Resistance to Adoption of an OO Software Engineering Process: An Empirical Study

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Abstract

Human Factors, the so-called Soft Issues, play a vital role in highlighting the difference between success and failure for any project where people are involved, resistance to change, both at a personal and organizational level, being one such factor. In this paper, we report the findings of two empirical studies, using Action Research (AR), that were conducted over a period of two years at a mid-size publishing organization in Sydney to investigate the effect of various human behavioural patterns during the organizational transition to Object Technology (OT). This investigation was carried out to validate our theory that the appropriate planning and managing of the human factors during an organizational change may eliminate/mitigate people's natural resistance to change and increase the chance of success. Here we focus on the resistance factor. Observations show that human factors such as resistance to change contributed to the first project's relative failure whereas acceptance of change (managing resistance) contributed to the second project's success. These case studies support the argument that both careful planning and management of specific human factors can positively impact the entire organizational transition process.

Keywords: Human Factors, Organizational Change, Resistance to Change, Process Adoption, Organizational Transition

Introduction

In software industries around the world, application development projects face serious problems, such as budget overruns, lack of programmers, insufficient software quality and schedule delay (Onoma, 1987). In order to solve these problems and ameliorate the ongoing software crisis, members of the software engineering community need to understand the work culture of their personnel and initiate any necessary changes in order to adopt and optimize the use of new approaches to developing software. This paper focuses on the human culture and, in particular, the associated resistance to change, during the entire transition process of an organization in their adoption of an object-oriented software development process/methodology.

Understanding the current state of an organization is always an obligatory starting point for a successful change (LaMarsh, 1995). During an organizational transition, different people play different rôles, such as motivators, adopters, resisters, opposers and neutral observers (Bridges, 1995). How they respond to change during a transition can, and in most cases does, dominate, thus determining the success or failure of the entire project. The unavoidable reality is that people are different and so act and react to changes differently. Indeed, from time to time, even the same person can behave in a different manner.

In this paper, we report the findings of two empirical studies (using action research: Avison *et al.*, 1999) that were conducted over a period of two years at a mid-size publishing organization in Sydney to investigate the effect of various human behavioural patterns during the organizational transition to Object Technology (OT). We focus on one of those factors: resistance to change. The organization under study was undergoing a transitioning process to an object-oriented development environment including the use of an object-oriented (OO) software development process, based on the OPEN Process Framework (OPF) (Firesmith and Henderson-Sellers, 2002) together with the UML notation (OMG, 2001). Initially, a single team had been charged with undertaking the process aimed at the adoption of an OO software development process prior to the diffusion of that technology throughout the organization. Here, we report on the adoption phase in which we were involved in two different projects with the same organization. The first project was unfortunately terminated after only five months, whereas the second project succeeded very effectively and achieved its major goals, as declared by senior management.

Analysis of our observations of the changes in the organization shows that human factors, particularly individual and collective resistance, contributed to the first project's disappointing termination and that successful management of resistance underpinned the second project's success.

In the following section, we discuss the background literature to change resistance and in Section *"Empirical results and analysis"* describe our results for the two observed cases of (a) failure due to resistance and (b) overcoming resistance leading to success.

Existence of natural resistance to change

Change is often seen as a personal threat by those involved in transition (Huse, 1975). Unfamiliarity with the new ways of working can lead to a discomfort that naturally increases people's resistance (Bridges, 1995). Consequently, people can develop a resistance to change, which itself can become the main obstacle to the whole organizational change. Resistance to change can also come from management, project leaders and customers/end users for similar reasons (Fayad and Laitinen, 1998).

Furthermore, adopting new technologies also require people to advance their skills and knowledge and/or gain new ones, as well as learning new tools and techniques – all

additional threats to the individual that strongly contribute to increasing their resistance to change.

Therefore, during any organizational change, managing an individual's resistance becomes a critical issue that must be seriously considered so as to accomplish overall satisfactory results. For that reason, organizations must be able to effectively manage people's resistance by leading and directing the change process. To do so, management must first understand what resistance really means. What do people really resist? Do they resist the new environment, new technology, or the changes they have to undertake? Finally, why do people really resist? Do they resist for psychological reasons, technological issues, personal concerns or a combination of all of these? These topics are discussed below.

