THE BRITISH COMPUTER SOCIETY

Case Study of Successful Complex IT Projects

AUGUST 2006

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1. Executive Summary

This case study is a follow-up to the British Computer Society (BCS) Royal Academy of Engineering report "The Challenges of Complex IT Projects", and the 2005 "Case Study of Successful Complex IT Projects" developed by other Lancaster University students. This case study has been produced by Lancaster University MSc E-Business and Innovation students for the BCS, focusing on two successful, complex, IT projects, which won BCS Awards in 2005. One is LogicaCMG's Instant Energy project – a company involved in designing, researching and producing a prepayment gas meter which would benefit both the energy suppliers and domestic customers. The other is the eCourier System project – a company involved in the development of mobile devices, global positioning systems (GPS) and an easy-to-use online booking system to connect clients with couriers in the same-day delivery of parcels.

The aims of this report are to explore what made these IT projects successful, form ideas about best practices regarding how to deal with complexity in IT projects and the critical success factors that are involved in such IT projects. The two projects were studied using secondary and primary data as real and on-going examples of successful IT projects.

When looking at project success, project failure and its recognition and avoidance is an important part of success. An important contributor to failure is complexity, because it creates and potentially overwhelms a project with much uncertainty and risk. A complexity model is created in this report (See Figures 1&2), illustrating that the complexity in IT projects is formed from macro-environmental, micro-environmental, organisational and project-related factors. The macro-environment requires a balance among political, economic, social, technological, environmental and legal factors (PESTEL). The micro-environment involves issues and people who control or influence the project, such as the client and other industry participants. The organisational and the project environment are

internal factors that can help in either detecting, managing and addressing external factors which contribute to complexity. Influence, or in adding to project complexity.

Each factor of complexity can influence the project in a different way and intensity. Successful projects depend on a project manager who can act to manage the balance among these various factors. Based on secondary research, various project processes can ameliorate this complexity and increase success, and are thus critical success factors (CSFs) for IT projects: market research, project planning, technical issues, change management, stakeholder management, risk management and communications management. To study the critical success factors for the two specific projects, secondary research and telephone and face-to-face interviews were conducted with LogicaCMG and eCourier. Change management, stakeholder management, risk management and communications management were identified as the four most important categories of success factors. Findings are derived from the four areas. The project manager has to have the skills and knowledge to manage change, stakeholder relationships and risk, through effective communication.

This study identified five general recommendations for the IT project managers;

1. Building a well structured team
2. Defining success criteria clearly with stakeholders
3. Understanding market needs
4. Understanding and managing technical issues
5. Managing the project through the proposed project control cycle (See Appendix 2), which consists of planning, monitoring, reporting, decision making, corrective actions and revising stages.

2. Introduction

2.1. Background to the study

This report is produced for the BCS (British Computer Society) by Lancaster University students, studying for an MSc in E-Business and Innovation. The team is composed of three students with complementary skills, and two supervisors from management science and computing science. This case study aims to explore the critical success factors in complex and successful IT projects. In addition, the sources of complexity in these projects will be analyzed in order to understand how complexity is managed and reduced in order to achieve project success. To do so, we will gather relevant concepts and categories from various literatures, and compare and contrast this with two cases of successful IT projects, in order to produce general recommendations for managing complexity in IT projects. The two cases, LogicaCMG and eCourier, were identified by the BCS as complex and successful projects, and thus serve as best-practice examples.

The sources of complexity in IT projects will be discussed in the introduction section. Research methodology and research questions are outlined in part I. Part II of the report describes the two cases, including the company and industry backgrounds. Sources of complexity in these two specific cases will be analyzed, as well as the similarities and differences between them. Part III discusses the general critical success factors for IT projects, based on secondary research. The findings from the two cases are discussed in part IV, which includes four main topics which address complexity: change management, stakeholder management, risk management and communications management. Lastly, general recommendations for IT projects are provided, based on the research results.

2.2. The complexity of IT projects

According to research from the Royal Academy of Engineering and the British Computer Society (2004), only 16% of IT projects are considered truly successful. Studying the factors and processes that contribute to complexity on IT projects and their management is important in understanding why IT projects fail, and how the management of complexity increases the chances of success.

While an important source of complexity in IT projects is technology, the key source of complexity is the scope of the project set by management, the various social, economic and technical factors that then influence the success or failure in meeting the project objectives, and the various social and technical strategies employed by the project team to detect and manage these internal and external influences.

