisation. This is to achieve better or more competitive performance gains. By defining specific performance metrics and indicators, organisations can map and align their strategic goals with measurable results, facilitate continuous performance improvement and help organisations track their progress toward achieving their DT goals.
- Introducing the conceptual model ensures ease of use, adaptability, and compatibility with existing frameworks. This allows organisations to adopt the new framework without disrupting their existing systems and processes. The conceptual model provides a flexible structure that can coexist and complement existing methodologies, which can enhance overall organisational efficiency and effectiveness.

- The logical model (ontology) formalises the concepts and relationships between DM and performance. By defining these concepts and their connections, ontology unifies the elements to facilitate a consistent understanding of terms, concepts, and their relationships. This formalisation addresses a research gap and provides a strong foundation for further academic exploration and practical application.
- The physical model was developed to provide concrete guidance examples, thus enhancing its ease of use. This model provides operational aspects to facilitate the understanding and practical application of the framework.

6.3.2 Implications for research

The findings of the research were shared in conference presentations and a journal publication to capture feedback from the academic community. These efforts have enhanced the growing knowledge base on DM, the digitalisation performance assessment model. The implications of the research are as follows:

- The framework is a practical, research-based framework for assessing DM and its performance.
- This research provides new insights into approaching and understanding how to assess DM and performance across EA.
- The two SLRs identified a lack of linking and understanding between the DM level and organisation performance outcomes in existing studies (Alsufyani and Gill, 2021, 2022). This deeper insight adds to the existing body of knowledge in DM, digitalisation performance, and EA.

6.4 Key contributions and publications

The main contribution of this research is to develop an integrated DM and performance framework. The developed framework brings new knowledge and understanding about assessing DM and performance to uplift DM and performance gains. The construction of the DEAMP assessment framework was significantly influenced by key publications. These conference and journal papers were peer-reviewed by prominent international researchers and experts. Table 6-3 highlights the thesis's main contributions.

Table 6-3 The thesis's main contributions

Contribution	Reference	Source
DEAMP assessment framework	Thesis outcome: The main contribution of this study is the development of the DEAMP assessment framework to help organisations determine whether to initiate digitalisation activities to achieve their intended performance outcomes by providing a comprehensive tool for self-assessing DM level for intended performance outcomes.	Chapter 4 Chapter 5 Chapter 6
Conference	Alsufyani, N. and Gill, A.Q., 2021, September. A Review of Digital Maturity Models from Adaptive Enterprise Architecture Perspective: Digital by Design. In 2021 IEEE 23rd Conference on Business Informatics (CBI) (Vol. 1, pp. 121-130). IEEE.	IEEE. CBI, 2021
Journal	Alsufyani, N. and Gill, A.Q., 2022. Digitalisation performance assessment: A systematic review. <i>Technology in Society</i> , p.101894.	<i>Technology in Society</i> , 2022
Conference	Alsufyani, N. and Gill, A.Q., 2022. A knowledge-graph based integrated digital EA maturity and performance framework. TEAR workshop of EDOC 2022 conference proceedings. Springer.	Springer. EDOC, 2022
Journal (In progress)	Title: A framework to assist with the digital EA maturity and performance assessment Authors: Alsufyani, N. and Gill, A.Q. and Proper, H.A.	IEEE Transactions on Technology and Society
Journal (In progress)	Title: Digital Enterprise Architecture Maturity and Performance Assessment Framework Authors: Alsufyani, N. and Gill, A.Q.	<i>Technology in Society</i>

6.5 Limitations and future work

6.5.1 Limitation

The final version of the DEAMP assessment framework exhibits several limitations despite the valuable research contributions outlined earlier, as follows:

- The top limitation stems from the time constraints inherent in the PhD program. It constrains the researcher's ability to investigate issues by conducting extended fieldwork due to the limitation of not being fully implemented in a real case scenario, instead mitigated by illustrative scenarios.

- Another limitation stems from the recruitment method and sample size of the expert survey utilised in this study. Participants were primarily recruited via LinkedIn. The survey remained open for 9 months as it initially was targeting domestic participants, then opened to experts globally, specifically from the US, the UK, Saudi Arabia, and the Emirates, due to insufficient participation. Thus, this exposed the evaluation of the DEAMP model to possible limitations due to the number of participants available using the recruitment method. However, it's important to note that the responses obtained are high quality, valuable and insightful for the scope of this evaluation. Future research could enhance the robustness of the current findings by recruiting a larger sample size to supplement the existing evaluation efforts.
- The scope of this research is limited to the human layer (business and information aspects) of the EA. It is because the information aspect is rarely addressed in the literature, and business drives information. Studying other architectural layers would extend beyond the scope and timeline of a PhD research project, as it is impractical to cover all layers comprehensively.
- The scope of the research is limited to the adaptive EA framework, as the purpose of adopting EA is to provide a lens to systematise conducting the assessment. However, adopting the adaptive EA as a lens offers the ability to switch to and integrate other EA frameworks and well-known practical frameworks relevant to the organisation's industry to help optimise decision-making effectiveness.

6.5.2 Future work

Several future research avenues could be proposed to enhance the DEAMP. Although these suggested topics lie beyond the scope of this thesis, they are recommended by expert survey participants. Implementing these suggested topics could be viewed as a significant enhancement to the final version of the DEAMP.

Table 6-4 provides a concise overview of potential future research directions based on different categories.

Table 6-4 Future directions

Area for future directions	Category	Description
Performance	Tailoring PIs for non-profit organisations	Non-profit organisations can adopt other categories of PIs besides financial ones, tailoring them to their industry and sector.
Performance	Use of analytics and AI	Explore the application of analytics and artificial intelligence to predict and assess the achievement of DT levels and the corresponding performance of an enterprise.
Performance	Industry-specific PI systems	Analyse how PIs can be designed for specific industries or enterprise contexts. Investigate the relevance and importance of each PI based on business nature, size, and strategic direction.
Performance	Incorporating Porter 5 Forces and SAFIA Roles-Based Framework	Revising PI competitiveness and enhancing resource utilisation with frameworks like Porter 5 Forces and the SAFIA roles-based framework.
Performance	Incorporating decision trees and PMI's disciplined agile framework	Decision trees could be used for developing KPIs within the model, leveraging methodologies like PMI's Disciplined Agile Framework.
Performance	Integration with the APQC Process Classification Framework for performance evaluation	Incorporating APQC to evaluate the current and target performance of the organisation's EA, if applicable.
EA	Alignment with other EA frameworks such as TOGAF	Aligning or coexisting with frameworks like TOGAF to facilitate organisation EA.
Performance	Recognising value stream alignment and governance PIs	Recognising value stream alignment as a dimension for PIs and considering risk, control, resilience, and compliance as potential PIs under the governance dimension.
Value realisation	Integration with value realisation framework:	Integration of established frameworks for value realisation, like the value realisation framework or business value articulation framework, to enhance benefit tracking resulting from roadmap actions.
Implementation tool	Using project management tools	Integration of project management tools for the efficient execution and monitoring of actions

Area for future directions	Category	Description
		outlined in the roadmap, improving project management within the framework.