What does resistance really mean?
Naturally, people want to improve and find better ways of doing things, yet at the same time can often resist that very change. People's resistance can be a result of different natural human reactions but is frequently seen by managers as a sign of laziness, stupidity or just unwillingness and stubborn opposition to change (Fayad and Laitinen, 1998). Of course, resistance may well be a sign of people's disinterest or they may consider themselves as too busy with other, more pressing, issues. Resistance could also be a signal of conflict of interest or contradictory points of view. Moreover, resistance could be a silent request for assistance, more information or an assertion of different priorities. Viewed more positively, resistance can be viewed as an opportunity to gather information and learn more about the current and desired state (Bamberger, 2002).

What do people really resist?
Naturally, people do not like to lose - people associate change with the loss of their existing comforts and, often, their skill sets and prestige within the organization. People do not resist the change itself so much as they resist the uncertainties, fear and discomforts associated with it. They often amplify the risks involved in facing the unknown (Bridges, 1995; Humphrey, 1997).

Why do people really resist?
To manage the resistance to change, it is important first to understand the various reasons behind it. Resistance could happen at an early stage of the introduction of the change and/or at a later stage, during the change process. Bamberger (2002) notes that change often meets with resistance because it is seen as a personal threat that may lead to fear of failure and rejection. Fayad and Laitinen (1998) relate resistance to the lack of a clear view of the current state and the objectives. They further note that resistance to change often exists as a result of structural conflicts within the organization. Lack of management's commitment and inconsistent actions with the impending change can also elicit resistance.

Bridges (1995) declares that when changes take place, people get angry, sad, frightened, depressed and confused. These emotional states can be mistaken for bad morale, but they rarely are. Rather, they are more likely to be a sign of grieving, the natural sequence of

emotions people go through when they lose something that matters to them. People resist the loss of recognition of the competence that they have in their old familiar tasks and that was once lauded – but no longer is.

Transition is tiring; during a change, people build resistance when they feel unfamiliar and uncomfortable with the new ways. Resistance happens when people feel that they can't use their existing old ways and, at the same time, they are not comfortable and familiar with the new ways. People resist change when they are unaware of the need to change and, accordingly, are uncertain of the final result. From a different perspective, people build resistance when they feel that the new ways they have to follow can negatively affect their productivity. For example, an inappropriate new methodology or technique can discourage people to change as it can lead to a perceived potential drop in people's productivity and hence lessen their self-esteem.

During the transition process, and when changes take place, people can develop more resistance and be less motivated for different reasons including:
- Their anxiety rises and their motivation falls.
- They are afraid of failing.
- They are unsure of the new way.
- They are afraid that they may be blamed if something goes wrong.
- They try to avoid learning new things.
- They become self-protective.
- They respond slowly and want to go back to the "old way".
- They doubt the benefits of the new way.
- They feel panic and confusion.

Defeating people's resistance to change
Lawrence (1969) suggests that resistance to change should not be treated as a problem, but rather as an expected symptom and an opportunity, or a request, for learning and better knowing the unknown. Also, Senge (1990) suggests that resistance to change, generally, has a real basis that must be understood in order for it to be dealt with.

Bridges (1995) reported that most managers and leaders put only 10% of their energy into selling the problem, but 90% into selling the solution to the problem. His concern is that more effort is needed to "sell" the problem leading to the recommendation for change (Humphrey, 1995). Management can't change people, they have to change themselves and they only change when they have the appropriate and supportive environment (Boyett and Boyett, 2000).

Anxiety is natural and the best way to defeat it is to educate and train people within their new environment. This can easily eliminate the fear of the unknown, the uncertainties about the final result and, thus, lead to the elimination of people's resistance.

One of the most effective ingredients in defeating people's resistance to change is to encourage them at an early stage to participate in the planning for the transition. Huse

(1975) confirms this fact by assuring that people – during transition – see change as a threat unless they have participated in its planning. Lawrence (1969) has demonstrated this through a case study of two factory groups. In this study, an identical change was introduced to the two groups: the first group were not offered any explanation and resisted all management's efforts, whereas the second group were involved in the change planning and carried out their transition with minimal resistance and their initial small productivity drop was rapidly recovered.

Managing resistance with small wins
Humphrey (1995) claims that people's resistance to change is proportional to its magnitude. Therefore, resistance can be managed and so reduced by planning a number of small changes instead of a single, large change. For example and in the context of this research, transitioning an organization to an OO environment and adopting a software development process involves many modifications to work practices e.g. psychological, organizational and technological changes that can be planned in an incremental manner or, as we have called it, *"small wins"* (Serour *et al.,* 2002). By introducing the new changes in small increments, each increment will be easy to sell and implement. People will feel confident and positive every time they successfully achieve one increment and become even more enthusiastic and motivated to implement the next increment. This technique can lead to a smooth transition by enhancing people's willingness to participate and reducing their overall resistance.