The external sources that need to be detected and considered in the IT project are depicted in Figure 1. The sources of complexity for an IT project are based in the project environment. Many social, political and economic issues in both the project's internal and external environment, in addition to technology, need to be considered.

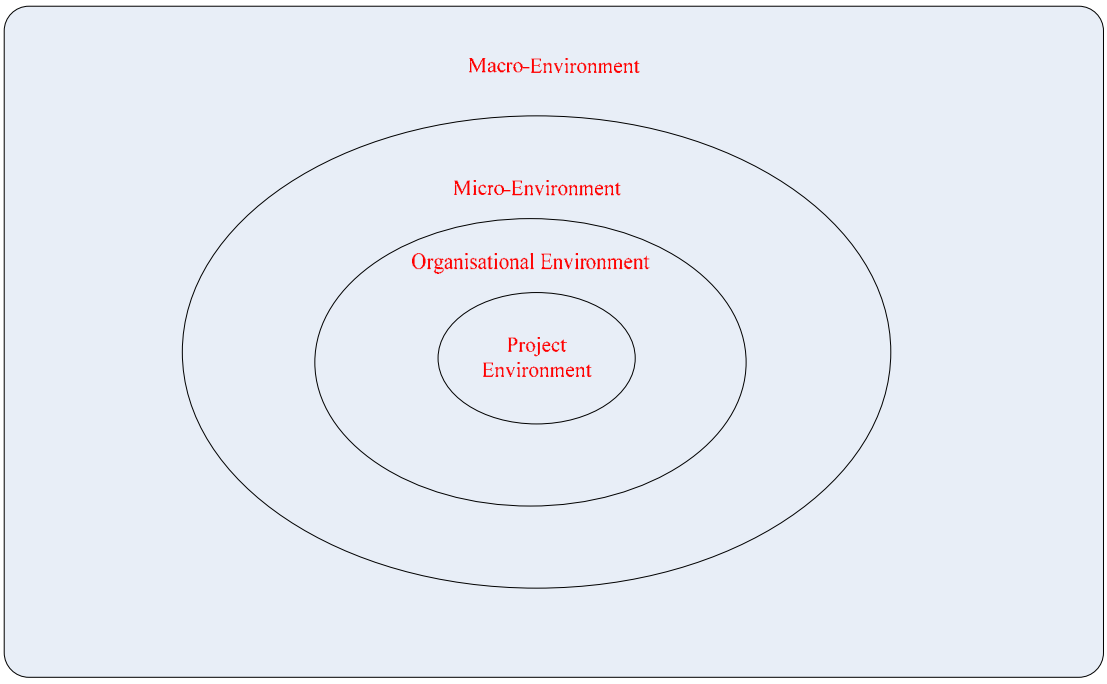

Figure 1 complexity model

An IT project is conceived and conducted within a large and uncertain environment, which can produce considerable complexity for the project planners and participants when the relationships among these various factors are numerous, interactive, unknown, unpredictable and ambiguous. In various environments, different issues contribute to the complexity of the project, but even in the same environment, particular project goals and outcomes will be affected by numerous and interacting factors. It is the anticipation, detection, evaluation and consideration of what role these factors play in the success and failure of the project that increases project success. The sources of these environmental influences are to be considered next, using the PESTEL framework: political, economical, social, technological, environmental and legal.

- Macro-environment

For different IT projects, the ranking of importance for the five issues in the macro-environment differ (political, economical, social, technical, environmental, and legal). Considering the macro-environment around an IT project, the technical issues bring a large source of uncertainty and complexity to the project. An important part of this complexity is the pace of change in the technical environment which can quickly render current business and technical plans obsolete, as new technologies present ever-changing social and business possibilities.

- Micro-environment

Clients of IT projects are included in the micro-environment. As a source of complexity, determining a stable set of client requirements is an important issue. Due to the complex technical issues that may be present in the project, the clients may not fully understand what they want. Their requirements may be unrealistic, unachievable, and often change, because of the uncertain technical issues or capabilities, as well as an uncertain business environment and an infinite number of business possibilities that could arise from a given technical system. Developing, constricting, understanding and communicating such requirements is a challenge for the whole

project team, especially in setting a reasonable project scope with the user's input, and deciding where and how particular users will be involved in the setting of the scope and system requirements. "Many projects fail due to flaws in the elucidation of requirements, others fail because the requirements have become obsolete by the time the project is delivered" (The Challenges of Complex IT Projects)

Within some industries, the client is the customer of project deliverables, and their needs are difficult to predict, in particular when IT projects are meant to develop systems that deliver new products and services. The risk is high because it is hard to know whether the innovative product or service will be accepted and used by the end-user clients. In this scenario the project needs to find a market of business or retail consumers that demands a solution that could be created from the IT.