6.6 Research validity discussion

This section discusses the thesis's internal and external validity. The focus of this discussion is to highlight the strength of the research design and the extent to which the findings can be generalised.

This research aims to construct the DEAMP assessment framework to answer the main RQ: How to assist organisations in measuring and linking inherently isolated DM and performance elements for performance gain? This question captures a gap identified in the existing literature. This gap reveals a lack of understanding of linking inherently isolated DM and performance elements for performance gain. The main RQ was divided into three sub-questions. This ensured a focused and structured research approach.

To strengthen internal validity, the study's RQs were formulated and refined through two SLRs, both of which were peer-reviewed and subsequently published. This rigorous approach ensured that the RQs were firmly grounded in a robust foundation of peer-reviewed literature, thus validating the significance of the research aims.

DSR methodology was employed to develop and construct the DEAMP assessment framework. This methodology is a recognised approach that provides a structured and systematic process for the framework's development and iterative evaluation. The validity of this methodology is detailed in Chapter 3, Section 3.7, following the DSR guidelines as discussed in Section 3.3. This approach leverages established theories and existing knowledge to ensure the framework's robustness.

The DEAMP assessment framework includes two key components: the DEAMP assessment model and process. It is designed to offer a practical solution to the RQs. This was accomplished by incorporating insights from relevant studies, theoretical frameworks, and valuable feedback from expert evaluations to refine the framework.

The design and validation of the research instruments were accomplished through an iterative process. This approach involved continuous improvement of the instruments that incorporate internal evaluations by supervisors and external assessments by field specialists. To enhance the instruments' effectiveness and relevance, insights from these reviews were utilised for both instrument scenarios and surveys. Also, a preliminary pilot test involving three participants was conducted to assess the survey questionnaire's design and relevance. The feedback from this pilot study led to further modifications of the research survey.

6.7 Conclusion and summary

This thesis introduces the DEAMP assessment framework, offering a practical solution to determine whether to initiate digitalisation activities to achieve their intended performance outcomes by providing a comprehensive tool for self-assessing the DM level for the intended performance outcomes. Developed iteratively using recognised DSR methodology, the DEAMP assessment framework is designed for use by DT, EA, and/or business architecture experts, including researchers. The DEAMP assessment framework provides decision makers with valuable insights to make informed decisions and guide the enhancement of DM for the desired performance across the EA layers. This can be accomplished by a framework process to guide organisations on how to assess their DM for performance gain using the framework models, the two main components of the DEAMP assessment framework. This research expands the existing knowledge base and deepens the understanding of DM and digitalisation performance. Moreover, this thesis discusses relevant findings for both academia and real-world applications. The DEAMP assessment framework is designed to be refined and developed by incorporating ongoing learning, further research, and practical insights gained from its application.

* A proofreader reviewed the language of the thesis to ensure the elimination of any grammatical errors. Grammarly software was also used in this thesis for proofreading and editing to enhance clarity and readability.

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Appendices

Appendix A SLR 1 selected studies

ID	Literature Paper (A# from the SLR, M# from the manual research)
A1	Aguiar, T., Bogie Gomes, S., Rupino da Cunha, P. & Mira da Silva, M. 2019. "Digital Transformation Capability Maturity Model Framework," in <i>2019 IEEE 23rd International Enterprise Distributed Object Computing Conference (EDOC)</i> , IEEE, pp. 51–7.
A2	Aleem, S., Capretz, L.F. & Ahmed, F. 2016. "A Digital Game Maturity Model (DGMM)," <i>Entertainment Computing</i> , vol. 17, pp. 55–73.
A3	Balaban, I., Begicevic Redjep, N. & Klacmer Calopa, M. 2018. "The Analysis of Digital Maturity of Schools in Croatia," <i>International Journal of Emerging Technologies in Learning (IJET)</i> , vol. 13, no. 06, p. 4.
A4	Berger, S., Bitzer, M., Häckel, B. & Voit, C. 2020. "Approaching digital transformation - Development of a multi-dimensional maturity model," in <i>Proceedings of the 28th European Conference on Information Systems (ECIS)</i> , A Virtual AIS Conference, pp. 1–18.
A5	Berghaus, S. & Back, A. 2016. "Stages in Digital Business Transformation: Results of an Empirical Maturity Study.," in <i>MCIS 2016 Proceedings</i> , Paphos, p. 22.
A6	binti Haini, S.I., Ab Rahim, N.Z. & Norziha, N.M. 2017. "Citizen centric impact on success factors of digital government maturity in Malaysian public sector," in <i>Proceedings of the 21st Pacific Asia Conference on Information Systems: Societal Transformation Through IS/IT, PACIS 2017</i> , p. 194.
A7	Boufim, M. & Barka, H. 2015. "Building holistic social media strategy referring to social intelligence and digital maturity," in <i>2015 IEEE/ACS 12th International Conference of Computer Systems and Applications (AICCSA)</i> , vol. 2016-July, IEEE, pp. 1–8.
A8	Bouzugenda, I., Alalouch, C. & Fava, N. 2020. "Examining digital participatory planning: Maturity assessment in a Small Dutch city," <i>Journal of Cleaner Production</i> , vol. 264, p. 121706.
A9	Büyükoçkan, G. & Güler, M. 2020. "Analysis of companies' digital maturity by hesitant fuzzy linguistic MCDM methods," C. Kahraman (ed.), <i>Journal of Intelligent & Fuzzy Systems</i> , vol. 38, no. 1, pp. 1119–32.
A10	Canetta, L., Barni, A. & Montini, E. 2018. "Development of a Digitalization Maturity Model for the Manufacturing Sector," in <i>2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)</i> , IEEE, pp. 1–7.
A11	Cognet, B., Pernot, J.P., Rivest, L., Danjou, C., Wuest, T., Kärkkäinen, H. & Lafleur, M. 2019. "Towards a Novel Comparison Framework of Digital Maturity Assessment Models," in <i>IFIP Advances in Information and Communication Technology</i> , vol. 565 IFIP, Springer International Publishing, pp. 58–71.
A12	Durek, V., Kadoic, N. & Begicevic Redep, N. 2018. "Assessing the digital maturity level of higher education institutions," in <i>2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)</i> , IEEE, pp. 671–676.
A13	Enkel, E., Bogers, M. & Chesbrough, H. 2020. "Exploring open innovation in the digital age: A maturity model and future research directions," <i>R&D Management</i> , vol. 50, no. 1, 23 January, pp. 161–168.