Empirical study using Action Research

For this study, Action Research was chosen since it aims to contribute both to the practical concerns of people in an immediate problematic situation, and to the goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport, 1970). There was a need for a research method where the authors could work with real organizations in real life business situations, using real projects to test and gain a solid substantiation for the hypothesis that appropriate planning and managing of the human factors during an organizational change may eliminate/mitigate people's natural resistance to change and increase the chance of success.

During the two case studies, AR focused on the collaboration and mutual interest between the authors who were aiming to test their hypothesis and practitioners who were aiming to solve their immediate problem. AR played an effective role in solving the practical problem by increasing the understanding of the given social situation concerning people's resistance to change through the direct involvement of the authors in the organizational change. Due to the fact that AR has dual aims of providing a mechanism for practical problem solving (Action) and for generating and testing theory (Research), we have achieved action and research simultaneously.

First project and resistance to change
In the study organization, during the first case study, some members of the development teams showed resistance to changing their essentially ad-hoc software development process (i.e. no formal process). During one of the early transition meetings with

development teams regarding the introduction of an object-oriented environment and the rôle of a formal OO software development process/methodology, the project leader for the on-line team, opposed the change by saying, *"Following a process is an academic thing and is not suitable for practice. I am not interested in the whole transition process because I am the project leader for on-line production and following a process will definitely slow us down. Due to the nature of our applications, we have to work fast and deliver at least once a week. How can we simply follow a process?"*

From the above comment, and from the analysis of a further discussion with other project leaders, it was quite clear that people's resistance resulted from their serious lack of understanding of the reasons behind the proposed change. IT personnel were not involved in the initial stage of the transition planning and were asked to change their work culture without a full explanation as to why this was necessary. Management invested a great deal of time in selling the solution to its people with minimal effort to sell the problem itself (as noted above). The resistance from the on-line team came as a way of self-protection and from a fear of failure.

Then, a developer from the same team said, *"The process is good for the people working with the value-added system and it is their process, we really don't have anything to do with it"*. Again, the above comment resulted from a lack of proper education regarding the flexibility and the customisability of a formal OO methodology to suit different projects. The resistance came in the form of escaping the adoption, as if it was not appropriate for the on-line projects. The comment reflects the developer's uncertainties of the effective rôle of such a methodology including doubting the final result.

During another meeting, one of the system architects tried to protect their existing work culture by saying, *"Using a process is not the way I do my work; it has nothing to attract me"*. This was another form of resistance as a result of the poor introduction of the new technology to everyone. Here, people doubted the applicability and the suitability of an OO process for developing their software applications. Furthermore, due to their lack of OT knowledge and awareness, developers could not see anything to attract them to start to follow a formal methodology.

During another meeting between the transition team and developers to discuss and explore the OO process and its work products, a system analyst declared that, *"No one in my section likes doing documentation; can we follow the process without documentation?"* This sort of resistance to replacing the existing ad-hoc process with a formal one resulted from a lack of understanding of the importance of the various work products. It was also an attempt by developers to stick to their existing way with which they felt comfortable. Following a process without documentation was an attempt to resist the necessary culture change to comply with the new OO work environment.

Another interesting quote came from a programmer, when she said, *"The process doesn't have what I want, maybe it is me; I really don't know much about software development process"*. This was an interesting statement owing to the fact that she not only demonstrated her resistance to following a formal process, but also stated the reason for

her resistance - lack of knowledge coupled with improper and very limited education provided to the developers and project managers on the subject of software development process.

Another meeting was conducted between the transition team and project leaders and managers to discuss the issue of project management support offered by OT. A project leader opposed the change very strongly by saying, *"The most important process component is project management and we do have a complete project management methodology in practice. Do we have to waste our time learning a new technique?"* From further discussion with other managers, it was clear that they resisted the new technology for two reasons. First, there was no proper assessment to explore the weaknesses and strengths of their existing project management methodology. Second, there was no proper investigation or analysis of the available project management support offered by OO methodologies.

In general, there was no clear understanding of the existing work environment in comparison with the new technology. Consequently, IT personnel couldn't see any value in changing their existing methodology nor in identifying a compelling reason for undertaking the change. They focussed on the technology itself rather than its contextual use in delivering a product.