Complexity is also increased and transformed, to a large extent, through industrial dynamics such as competitive rivals, and the IT services they are offering now and in the future. It is difficult, complex and uncertain for a project manager to recognize and predict the nature of these competitive forces, and how they will affect the project's current and future success. Thus, in addition to technology that is rapidly developing, the application of these technologies is constantly changing. So complexity is increased by a search to find and sustain first-mover advantages from new technology and revised business practices, which remain valuable and protected from competitors.

- Organizational environment

Often, IT projects start with an innovative idea, but the unpredictable nature of the cost and return on investment makes it difficult for the IT project team to justify and gain support from senior management. In some companies, the organisational environment may discourage business-process and innovation, by failing to provide the necessary resources to support the error-prone exploration and development of new information systems.

In addition to these project-related factors, establishing an IT project within an organization will cause uncertainty and changes in the organizational environment. This is true whether the IT system is to be used by either the company itself (internally) or by their customers (externally). Change management is required in the project's post-implementation stage. A source of additional complexity lies with the potential conflicts between the internal and the organisational environment, including cultural, business strategy, and structural and historical conflicts, to name only a few salient areas. To prevent or resolve such conflicts, the various stakeholders should fully understand each other's strategy objectives through two-way communication, in order to achieve an agreement on how to implement the technology and systems, and the resulting benefits and costs they accrue to each party.

- Project internal environment

An important source of complexity and its reduction is the project environment. Project complexity can increase during the translation of business requirements into technical specifications. This involves identifying and eliminating any discrepancies in interpretation, which may be difficult until systems are developed and implemented. At later project development stages, core changes can be critical and potentially devastating to the project, leading to scope creep or out-of-control projects. The project team, as well as the project manager need to have comprehensive ability and skills, while being able to talk across functions, to both technical and managerial groups. Unlike other projects, IT project progress is often invisible and the scopes are hard to control. This makes the monitoring and controlling process complex.

Generally, the complexity of IT projects is based on:

- Managing issues in all environments highlighted above
- Coping with changes to those issues
- Managing relationships among the stakeholders and groups within the environment
- Managing across project boundaries

Complexity can overwhelm projects, and its management is therefore an important source of IT success. In extreme cases, managing and dealing with complexity is inherent to IT project success. This project success can be measured along three dimensions: within time, on budget, and with the anticipated functionality. The question is how people in successful IT projects succeed in detecting and managing complexity. To answer this question, two complex IT projects were examined. We seek for the critical success factors for these two projects, and with the relevant literature on the topic.

3. Part I: Research Methodology

Research for this case study was undertaken by direct contact with the project leaders in each of the two companies. This project leader provided us with a single point of contact for our questions, and to arrange meetings with other members of the team.

For initial data, we were provided with the BCS Award Application, giving details of the two IT projects. From this, areas that required further clarification or understanding about the project were identified and research was conducted to address areas that required additional data to understand the management of project complexity. This research involved the gathering of information from the websites of both companies, in addition to press releases concerning both companies. Also at this stage secondary research of the information technology and project management literatures was conducted. This included books, journals and e-journals.

Once satisfied with the level of understanding of the companies and the technologies they were utilising, initial contact was made with an appointed person of the research team via email. Through this, a telephone interview was scheduled. Questions were written in advance, based on the research framework, and a copy was distributed to both companies prior to the interview to ensure that they were prepared. In addition to these initial questions, any further questions that emerged as a result of the interviews were asked and answered. During the initial interview, the responsibilities of each member of the project team were clarified. Following this telephone interview, a face-to-face interview was arranged on the client's premises, with the project leaders and other key employees identified as important participants in the case during this initial telephone interview.

Before the face-to-face interviews, the clients were informed which subject areas would be covered by our questioning, so that they could prepare and bring any

relevant internal documentation. At this stage, the research team were given CVs of key employees, and their skills were mapped into the BCS SFIAplus (version 3) skill framework (See Appendix 1). According to BCS.org (2006), the Skills Framework for the Information Age (SFIA) is the high level UK Government competency framework describing the roles within IT and the skills needed to fulfil them. SFIAplus (version 3) builds on SFIA and it is the most widely adopted model to allow employers and individuals to map skills within an IT job role, identify career paths, plan training and development activities. It contains 8 addition skill resources and 6 additional task components for all 78 skills and 263 tasks. The objective of applying SFIAplus was to analyse how the participants' skills in each project mapped into those identified as important in the SFIAplus model.