ID	Literature Paper (A# from the SLR, M# from the manual research)
A14	Eremina, Y., Lace, N. & Bistrova, J. 2019. "Digital Maturity and Corporate Performance: The Case of the Baltic States," <i>Journal of Open Innovation: Technology, Market, and Complexity</i> , vol. 5, no. 3, p. 54.
A15	Flott, K., Callahan, R., Darzi, A. & Mayer, E. 2016. "A Patient-Centered Framework for Evaluating Digital Maturity of Health Services: A Systematic Review," <i>Journal of Medical Internet Research</i> , vol. 18, no. 4, p. e75.
A16	Gollhardt, T., Halsbenning, S., Hermann, A., Karsakova, A. & Becker, J. 2020. "Development of a Digital Transformation Maturity Model for IT Companies," in <i>2020 IEEE 22nd Conference on Business Informatics (CBI)</i> , vol. 1, IEEE, pp. 94–103.
A17	Ilin, I., Levaniuk, D. & Dubgorn, A. 2019. "Assessment of Digital Maturity of Enterprises," <i>Advances in Intelligent Systems and Computing</i> , vol. 1259, Cham: Springer International Publishing, pp. 167–77.
A18	Klötzer, C. & Pflaum, A. 2017. "Toward the Development of a Maturity Model for Digitalisation within the Manufacturing Industry Supply Chain," in <i>Proceedings of the 50th Hawaii International Conference on System Sciences (2017)</i> , pp. 4210–9.
A19	Nilsson, A. & Clausen, P. 2019. "Digital Maturity: Transitioning from Analogue to Digital Shop Floor Management Board Meetings," in <i>2019 First International Conference on Digital Data Processing (DDP)</i> , IEEE, pp. 104–11.
A20	Pulkkinen, A., Anttila, J. & Leino, S. 2019. "Assessing the maturity and benefits of digital extended enterprise," in <i>Procedia Manufacturing</i> , vol. 38, no. 2019, pp. 1417–26.
A21	Remane, G., Hanelt, A., Wiesboeck, F. & Kolbe, L. 2017. "Digital Maturity in Traditional Industries - An Exploratory Analysis," in <i>25th European Conference on Information Systems (ECIS)</i> , Guimarães, Portugal, pp. 1–16.
A22	Ryan, W.G., Fenton, A., Ahmed, W. & Scarf, P. 2020. "Recognising events 4.0: the digital maturity of events," <i>International Journal of Event and Festival Management</i> , vol. 11, no. 1, pp. 47–68.
A23	Salviotti, G., Gaur, A. & Pennarola, F. 2019. "Strategic Factors Enabling Digital Maturity: An Extended Survey," in <i>MCIS 2019 Proceedings</i> .
A24	Schumacher, A., Nemeth, T. & Sihm, W. 2019. "Roadmapping towards industrial digitalisation based on an Industry 4.0 maturity model for manufacturing enterprises," in <i>Procedia CIRP</i> , vol. 79, pp. 409–414.
A25	Schwer, K., Hitz, C., Wyss, R., Wirz, D. & Minonne, C. 2018. "Digital maturity variables and their impact on the enterprise architecture layers," <i>Problems and Perspectives in Management</i> , vol. 16, no. 4, pp. 141–154.
A26	Sjödin, D.R., Parida, V., Leksell, M. & Petrovic, A. 2018. "Smart Factory Implementation and Process Innovation," <i>Research-Technology Management</i> , vol. 61, no. 5, pp. 22–31.
A27	Sundberg, L., Gidlund, K.L. & Olsson, L. 2019. "Towards Industry 4.0? Digital Maturity of the Manufacturing Industry in a Swedish Region," in <i>2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)</i> , IEEE, pp. 731–5.
A28	Wiesner, S., Gaiardelli, P., Gritti, N. & Oberti, G. 2018. "Maturity Models for Digitalization in Manufacturing - Applicability for SMEs," in <i>IFIP Advances in Information and Communication Technology</i> , I. Moon, G.M. Lee, J. Park, D. Kiritsis & G. von Cieminski (eds), vol. 536, Cham: Springer International Publishing, pp. 81–8.