Throughout the introduction of the OO process, with discussions of the unique Incremental, Iterative and Parallel (IIP) characteristics of any OO software development process, a project leader said, *"We don't waste time; we code our programs quick and then fix them when they are broken. Management doesn't give us enough time to model our software before coding. How can we keep all those different diagrams in sync? It is not easy".* This was a clear message from IT personnel that they are overloaded with their current projects and do not have enough time to manage their transition. Owing to the lack of resources, management put pressure on developers for fast delivery with a compromise on quality (*"quick and dirty"*).

In summary, and based on the above analysis, the development and management teams of the study organization have shown a considerable degree of resistance as a result of one, or a combination, of the following reasons:
- Improper planning and management of the transition process.
- Inadequate and inappropriate introduction of Object Technology.
- Misunderstanding of the rôle of a formal software engineering process/methodology in software development.
- Lack of formal education and training to IT technical staff.
- Lack of management support and commitment.
- Lack of time to understand and comprehend the new way of developing software since every team member was overloaded with his or her current projects.
- Lack of management and technical staff commitment to the transition.
- Lack of resources, such as time, funds, education and publications, to support the introduction of the new technology.

Second project: defeating resistance

With the second case study, and in order to defeat people's resistance to change, management showed more commitment and dedication and provided more support to the transition project. IT personnel were significantly involved in the planning stage, which resulted in enhancing their willingness to positively participate in the transition. The following decisions were made during the transition planning activity to better understand the existing work environment to professionally introduce the new OO work environment:

- Conduct a formal assessment of the existing work culture.
- Provide IT personnel with full explanations of the compelling reasons for the necessary transition and culture change.
- Introduce Object Technology in a professional and formal way to everyone involved and at different levels (senior management, middle management, technical staff and customer/end users).
- Create or adopt a specific software development process/methodology that best suits the organizational environment and do so in an incremental manner (start simple and augment it later as more knowledge and skills are acquired).
- Provide people with the required time and resources to understand and comprehend the new technology.
- Plan for enhancing and upgrading people's OO knowledge and skills.
- Use outside expertise and consultants to provide adequate and professional education and training, and other specialised services.
- Eliminate most of the communication channels between management and technical staff to speed up and ease the transition process.
- Form a special team to promote and support the transition project within the whole organization.

Members of the transition team were carefully selected with expertise in related fields such as Object Technology, software development process, process engineering and change management. Senior management gave the transition team their full support with adequate resources to ensure they would be technically and politically capable of "*selling*" the transition project to everyone.

Through the formal introduction of deploying an OO software development process in practice, it was explained to IT personnel in a simple and clear manner that the main rôle of such a process is to be used as a road map to provide them with the best direction (Unhelkar and Mamdapur, 1995), rather than a recipe book that they have to follow step by step. This useful advice gave everyone the feeling of self-confidence and ability to follow the new process with less fear. It also helped them to feel more comfortable and familiar with the new work environment.

Management emphasised their intention and commitment to replacing their existing ad-hoc process with a formal one in order to improve and ensure the quality of their software products. They also delivered a clear message to everyone that their new process is

neither to measure people's productivity nor to track their performance. Rather, the deployment of a formal process with associated tools, such as a drawing tool supporting UML, could be a good communication tool between development teams, management and end users. Furthermore, management assured all IT personnel that the process is an organizational property and doesn't belong to any individual or a group of individuals within the organization; rather, it is owned by everyone. This feeling of joint ownership considerably helped management to eliminate people's resistance to change.

Signs of rapid acceptance

After the professional introduction of Object Technology, the OO software development process and project management that were given to developers and project managers over a number of sessions, IT personnel have shown a great deal of interest in changing their work culture and adopting OT. On conclusion of the comprehensive UML course designed specifically to best fit the work environment of our study organization, IT personnel demonstrated their understanding of their new work culture. This was shown through their interesting discussion with the trainer and also with the members of the transition team regarding the new technology.

A number of developers kept in contact with the course trainer by phone and emails to discuss further issues. This can be taken as a positive sign that people's resistance to change was almost eliminated and that they were now enthusiastic and willing to participate and support their transition to the new software development environment with no fear and less uncertainty. In addition, management decided to conduct a formal evaluation of the contemporary OO software development processes/methodologies to choose the most appropriate one to be adopted by their people. Management insisted, and encouraged everyone, to participate in that assessment whether by attending the assessment sessions or by providing suggestions and feedback. This was a wise decision by management that gave everyone the impression that they are sharing decision-making regarding their transition. Moreover, giving IT personnel the opportunity to participate in making decisions and act as an agent has increased their participation and commitment and also reduced their resistance to change. Sherwin (1975) explained this human behaviour when he said "*Change is great when you are its agent; it is only bad when you are its object*".