Any questions arising after the face-to-face interviews were sent to the companies by email. This ensured that participation in the case study did not place any unnecessary burden on the client's time. The client was able to answer the email questions at any time that was convenient to them, rather than having to arrange a mutually convenient time to communicate.

The data from all of the interviews was recorded, for later analysis by the research team. This helped gain a broader interpretation of the data, decrease the risk of error, and provide the opportunity for discussion within the team.

The face-to-face interviews were conducted on client premises, as this provided the research team with a valuable insight into how the businesses and projects were run. At both companies the research team were given a live demonstration of the information technology and systems, seeing how both the utility meter and courier tracking systems worked. This helped provide insight and aid understanding of the project.

These were the research questions that shaped the interview questions, and addressed the management of project complexity:

1. What changes occurred during the project?
2. How do these organisations manage change arising from complex IT project implementation?
3. Does change only occur within the organisation or is there a wider impact, i.e. within the industry, culture, globally, or within the macro environment?
4. Which group of stakeholders are important to these two projects and why?
5. How do the project managers manage those key stakeholders?
6. How stakeholder requirements influence the project deliverables?
7. What are the challenges in managing stakeholders?
8. What are the sources of risk in IT projects?
9. How to manage IT project risks through project management processes?
10. What strategies can be used for risk management?
11. What would the companies have done differently if they did this project again?

4. Part II: Case Description

Research questions were set to examine the nature of complexity and their management within these IT projects following a review of current academic literature. The cases were used to answer these research questions while also being used to test existing theoretical frameworks. The aim of this is to highlight examples of best practice complex IT projects

4.1. eCourier company background

eCourier are a same day 24/7 courier service based in London, UK. The company was formed in 2003 with the aim of providing a courier service that is focused on delivery transparency and automated customer interaction. Parcels are collected from any London address and taken to any final destination requested by the client. Although the company originally only delivered parcels to London addresses, they now deliver parcels to any global location requested by corporate clients. Advanced Information Based Allocation (AIBA), an intelligent dispatch and fleet management system is utilised to allocate a booking to the most appropriate vehicle (including bicycles, motorbikes and vans of varying sizes) and sends a message to the courier to alert them to the job through their handheld terminal. In addition to detecting the nearest vehicle to the pickup location, AIBA also undertakes an analysis of the individual performance of couriers, trends such as congestion affecting speed of delivery during peak times, and weather conditions which may affect the performance of some vehicles.

Couriers are rewarded and motivated with high pay for the service levels they provide, supported by the technology, thus rendering a courier service that is reliable, trustworthy and transparent. This industrial and organisation ethos was complex to initiate, requiring extensive training to be given to the couriers to change the way in

which they worked and behaved in order to fit the new organisational practices and image, enabled by new information technology.

In addition to systems for employees, the customer has been provided with a real time tracking of their parcel on a map, utilising GPS technology. They are also shown the shortest route, for which they are billed, from pick-up to despatch. On the same map they can watch their parcel on route to the final destination. Once the parcel has arrived, a Proof of Delivery e-mail is sent within seconds. It is this high level of human to system connectivity that is at the heart of eCourier. Because the majority of bookings and customer queries are taken online owing to the ease of use of the website, fewer staff members need to be hired, and these can focus on any complex issues that arise. eCourier recruited and headhunted top employees for their skills and experience in specific areas to most benefit eCourier.

Based on the five CVs supplied by the project team, the BCS SFIAplus model was used to identify the skills of project members (See Appendix 1 for the outcome). In the project, many skills were brought into the company by hiring employees with specific skill sets. The skills of the five core team members include Management and operations (COPS), Systems development management (DLMG), Business risk management (BURM), Web site specialism (WBSP), Information assurance (INAS), Benefits management (BENM) and Project management (PRMG). All skills are generic Level 4 out of a possible level 7. In eCourier's SFIAplus framework, Business Change sub-category and Systems Development Model were endorsed, but the rest of sub-categories were lower?. If the project had applied the BCS SFIAplus framework in the beginning of the project, they could have consciously recruited staff to build a complete skill set, which would also manage and develop the team members' skills even more effectively through learning from the complementary skills within the organisation. Due to the success of this project without having a full skill set, it can be suggested that an incomplete but complementary skill set can contribute towards project success.