ID	Literature Paper (A# from the SLR, M# from the manual research)
A29	Zaoui, F. 2020. "A Triaxial Model for the Digital Maturity Diagnosis," <i>International Journal of Advanced Trends in Computer Science and Engineering</i> , vol. 9, no. 1, pp. 433–9.
A30	Braga Tadeu, H.F., Duarte, A.L.D.C.M., Taurion, C. & Jamil, G.L. 2019. "Digital Transformation: Digital Maturity Applied to Study Brazilian Perspective for Industry 4.0," In <i>Best Practices in Manufacturing Processes</i> . Cham: Springer, pp. 3-27
M1	Schumacher, A., Erol, S. & Sihh, W., 2016. "A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises," in <i>Procedia Cirp</i> , 52(1), pp.161-166.
M2	Leyh, C., Schäffer, T., Bley, K. & Forstehäusler, S., 2016. "Assessing the IT and software landscapes of Industry 4.0-Enterprises: the maturity model SIMMI 4.0," in <i>Information technology for management: New ideas and real solutions</i> . Springer, Cham, pp. 103-119
M3	De Carolis, A., Macchi, M., Negri, E. & Terzi, S., 2017. "Guiding manufacturing companies towards digitalisation a methodology for supporting manufacturing companies in defining their digitalisation roadmap," in <i>2017 International Conference on Engineering, Technology and Innovation (ICE/ITMC)</i> , IEEE, pp. 487-495
M4	Colli, M., Madsen, O., Berger, U., Møller, C., Wæhrens, B.V. & Bockholt, M., 2018. "Contextualising the outcome of a maturity assessment for Industry 4.0," <i>Ifac-papersonline</i> , 51(11), pp.1347-1352.
M5	Ifenthaler, D. & Egloffstein, M. 2020. "Development and Implementation of a Maturity Model of Digital Transformation," <i>TechTrends</i> , 64(2), pp. 302–309. doi: 10.1007/s11528-019-00457-4.
M6	Mittal, S., Romero, D. & Wuest, T. 2018. "Towards a Smart Manufacturing Maturity Model for SMEs (SM3E)," in <i>IFIP Advances in Information and Communication Technology</i> , Moon I., Lee G., Park J., Kiritsis D., von Cieminski G. (eds), Cham: Springer, pp. 155–163. doi: 10.1007/978-3-319-99707-0_20.

Appendix B SLR2 selected studies

ID	Literature Paper
B1	Betchoo, N. K. (2016) 'Digital transformation and its impact on human resource management: A case analysis of two unrelated businesses in the Mauritian public service', <i>2016 IEEE International Conference on Emerging Technologies and Innovative Business Practices for the Transformation of Societies, EmergiTech 2016</i> , pp. 147–152. doi: 10.1109/EmergiTech.2016.7737328.
B2	Rungi, M. (2019) 'Digitalisation: Size Doesn't Matter, Put Focus on Product-and-Service, Not on Process', <i>IEEE International Conference on Industrial Engineering and Engineering Management</i> , pp. 741–745. doi: 10.1109/IEEM44572.2019.8978749.
B3	Meng, F. and Wang, W. (2020) 'Research on the Mechanism of Digitalization to the improvement of Manufacturing Enterprises Performance Based on Mediating Effect', <i>2020 6th IEEE International Conference on Information Management, ICIM 2020</i> , pp. 122–126. doi: 10.1109/ICIM49319.2020.244683.
B4	Li, Y., Dai, J. and Cui, L. (2020) 'The impact of digital technologies on economic and environmental performance in the context of industry 4.0: A moderated mediation model', <i>International Journal of Production Economics</i> , 229(May 2019), p. 107777. doi: 10.1016/j.ijpe.2020.107777.
B5	Scott, S. V., Van Reenen, J. and Zachariadis, M. (2017) 'The long-term effect of digital innovation on bank performance: An empirical study of SWIFT adoption in financial services', <i>Research Policy</i> , 46(5), pp. 984–1004. doi: 10.1016/j.respol.2017.03.010.
B6	Zhou, Y. <i>et al.</i> (2021) 'The impact of HRM digitalisation on firm performance: investigating three-way interactions', <i>Asia Pacific Journal of Human Resources</i> , 59(1), pp. 20–43. doi: 10.1111/1744-7941.12258.
B7	Forcadell, F. J., Aracil, E. and Úbeda, F. (2020) 'The Impact of Corporate Sustainability and Digitalization on International Banks' Performance', <i>Global Policy</i> , 11(S1), pp. 18–27. doi: 10.1111/1758-5899.12761.
B8	Da Silva Freitas, J. C., Gastaud Maçada, A. C. and Brinkhues, R. A. (2017) 'Digital capabilities as key to digital business performance', <i>AMCIS 2017 - America's Conference on Information Systems: A Tradition of Innovation</i> , 2017–August(2015), pp. 1–10.
B9	Fabian, N. E. <i>et al.</i> (2021) 'The value of being different: Industry digital fashion, firm digital skills and financial performance', <i>International Conference on Information Systems, ICIS 2020 - Making Digital Inclusive: Blending the Local and the Global</i> , pp. 0–9.
B10	Chi, M., Zhao, J. and Li, Y. (2016) 'Digital Business Strategy and Firm Performance: The Mediation Effects of E-collaboration Capability', <i>Wuhan International Conference On E-Business: 2016 Proceedings</i> , 58, pp. 86–97. Available at: http://aisel.aisnet.org/whiceb2016/58 .
B11	Queiroz, M. <i>et al.</i> (2020) 'Digital Infrastructure, Business Unit Competitiveness, and Firm Performance Growth: The Moderating Effects of Business Unit IT Autonomy', <i>Proceedings of the 53rd Hawaii International Conference on System Sciences</i> , 3, pp. 5643–5652. doi: 10.24251/hicss.2020.693.
B12	Park, Y. and Saraf, N. (2016) 'Investigating the complexity of organisational digitisation and firm performance: A set-theoretic configurational approach', <i>AMCIS 2016: Surfing the IT Innovation Wave - 22nd Americas Conference on Information Systems</i> , pp. 1–10.