As a result of the process evaluation, management and development teams decided to adopt the OPEN Process Framework (Firesmith and Henderson-Sellers, 2002) to engineer their own process using a method engineering approach. One of the major reasons for choosing OPF was due to its unique characteristics of tailorability and flexibility. These features allow IT people within our study organization to create their own process in an incremental manner following the concept of "*small wins*" (Serour *et al.*, 2002). Following such an incremental approach to build their own process in a number of increments helped IT professionals to get familiar and comfortable with the new OO process. This again resulted in enhancing their capabilities and also in reducing their total resistance to change.

As a positive sign of acceptance, during one of the process review sessions, a developer from the on-line team revealed his change of attitude and behaviour towards the change by saying: *Process is a good communication tool for the whole IT department; otherwise we will keep updating our software based on phone calls and sticky notes*. This comment came as a result of the effective education and training that were adequately and appropriately provided to IT personnel. The same person, who could not see any value in following a formal process during the first project, now confirms the important rôle of a process in software development. This not only demonstrated people's acceptance but also illustrated their understanding of the weaknesses of their existing work culture, leading to a widespread understanding of the need for a change in their culture and for adoption of a new technology.

Management made another effective decision by commissioning the task of an evaluation of CASE (drawing) tools and their vendors by a professional consultant. Later on, and based on the consultant's report, IT personnel jointly decided to acquire the "TogetherSoft" CASE tool as it was agreed on by everyone. It was a convincing decision made after achieving a consensus from all people within the organization. Following that decision, management, in consultation with the transition team, decided to provide developers and modellers with professional hands-on training on the selected tool. An agreement was reached with the tool vendor to provide the training at the most appropriate time that was convenient to everyone.

Following the successful training sessions on the selected CASE tool, a few notable comments came from some members of the development team. Some of those comments are:

A developer emphasised the benefits of training by saying:
"I could not see any benefits of following a process and using CASE tool before. Maybe it was because of my lack of knowledge. Now and after all the training we been through, I can see the benefits of following a formal process and using a supportive CASE tool. They are good; I can't wait to try them on my real projects"

Another developer highlighted the imperative rôle of CASE tool in software development by saying,
"For future development, a CASE tool is a good investment and it can save a lot of resources, especially our time. I really like its ease of use and its support for reverse engineering"

These comments proved that IT personnel are no longer afraid to face the challenge of changing their existing work culture. The professional education and training have strongly contributed to eliminating the "*mysteries of the unknown*". It was clearly demonstrated that after IT personnel became familiar with and learned more about their new process and CASE tool, they were excited to try them and deploy them in real projects. This again empirically underlines what Humphrey (1997) declared before: "Every change involves unknowns and people are reluctant to take risks and face the unknown".