4.2. eCourier industry background

Traditionally, the courier industry has been a particularly unattractive industry for both customers and employees. Courier stories in the media portrayed fraud and breaches in trust, including security issues such as fraudsters posing as a legitimate and well-known courier company. Given these reliability problems, high value or time critical deliveries had companies deliver their parcels with one of their own employees in a taxi rather than entrust it to a courier.

eCourier revolutionised the industry by focusing on transparency of the package and service using information technology. Rather than informing customers that their parcel was ‘stuck in traffic’ while it was really being taken to many other drop-off points first, the user and employee had real-time access to information about the parcel.

With typical courier strategies, there are low barriers to entry into the courier industry. eCourier have, however, erected higher barriers to entry, because the service they offer is an enhanced service through their use of technology applied to their courier business. This increases the competitive distance between them and other courier companies, by making if difficult for others to replicate a set of business practices only possible through their technical systems. It is this overlap of traditional industry and innovative use of existing technologies that makes the project complex.

4.3. eCourier technological issues

The technology behind eCourier aims to utilise a system to predict travel times between any two places in the UK. eCourier developed two key IT systems: one is their intelligent back-end ABIA system and another is their website www.ecourier.co.uk. The ABIA system is written in Java and is running on a Linux platform. It combines mobile devices, GPS, and IT based fleet management with an

Internet platform. Their main servers include: Web server, Microsoft SQL server, Mapping server, Gateway server, Allocation server, and MySQL server. Technology has been used to ensure the smooth running of the business. Disaster recovery systems have been put in place to ensure that the computers and operations have a constant supply of power. This is backed up by generators, although by the very nature of the system, can also be run remotely. Their website is powered by an ISAP dll module written in Delphi. The advanced interactive mapping technology on their online tracking system is a key marketing point for eCourier as it allows customers to zoom, pan, and focus on couriers to street level without refreshing the whole web page. Each of their couriers is given a handheld computer and GPS equipment, which allows clients to watch and follow the progress of their delivery.

4.4. LogicaCMG company background

LogicaCMG undertook a project in which to design, research and produce a prepayment gas meter for use by domestic energy provision customers, to accept monetary top-ups by the customer using a mobile phone. This Smart Meter would be sold to energy companies to replace the existing meters in customer's homes, including the now out-dated token meters. This project is complex as it involves putting an innovative use of relatively new technologies into the already well-established market for energy.

LogicaCMG have a large international presence, spanning thirty-six countries worldwide, giving potential for this service to become global. The project is responsive to the need for change in order to meet different market needs, such as planning to accept payments in Euros and to meet European standards. Equally, the Smart Meter could be used by less developed countries that do not currently have an energy provision infrastructure to enable energy to be paid for in advance in a reliable way. In these countries, a pin code could be entered into the Smart Meter after the code was purchased and the meter would be topped up with credit, in the same way as if the transaction had been conducted using a mobile phone.

The seven team members involved in the Instant Energy project were identified, and a wide range of skills were brought in the project and average Level 4 or above out of 7 (See Appendix 1 for the outcome). The team member skills were highlighted against on Business Change sub-category and Systems Development Industry Model, but no specialist and support skills were identified.

4.5. LogicaCMG industry background

The energy industry contains a few key energy suppliers, which implies that if one of these suppliers could be persuaded to be a customer of the new Smart Meter, then the others would soon follow to remain competitive. The Smart Meter allows customers to change energy suppliers with ease, without changes needing to be made to the meter to allow customers to switch supplier – a common market feature in this industry. Companies would be willing to purchase these meters because they offer significant cost savings in the longer term, and they reduce the cost of providing customer service. Rather than having to send meter readers and maintenance people to a customer's home, these meter services can be provided remotely, which in addition to costing less to provide, also means that some customer queries can be answered quicker. This improves customer service.

Political factors have a large influence on the project and the market demand for the end product. Currently, the political and energy prices are encouraging the project, with more customers wanting the advantages of prepay for budgeting purposes. The project is occurring within the right political environment, with the rise in fuel poverty, government drives to increase energy efficiency, and a reduction in energy consumption. By the nature of prepay, customers would be more aware of their energy usage and energy monitoring facilities are available through the meter.