ID	Literature Paper
B13	Ortiz de Guinea, A. and Raymond, L. (2018) 'IT Ambidexterity Configurations for Competitive Performance: An Exploratory Study of the Digital Ecodynamics of Small and Medium-Sized Enterprises', <i>M CIS 2018 Proceedings</i> .
B14	Aasi, P. and Rusu, L. (2017) 'Facing the digitalisation challenge: Why organisational culture matters and how it influences IT governance performance', <i>Information Systems Development: Advances in Methods, Tools and Management - Proceedings of the 26th International Conference on Information Systems Development, ISD 2017</i> .
B15	Nwankpa, J. K. and Roumani, Y. (2016) 'IT capability and digital transformation: A firm performance perspective', <i>2016 International Conference on Information Systems, ICIS 2016</i> , pp. 1–16.
B16	Beutel, S. (2018) 'The relationship between digital orientation and firm performance', <i>International Conference on Information Systems 2018, ICIS 2018</i> , pp. 1–9.
B17	Murawski, M. <i>et al.</i> (2018) 'How digital business strategy affects profitability: Opening the "black box" of performance', <i>Americas Conference on Information Systems 2018: Digital Disruption, AMCIS 2018</i> , (2013).
B18	Mani, D., Bharadwaj, A. and Nandakumar, A. (2016) 'Digital centricity and innovation performance', <i>International Conference on Information Systems 2016 Proceedings</i> , pp. 1–13.
B19	Leischnig, A., Woelfl, S. and Ivens, B. S. (2016) 'When does digital business strategy matter to market performance?', <i>International Conference on Information Systems 2016 Proceedings</i> , pp. 1–16.
B20	Leischnig, A. <i>et al.</i> (2017) 'From Digital Business Strategy to Market Performance: Insights into Key Concepts and Processes', <i>International Conference on Information Systems 2017 Proceedings</i> , pp. 0–16.
B21	Saldanha, T. J. V. <i>et al.</i> (2017) 'Leveraging Digitalisation of Services for Performance: Evidence from the Credit Union Industry', <i>International Conference on Information Systems 2017 Proceedings</i> , pp. 0–19.
B22	Guzmán-Ortiz, C. V. <i>et al.</i> (2020) 'Impact of digital transformation on the individual job performance of insurance companies in peru', <i>International Journal of Data and Network Science</i> , 4(4), pp. 337–346. doi: 10.5267/j.ijdns.2020.9.005.
B23	Chinakidzwa, M. and Phiri, M. (2020) 'Impact of digital marketing capabilities on market performance of small to medium enterprise agro-processors in Harare, Zimbabwe', <i>Business: Theory and Practice</i> , 21(2), pp. 746–757. doi: 10.3846/btp.2020.12149.
B24	Wardaya, A. <i>et al.</i> (2019) 'Mediating effects of digital marketing on dynamic capability and firm performance: Evidence from small and Medium-sized Enterprises (SMEs) in Indonesia', <i>International Journal of Recent Technology and Engineering</i> , 8(1C2), pp. 461–464.
B25	Buer, S. V. <i>et al.</i> (2021) 'The complementary effect of lean manufacturing and digitalisation on operational performance', <i>International Journal of Production Research</i> , 59(7), pp. 1976–1992. doi: 10.1080/00207543.2020.1790684.
B26	Mekhum, W. and Torasa, C. (2020) 'Effect of Knowledge Sharing and Digital Management to Performance on Ecotourism in Ranong Province, Thailand', <i>Research in World Economy</i> , 11(5), pp. 481–492. doi: 10.5430/rwe.v11n5p481.

ID	Literature Paper
B27	Nasiri, M. <i>et al.</i> (2020) 'Digital-related capabilities and financial performance: the mediating effect of performance measurement systems', <i>Technology Analysis and Strategic Management</i> , 32(12), pp. 1393–1406. doi: 10.1080/09537325.2020.1772966.
B28	Jabr, W. and Zheng, Z. (2020) 'Exploring firm strategy using financial reports: performance impact of inward and outward relatedness with digitisation', <i>European Journal of Information Systems</i> , 00(00), pp. 1–21. doi: 10.1080/0960085X.2020.1829511.
B29	Abou-foul, M., Ruiz-Alba, J. L. and Soares, A. (2020) 'The impact of digitalisation and servitisation on the financial performance of a firm: an empirical analysis', <i>Production Planning and Control</i> , 7287. doi: 10.1080/09537287.2020.1780508.
B30	Patrucco, A. S., Agasisti, T. and Glas, A. H. (2020) 'Structuring Public Procurement in Local Governments: The Effect of Centralization, Standardization and Digitalization on Performance', <i>Public Performance and Management Review</i> . doi: 10.1080/15309576.2020.1851267.

Appendix C SLR2 PIs Analysis

The link provided below allow access to the data extracted and synthesised conducting the second SLR as reported in (Alsufyani and Gill, 2022)

- https://studentutsedu-my.sharepoint.com/:x/g/personal/nujud_alsufyani_student_uts_edu_au/ESnV4srxrq4lCq8K6tP2a6WABS-UkDYtiv5KudB5niMIVA?e=3tleUd

Appendix D Ethical approval

From: research.ethics@uts.edu.au <research.ethics@uts.edu.au>

Sent: 20 September 2021 22:05

To: Asif Gill <Asif.Gill@uts.edu.au>; Nujud Alsufyani <Nujud.Alsufyani@student.uts.edu.au>

Subject: Your ethics application has been approved as low risk - ETH21-6500

Dear Applicant,

Re: ETH21-6500 - "Digital Transformation: A Framework to Assess the Digital Enterprise Architecture Maturity and Performance"

Your local research office has reviewed your application and agreed that it now meets the requirements of the National Statement on Ethical Conduct in Human Research (2007) and has been approved on that basis. You are therefore authorised to commence activities as outlined in your application, subject to any conditions detailed in this document.

You are reminded that this letter constitutes ethics approval only. This research project must also be undertaken in accordance with all UTS policies and guidelines including the Research Management Policy.

Your approval number is UTS HREC REF NO. ETH21-6500

Approval will be for a period of five (5) years from the date of this correspondence subject to the submission of annual progress reports.

The following standard conditions apply to your approval:

- Your approval number must be included in all participant material and advertisements. Any advertisements on Staff Connect without an approval number will be removed.
- The Principal Investigator will immediately report anything that might warrant review of ethical approval of the project to the Ethics Secretariat.
- The Principal Investigator will notify the Committee of any event that requires a modification to the protocol or other project documents, and submit any required amendments prior to implementation. Instructions on how to submit an amendment application can be found [here](#).
- The Principal Investigator will promptly report adverse events to the Ethics Secretariat. An adverse event is any event (anticipated or otherwise) that has a negative impact on participants, researchers or the reputation of the University. Adverse events can also include privacy breaches, loss of data and damage to property.
- The Principal Investigator will report to the UTS HREC or UTS MREC annually and notify the Committee when the project is completed at all sites. The Principal Investigator will notify the Committee of any plan to extend the duration of the project past the approval period listed above.
- The Principal Investigator will obtain any additional approvals or authorisations as required (e.g. from other ethics committees, collaborating institutions, supporting organisations).
- The Principal Investigator will notify the Committee of his or her inability to continue as Principal Investigator including the name of and contact information for a replacement.

This research must be undertaken in compliance with the Australian Code for the Responsible Conduct of Research and National Statement on Ethical Conduct in Human Research.