Conclusion

During the two projects that were conducted at the organization under study, it was shown that, during the first project, the lack of proper planning and management of the organizational transition led to a strong resistance from IT personnel towards the change, whereas, during the second project, understanding people's existing culture, identifying the major reasons for transition and involving people in planning and making decisions have positively eliminated people's resistance to change and enhanced their ability to carry out a successful transition.
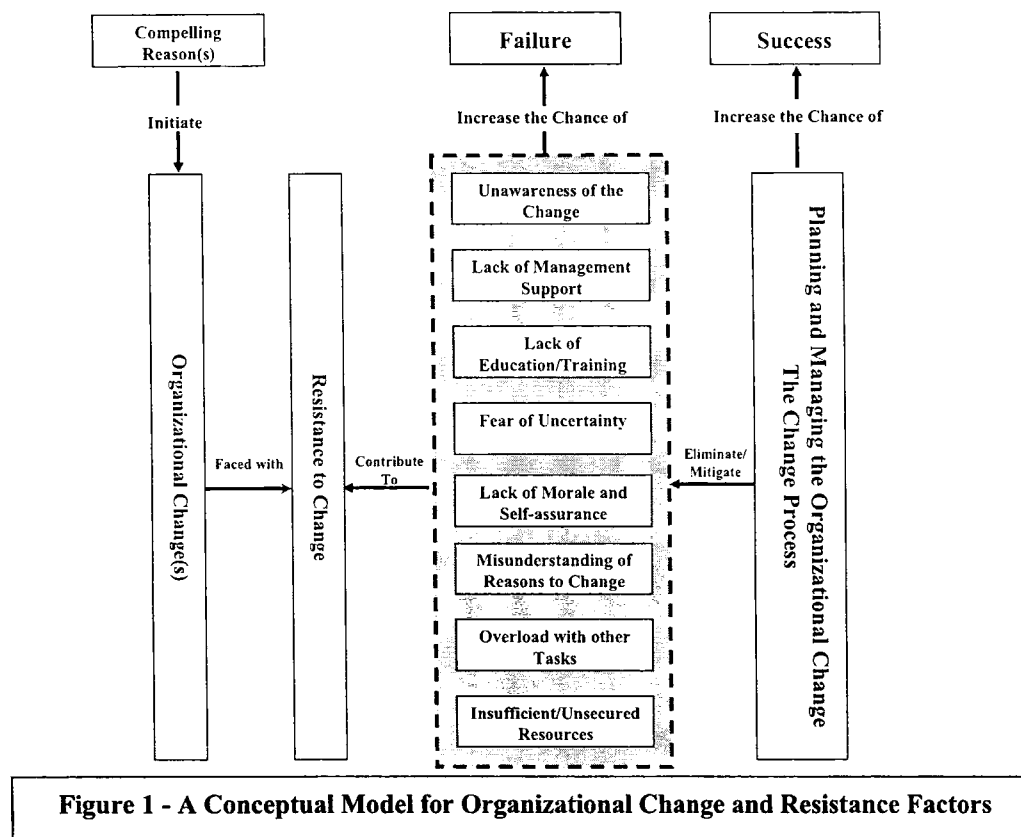

Figure 1 - A Conceptual Model for Organizational Change and Resistance Factors

Based on our empirical findings, Figure 1 illustrates a conceptual model that provides an abstract view of the two projects that were carried out at the study organization. The organizational change process was initiated by a set of compelling reasons for the study organization to remain competitive in its marketplace. The organizational change was, unsurprisingly, faced with people's natural resistance to change due to a number of contributing factors such as the unawareness of the change, lack of management support and insufficient resources. These resistance factors have negatively reduced people's

readiness and willingness to change and also increased the chance of the early project termination (failure). For the second project, the early and appropriately planning and managing of the resistance contributing factors have positively reduced people's resistance that obviously enhanced their commitment and dedication to the proposed change. As a result, the effective task of planning and managing these resistance factors has significantly increased the chance of the second project success.

We found that by considering and examining the human factors in great detail the chances of successful adoption and diffusion of processes are enhanced significantly. From our empirical study, we concluded the following:

- Human factors play a vital rôle during the organizational transition to Object Technology as they can form either a promoting or resisting force.
- Understanding of the new, desired OO work environment can assist management to put together a plan to manage the necessary cultural change.
- During an organizational change, managing people's resistance becomes a critical issue that must be seriously considered so as to accomplish satisfactory results.
- Organizations must be able to effectively manage people's resistance to lead and direct the change process.
- Involving individuals in planning and making decisions can positively eliminate their resistance to change and enhance their ability to carry out a successful transition.
- The individual's knowledge and experience related to the new technology play an effective rôle in making the decision for the transition.
- More knowledge and experience enable people to contribute more towards the transition and the adoption of new technology.
- Gaining adequate knowledge and proper training on OT concepts and tools can significantly contribute to enhancing people's ability to positively involve themselves in the transition process.

Our experience with Action Research has been fruitful. It has provided the research infrastructure within which real industry-focussed problems can be tackled. In particular, in this study we proffered the hypothesis that appropriate planning and management of human factors during an organizational change may assist in eliminating, or at least mitigating, people's natural resistance to change and increase the chance of success. Our longitudinal study permitted us to analyze how an organization responded to organizational change, focusing here on an analysis of the resistance to change exhibited by the personnel involved. We were fortunate to follow two projects in the same organization, one deemed a failure and one a success. This permitted us to analyze the influencing factors that help to determine "success" or "failure" (albeit a subjective label). There are many potential causes of failure, as shown in Figure 1. Planning and managing for change does appear to offer an increased chance of success in the context, examined here, of organizational transition to a contemporary computing culture.

Acknowledgements

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