4.6. LogicaCMG technological issues

In terms of the technological issues, the LogicaCMG prepayment system contains a central service implemented on AIX Unix server database and application server with TCP/IP interfaces and the UK 2nd tier supply infrastructure (ELEXON). The central system is comprised of a web interface and an Oracle database built around a Distributed Computing Infrastructure (DCI). This can integrate the central system and allow online payment to be identified by the payment agent and the message is processed by the SMS service provider system. An apache web server was used to deliver user interfaces, and an Oracle 9i database was used to provide the database. A Tomcat servlet container is driven by Java and the STRUTS framework, using Java Server Pages and cascading style sheets for the presentation layer. The project also developed a Prepayment Metering Infrastructure Provider (PPMIP) application, which allows suppliers to interact with their meters in real-time.

4.7. Complexity of the two projects

This ‘Complexity Model’ has been devised by the research team to illustrate why the case studies in this report could be regarded as complex by showing the illustrating the factors and their interactions in their respective IT environments. The elements from this model show the sources of complexity found in these cases. This is a specific model to our findings, drawing upon models in the literature, such as Porter’s five forces model and the PESTEL framework. We also will explain how complexity can be managed by the careful management of the project risks associated with these environmental factors, and the micro-environmental strategies used to mitigate risk.

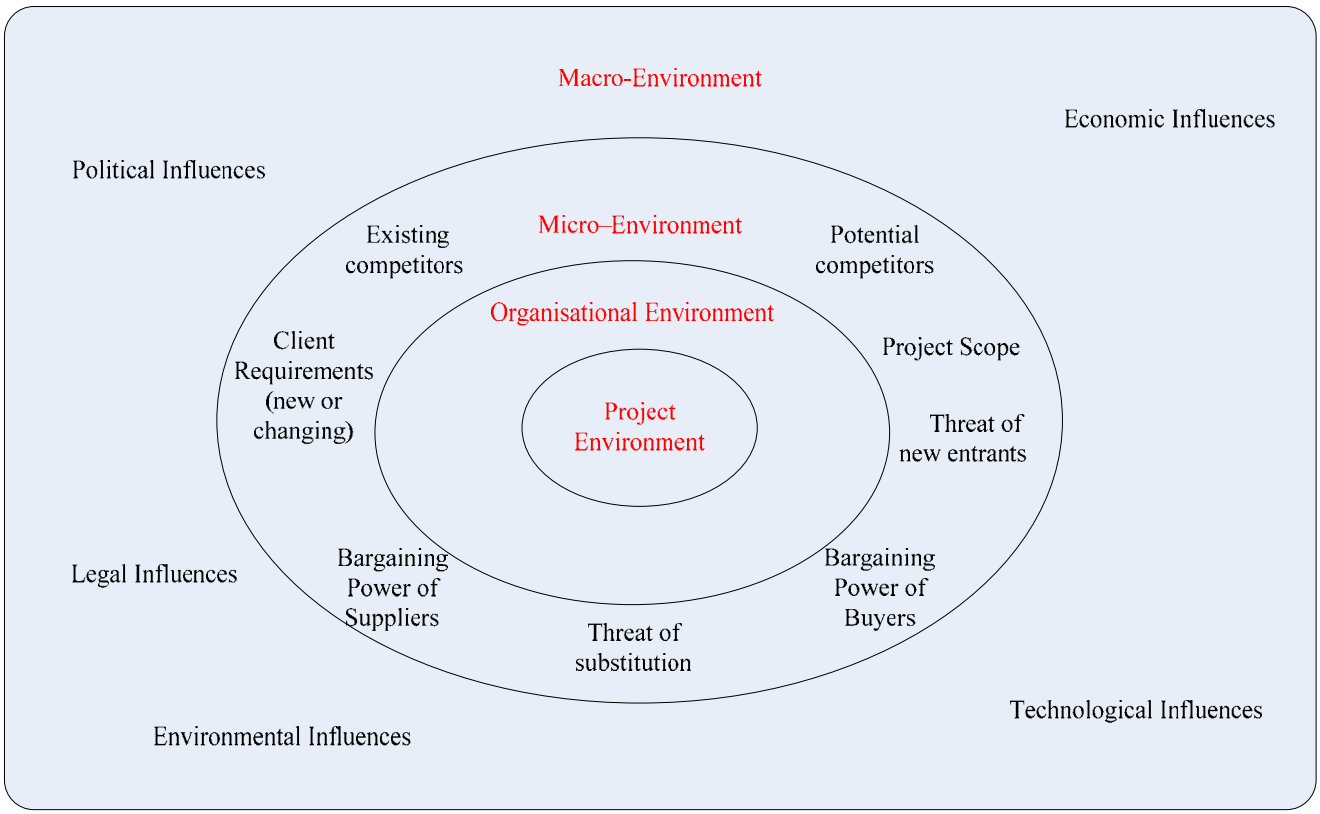

Figure 2 complexity model for the two projects

Macro-environment

This environment is complex because it is highly influenced by, and requires careful balancing of, political, economic, social, technological, environmental and legal factors (PESTEL). These factors are by their nature, largely out of the control of the project leaders or initiators and are discussed in more detail below. However, decisions about project scope will dictate whether, and to what extent, specific factors will play a role in increasing or reducing the factor complexity of a project.

In both cases, the scope and ambition of the projects included a complex array of interacting macro-environmental factors. At LogicaCMG the energy industry is complex, as it involves client needs and solutions that are continuously changing, thus making it risky that a specific IT-based product or service will eventually and consistently meet their business needs. At eCourier, however, despite a traditional

business service and industry, the complexity results from implementing an innovative, highly technical solution into a transformed approach to the service.

Political

The government can have a massive impact on IT projects. They may make it harder or easier for new companies to start up with an IT concept or idea for a project. Taxes on business and financial incentives to encourage entrepreneurship have an impact on whether or not an IT project may be regarded as a viable business option.

At LogicaCMG political forces have had a substantial impact on the project. The current situation in the UK is of an impeding energy crisis with political ramifications. Energy prices are increasing, leading to the risk of fuel poverty, which the government is obviously aiming to curtail by 2010, making energy high on the political agenda.

It is fair to suggest, however that although these macro factors may be important in determining the complexity of IT projects, individual factors may vary in importance between projects. For eCourier, political factors were not as important as at LogicaCMG because the courier industry is not on the political agenda.