You should consider this your official letter of approval.

If you have any queries about this approval, or require any amendments to your approval in future, please do not hesitate to contact your local research office or the Ethics Secretariat.

Ref: 12a

From: research.ethics@uts.edu.au <research.ethics@uts.edu.au>

Sent: 27 June 2023 12:08

To: Research Ethics <research.ethics@uts.edu.au>; Nujud Alsufyani <Nujud.Alsufyani@student.uts.edu.au>; Asif Gill <Asif.Gill@uts.edu.au>

Cc: Peter Zhao <Hua.Zhao@uts.edu.au>; James Tan <James.Tan@uts.edu.au>; Lisa Merry <Lisa.Merry@uts.edu.au>; May Aung Su <May.AungSu@uts.edu.au>

Subject: Your ethics application has been approved as low risk - ETH23-8374

Dear Applicant,

Re: UTS HREC Ref. No. ETH23-8374 - "Digital Transformation: A Framework to Assess the Digital Enterprise Architecture Maturity and Performance"

Your local research office has reviewed the amendment application for your above-named project and agreed that the amendments meet the requirements of the National Statement on Ethical Conduct In Human Research (2007). I am pleased to inform you that your amendment has been approved as follows:

I want to include participants from outside Australia, including countries that scored >50 on the Corruption Perception Index (CPI), such as the US, UK and Europe.

This amendment is subject to the standard conditions outlined in your original letter of approval.

You are reminded that this letter constitutes ethics approval only. This research project must also be undertaken in accordance with all UTS policies and guidelines including the Research Management Policy.

You should consider this your official letter of approval. If you require a hardcopy please contact your local research office.

To access this application, please click [here](#). A copy of your application has also been attached to this email.

If you have any queries about this approval, or require any amendments to your approval in the future, please do not hesitate to contact your local research office or the Ethics Secretariat (Research.Ethics@uts.edu.au).

Ref: 12e

Appendix E Invitation letter

Digital Enterprise Architecture Maturity and Performance Assessment (DEAMP) Framework

(UTS HREC REF NO. ETH21-5790)

Dear participant,

My name is Nujud Alsufyani, and I am a student at the school of Computer science/ FEIT at the University of Technology Sydney.

You are invited to participate in a survey questionnaire research in the area of digital maturity, organisational performance and enterprise architecture (EA). I would greatly appreciate your participation in reviewing and evaluating the developed framework because of your outstanding experience in digital transformation, business architecture, and EA. The online survey should take no more than 60-90 minutes of your time. This timeframe includes reading the framework's description and answering the online survey. However, you can leave the survey and re-enter to complete it later.

This research is supported as a scholarship by Taif University/Saudi Arabia as a part of academic career requirements to pursue a PhD in Information Systems at the University of Technology Sydney.

If you are interested in participating, you can access the online survey:

https://utsau.au1.qualtrics.com/jfe/form/SV_06QLAlw59vYFmzc

Submission of the online questionnaire is an indication of your consent.

****You are under no obligation to participate in this research. If you decide to participate, the responses will be treated confidentially. The data will be stored in UTS systems as per UTS research data management policy. Only my supervisor and I have access to data via UTS secure login. The collected anonymous data from your response to the online survey form will not identify you in any way and will only be used for the purpose of this research project (thesis) and papers publications (conference and journal).**

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact us at Nujud Alsufyani (researcher): Nujud.Alsufyani@student.uts.edu.au, Associate Professor Asif Q. Gill (supervisor): Asif.Gill@uts.edu.au.

Yours sincerely,

Nujud Alsufyani

School of Computer Science

University of Technology Sydney

Ultimo NSW 2007, Australia

NOTE: This study has been approved by the University of Technology, Sydney Human Research Ethics Committee. If you have any complaints or reservations about any aspect of your participation in this research that you cannot resolve with the researcher, you may contact the Ethics Committee through the Research Ethics Officer (ph: +61 2 9514 2478 Research.Ethics@uts.edu.au) and quote the UTS HREC reference number. Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.

Appendix F Online survey information sheet

ETH21-5790 - Digital Enterprise Architecture Maturity and Performance Assessment Framework

WHO IS CONDUCTING THIS RESEARCH?

My name is Nujud Alsufyani, and I am a student at the School of Computer Science/ FEIT at UTS. My supervisor is A/Prof Asif Q. Gill

WHAT IS THE RESEARCH ABOUT?

The purpose of this research/online survey is to design a digital enterprise architecture maturity and performance assessment framework. The framework aims to assess the digital maturity and performance assessment across different layers of enterprise architecture.

WHY HAVE I BEEN INVITED?

You have been invited to participate because of your distinguished experience in digital transformation, digital maturity models and enterprise architecture.

Your contact details were obtained from the LinkedIn professional network for the supervisor, industry and academic conference of digital transformation, and white paper and journal articles of digital transformation, digital maturity models and enterprise architecture.

FUNDING

This research is supported as a scholarship by Taif University/ Kingdom of Saudi Arabia as a part of academic career requirements to pursue a PhD in Information technology at the University of Technology Sydney. This research will be conducted as a part of a phd program at University of Technology Sydney.

WHAT DOES MY PARTICIPATION INVOLVE?

Participation in this study is voluntary. It is entirely up to you whether or not you decide to take part.

If you decide to participate, I will invite you to kindly participate in evaluating my research outcome using the online survey method. The survey includes a set of questionnaires designed to evaluate the developed framework (DEAMP framework).

Further information:

- The survey questionnaire may require 60 to 90 minutes. This timeframe includes reading the proposed framework, listening to recorded information about the proposed framework, as well as answering the online survey.
- Participants' responses should be received within 2-3 weeks from the date of sending the invitation email.
- Participants may ask for clarification before providing their response to the survey questions.
- Participants may use the propose framework for their own real or assumed test scenario based on their exprince before providing their response to the survey questions.
- A follow-up reminder will be sent to the potential participants in the second week.
- No travelling or payments are required.
- The surveys will be conducted online. Upon completion, the data will be sent back to me.
- The data will not include any information that may identify you in any way. No personal data will be collected; the data collected via survey is technical and completely anonymous.
- The data will be stored in UTS systems. Only my supervisor and I have access to the stored data.
- The collected technical/anonymous data will be used for publications of conference papers, journal papers and the research thesis.

You can change your mind at any time and stop completing the survey/s without consequences.

ARE THERE ANY RISKS/INCONVENIENCES?

Yes, there are some risks/inconveniences. You may encounter a potential inconvenience of contributing 1-1.5 hours to the study. However, you can save the survey and complete it later. Furthermore, your participation is voluntary, and you can withdraw your participation anytime.

WHAT WILL HAPPEN TO INFORMATION ABOUT ME?

Access to the online questionnaire is via

https://utsau.au1.qualtrics.com/jfe/form/SV_080pkDZcilMtDv0

Submission of the online questionnaire/s is an indication of your consent.

It is anticipated that the results of this research project will be published and/or presented in a variety of forums. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, except with your permission. The responses will be treated confidentially. The data will be stored in UTS systems as per UTS research data management policy. Only my supervisor and I have access to data via UTS secure login. The collected anonymous data from your response to the online survey form will not identify you in any way and will only be used for the purpose of this research project (thesis) and papers publications (conference and journal).

In accordance with relevant Australian and/or NSW Privacy laws, you have the right to request access to the information about you that is collected and stored by the research team. You also have the right to request that any information with which you disagree be corrected. Please inform the research team member named at the end of this document if you would like to access your information.

The results of this research may also be shared through open access (public) scientific databases, including internet databases. This will enable other researchers to use the data to investigate other important research questions. Results shared in this way will always be de-identified by removing all personal information (e.g. your name, address, date of birth etc.).

WHAT IF I HAVE ANY QUERIES OR CONCERNS?

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact us Nujud Alsufyani (researcher): Nujud.Alsufyani@student.uts.edu.au, Associate Professor Asif Q. Gill (supervisor): Asif.Gill@uts.edu.au

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 9772 or Research.ethics@uts.edu.au and quote this number ETH21-5790

Appendix G Online field survey questionnaire

Digital Enterprise Architecture Maturity and Performance (DEAMP) Framework

As organisations have been fast-tracking digital transformation, many face uncertainties around the impact of digitalisation on performance which challenges leaders on whether to initiate those transformations to maintain growth and profitability. Thus, organisations need guidance to assess the current digital maturity to make evidence-based decisions and explore feasible options by performance metric approaches as they move toward digital transformation. DEAMP framework (Digital Enterprise Architecture Maturity and Performance) is designed to enable organisations to assess the digital maturity level and related performance indicators (PIs) of the current and target state of the enterprise architecture (EA) design to utilise data and information to help decision-makers identify actions toward improving digital maturity for performance gains. It will allow them to design for future state outcomes and leverage the best possible fit for their intended performance goals.

The DEAMP framework is assessment guidance composed of 4 main components. The main purpose of this survey questionnaire is to determine to what extent each component of the DEAMP framework is relevant and sufficient to achieve its purpose. It is intended to get your valuable opinion and feedback about each of those components.

Please refer to the DEAMP description and the framework questions in the next sections for further details about the framework.

Scope: The scope of the DEAMP framework is to utilise data and information to help decision-makers to improve digital maturity for desired performance with actions and roadmaps.

Assessment Criteria: DEAMP framework components are assessed based on: Generalisability, Understandability, Applicability and Comprehensiveness.

Glossary of terms:

DEAMP: Digital Enterprise Architecture Maturity and Performance

EA: Enterprise Architecture

PIs: Performance indicators

Survey Rating Factor:

Score	Rating	Description
5	Strongly Agree	Complete agreement
4	Agree	General agreement
3	Somewhat Agree - Average	Average/Natural
2	Disagree	General disagreement
1	Strongly disagree	Complete disagreement

Demographic Questions:

Which of the following best describes your area of experience?

- Digital Transformation
- Business Architecture
- Strategy, Planning & Roadmaps
- Enterprise Architecture
- Other

Please specify your area of experience: _____

Which of the following is your years of experience?

- Less than 5 years
- Between 5 and 10 years
- More than 10 years

DEAMP Framework Description:

DEAMP framework is an enterprise architecture-driven approach (based on Adaptive EA layers, by Gill 2015 - 2022) to link digital maturity and performance assessment across different layers of the EA to define actions that can be monitored and tracked by benefits tracking. The use of EA layers provides a systematic layered approach and elements for designing and evolving digitally-enabled enterprises. These EA layers provide a holistic illustration of the organisation's architecture design which are Interaction, Human, Technology, Environment, Facility, and Security layer. Thus, this framework can be used mainly to help decision-makers make well-informed decisions by utilising data and information to guide the improvement of digital maturity for desired performance across EA layers.

This framework is composed of 4 main components as follows: (As reported in a published study by Alsufyani & Gill 2023)

1. Performance Model
2. Digital Maturity Model
3. Actions Model
4. Benefit Model

** The following 4 sections describe each component and its relevant question to evaluate each framework component separately. Lastly, the 5th section is to evaluate the overall DEAMP framework.

1. Performance Model

The first component of the DEAMP framework is the performance model, which enables organisations to assess performance outcomes across different EA layers. The aim is to capture each EA layer's current and target performance outcomes and its underpinning elements, thereby identifying performance gaps and aligning them with related goals and objectives. This assessment is facilitated by utilising 51 PIs grouped into six dimensions: Competitiveness, Financial, Quality, Flexibility, Resource Utilization, and Innovation (refer to the figure above and table below). These PIs, as outlined in a study by Alsufyani & Gill (2022), can be tailored to fit the specific needs of an organisation and its goals depending on the layer and/or its underpinning elements being evaluated.

Please refer to the description, figure and table above to answer the following questions:

Generalisibility: Is the Performance Model generic enough to support different contexts or organisations to assess performance outcomes across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Understandability: Are the Performance Model and its components easy to understand?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Applicability: Can the Performance Model be used to assess the current and target performance outcomes across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the Performance Model provides enough components (refer to the figure above) to assess the current and target performance outcomes across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the 51 performance indicators (refer to the table above) provide enough indicators for assessing current and target performance across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Do you suggest any modifications or improvements to the model and its indicators including addition and deletion or any additional feedback? If so, please also give the reasons:.....