Economic

Economic factors may affect the willingness of customers to buy the products or services produced by a new information technology or system, and may in-fact create resistance to changes in times of economic uncertainty. At LogicaCMG the economic climate may be important if it affects the demand for prepay meters. This factor adds to the complexity of the project, because the various needs of different customers have an influence on the required flexibility of the system. In response, LogicaCMG has produced a meter that can be used for prepay or contract customers.

Technical

Technical issues give rise to uncertainty in IT projects, especially those utilising innovative technology and practices using technology. This is because technology and its use are rapidly changing, and a technical or competitive mistake can produce severe financial losses. LogicaCMG have found that there have been some cost overruns due to the unpredictable and rising costs associated with technology. This includes finding solutions to problems that were found during the development of the project, which could not have predicted at the outset, and were thus not assigned a level of risk in the project plan. However, their response to emerging and unexpected complexity was handled by spending more on technology in the early stages which helped ensure success in the longer term because they built the project using the most up-to-date technologies available.

Now that eCourier is in the post-implementation stage of the project, they are faced with continuing complexity and uncertainty, and so they need to make careful considerations about which technologies to invest in and which to avoid at this time. Because both companies are striving to obtain first-mover advantage they have to remain innovative and adaptive towards new technologies and their possible applications, in order to ensure that this advantage can be sustained. This also gives rise to uncertainty, because their innovative use of technology can now be imitated by others, and future advances in their own use of technology cannot depend on learning or copying from others.

Environmental

Environmental issues may be of a concern at eCourier. If there are additional taxes on fuel, increased parking charges/fines or initiatives to reduce the number of motor vehicles on the road, they may be encouraged to increase their use of bicycles or adjust their delivery approaches to pick up more orders at the same time. This adds to the complexity of this IT project as the automated despatch system would be programmed to allocate the most appropriate courier, not necessarily the most environmentally or economically suitable.

Legal

Legal issues can be a factor contributing to complexity in IT environments. There may be government legislation that affects the project output, such as specification guidelines. Both companies are able to apply for patent protection for the design of their product that was created through their project. If patents are registered then it may reduce complexity by reducing the threat of new entrants in the macro environment.

Micro-environment

In the micro-environment are the players who have control or can influence the project, including the client and the industry.

Client - The project and the project team need to cope with changing client requirements, especially given that the client may be uncertain about their requirements given the lack of awareness of technology and its novel applications. Therefore, it is often difficult to specify the client requirements at the outset, and this often leads to the changes in the project scope as client requirements emerge and change. Additionally, client requirements may change due to issues within the macro environment, another area that is beyond the control of the project team.