2. Digital Maturity Model

The second DEAMP framework component is the digital maturity model. The digital maturity model enables organisations to assess the level of digital maturity across EA layers. Digital maturity measures the extent to which each EA layer and its underlying elements have successfully leveraged digital technologies/practices/innovations to effectively achieve their objectives and resolve their pain points. The aim is to capture the current and target digital maturity levels for each EA layer and its underpinning elements, thereby identifying digital maturity gaps with the consideration of related pain points.

The digital maturity levels can be captured by 6 levels of digital maturity as follow (based on Alsufyani & Gill 2021):

- Level 0: None - Absence of digitalisation or basic digitisation
- Level 1: Beginner - Digitally aware or ad-hoc digitalisation
- Level 2: Learner - Adopting digital practices
- Level 3: Intermediate - Consistent, defined, integrated and digitally enabled
- Level 4: Advanced - Completely developed, predictable and proactive
- Level 5: Expert - Innovative, data-driven and adaptable

The digital maturity levels serve as a normative outline that organisations can adapt to their specific context, tailoring their own definitions of digital maturity based on their maturity levels. It is important to note here that one may only focus on a specific EA layer or layers when using the DM levels as appropriate for the scope of their maturity assessment project (e.g. the human layer) and underpinning elements (e.g. business capability). These levels can be summarised in the table below.

Please refer to the description and figure above to answer the following questions:

Generalisability: Is the Digital Maturity Model generic enough to support different contexts or organisations to assess digital maturity across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Understandability: Are the Digital Maturity Model and its components easy to understand?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Applicability: Can the Digital Maturity Model be used to assess current and target digital maturity across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the Digital Maturity Model provides enough components (refer to the figure above) to assess the current and target Digital Maturity levels across EA layers?

- Strongly Agree
- Agree

- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the six digital maturity levels (refer to the description) provide enough levels for assessing current and target digital maturity levels across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Do you suggest any modifications or improvements to the model and levels including addition and deletion or any additional feedback? If so, please also give the reasons:.....

3. Actions Model

The third component of the DEAMP framework is the actions model. Once the current and target digital maturity levels and performance outcomes are determined, these insights can guide the identification of actions that will bridge the gaps in integrated performance and digital maturity. These actions are aimed at improving digital maturity to enhance performance across the EA layers. These actions can be included in a roadmap providing a strategic plan for achieving the target digital maturity and performance outcomes. The roadmap outlines a sequence of actions based on identified timelines, dependencies, and priorities.

Please refer to the description and figure above to answer the following questions:

Generalisability: Is the Actions Model suitable for different contexts or organisations to identify actions and define roadmaps to improve maturity for desired performance across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Understandability: Are the Actions Model and its components (refer to the figure above) easy to understand?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Applicability: Can the integrated digital maturity and performance models be used to identify actions and define roadmaps to improve maturity for desired performance across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the integrated digital maturity and performance models provide enough components (refer to the figure above) to identify actions and define roadmaps to improve maturity for desired performance across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Do you suggest any modifications or improvements, including addition and deletion or any additional feedback? If so, please also give the reasons:.....

4. Benefits Model

The fourth component of the DEAMP framework is the benefits model. This component is implemented during the project's implementation phase to monitor the actual digital maturity and performance achieved as a result of the actions taken. The benefits model tracks the resolution of pain points and the achievement of goals and objectives, aligning them with the desired target maturity levels and performance outcomes. It serves as a means to measure and evaluate the effectiveness of the implemented actions and their impact on digital maturity and performance.

Please refer to the description and figure above to answer the following questions:

Generalisibility: Is the Benefits Model generic enough to support different contexts to monitor the actual digital maturity and performance outcomes as a result of roadmap actions?

- Strongly Agree
- Agree Somewhat Agree - Average
- Disagree
- Strongly disagree

Understandability: Are the Benefits Model and its components easy to understand?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Applicability: Can Benefits Model be used to monitor the actual digital maturity and performance outcomes as a result of roadmap actions?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the Benefits Model provides enough components (refer to the figure above) for monitoring the actual digital maturity and performance outcomes as a result of roadmap actions?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Do you suggest any modifications or improvements, including addition and deletion or any additional feedback? If so, please also give the reasons:.....

5. Overall Assessment

In this section, you can view the overall DEAMP framework that integrates the 4 models: performance, digital maturity, actions, and benefits models across various layers of the EA. This framework is designed to establish a link between digital maturity and performance assessment, enabling the identification of necessary actions and the development of roadmaps. These roadmaps can be monitored and tracked through benefits tracking across different EA layers. Ultimately, the DEAMP framework provides decision-makers with valuable insights to make informed decisions and guide the enhancement of digital maturity for desired performance across the EA layers.

Please refer to the description and figure above to answer the following questions:

Generalisibility: Is the DEAMP framework generic enough to support different contexts or organisations to integrate digital maturity and performance assessment across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Understandability:

Are the DEAMP framework and its components easy to understand?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Applicability: Can the DEAMP framework and its components be used to guide the improvement of maturity for desired performance across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Comprehensiveness: Do you agree that the overall DEAMP framework contains the necessary elements (refer to the figure above) to assess and improve maturity and performance across EA layers?

- Strongly Agree
- Agree
- Somewhat Agree - Average
- Disagree
- Strongly disagree

Do you suggest any modifications or improvements, including addition and deletion or any additional feedback? If so, please also give the reasons:.....

Submission of this online questionnaire is an indication of your consent.

**If you have any questions about the questionnaire, please feel free to contact Nujud Alsufyani (researcher):
Nujud.Alsufyani@student.uts.edu.au

Appendix H Research data

The links provided below allow access to the data used in this thesis, encompassing the online expert survey and the processed survey results. In line with UTS research data management policy, the raw data has been securely stored in UTS systems. Access to these data files is restricted to the researcher and the principal supervisor, Dr. Asif Gill.

- Online expert survey

https://utsau.au1.qualtrics.com/jfe/form/SV_06QLAlw59vYFmzc

- Processed Quantitative Data from Field Survey online documents

<https://studentutsedu->

my.sharepoint.com/:x/g/personal/nujud_alsufyani_student_uts_edu_au/ETCJLRhc171Fvnwyfsulwr4BY5nW_mJWXhqxAr2HIP1ALQ?e=tUXoSO