At LogicaCMG complexity is high because there are a numerous possible ‘clients’ for this projects whose needs must be considered and generalized into a flexible product. Such stakeholders include the end users who have the Smart Meter in their homes, in addition to the energy companies who would buy the meters and use the software to monitor the meters and use the enhanced services offered by LogicaCMG. If the end users’ requirements were not met by the product-service, or the energy companies feel they won’t be met, both the company and the end users would never implement the product, or they would demand that the meter be taken out of their home and replaced

with a different meter, possibly reverting back to token systems. The meter companies on the other hand would have the power to buy meters from a rival producer.

This complexity of purpose and use increases the possibility that energy companies may set unreasonable demands for the functionality of the meter. Scope creep could then occur before or after as the project leader attempts to anticipate or respond to energy company and end user requests.

Industry – IT projects may strive to be first movers, but the definition of a first-mover within an industry is difficult to define. Both companies studied are first movers with their combination of technologies and the way they have brought such technological innovation into traditional industries. On the other hand, they are not first movers in terms of being the first to courier and offer energy meters. Within the industry, it may be difficult to develop or maintain competitive advantages when second movers start to imitate significant first-mover strategies using software and technology. This produces economic uncertainty, which can be handled only by constant adaptation and innovation with current or new technology.

Organisational Environment

Under more control and therefore both a source of increased and reduced complexity, is the organisational environment. The organisational environment and the impact this has on complexity is an important consideration. At eCourier, the organisational environment of transparent walls and people working together mirrors the image that the company wishes to project to their customers, that of transparency and honesty within the courier industry. At LogicaCMG they use “hot-desking” across multiple sites. Project team members may be geographically distant, but still keep in regular contact by using various methods of communication. As all team members are passionate about the project and want it to be completed to the highest quality possible, there is trust instilled on every member to complete allocated tasks and to work to the benefit of the project. At the heart of this trust is communication. Both

projects studied focus heavily on communication between all of the project stakeholders and this helps create an organisational environment under which the development of the project goals and objectives could flourish.

Project Environment

Complexity can also arise if there are conflicts between the organisational environment (the norms within the project between the team) and the project environment. Within the organizational environment, complex IT projects may find it more difficult to gain support, either financial or other resources from the senior management team. This would be especially prevalent for projects such as at LogicaCMG that necessitated a longer project nurturing period, from conceptualisation to the time at which the project output can be presented to the market and start to make money. The complexity of the IT project can be reduced if, as is the case in these two examples, the senior management team have industry or technical experience, or other experiences that they can bring to simplifying complexity and reducing ambiguity.

Complexity within the project environment can occur because the project is making extensive use of new technology and the obvious uncertainty and 'trial and error' that occur within such IT environments. eCourier for example were the first courier company to utilise technology in such an all encompassing way, to manage the entire process of courier delivery. This may increased the difficulty of project leaders' to secure funding for the project, as being first-mover is associated with a higher level of risk than when a project has predecessors. Because of the nature of an IT project, funding would need to be secured on the concept of the project, which may not have an accurate or reliable prediction of return on investment. As has been confirmed with this case study, this may make it more difficult to obtain outside (venture capital) funding when compared to a more tangible investment option. Costs and benefits may be difficult to predict considering that there are no competitors to provide an estimate of these, and being a first mover exposes the company to the majority of the

uncertainty and research-related costs to manage this complexity. Benefits may be more prevalent in the longer term, once the IT project has overcome initial issues. For example, eCourier has overcome their initial issues and now are benefiting from the scalability of the IT project to make money from their initial and currently reduced funding of the project. Relevant to influencing potential funding options may be whether the project was to be market driven, or driven by the research and technical skill of the company. If the latter was the scenario, it may be difficult to market the end product of the project due to it being previously unknown to them.

Overall, complexity arises from managing all of the issues discussed above within the environments identified in the model. It is complex because relationships between all of the actors need to be nurtured and managed. This involves effective communication between all parties, not just within the individual zones in the model but between zones. At both LogicaCMG and eCourier the project team needed to communicate with heterogeneous clients in order to discover their requirements within the micro environment zone. Complexity does not stop when the software has been developed for example, it remains (albeit in a modified form) after post-implementation as technology and business environments change. At eCourier even though the software has been developed and implemented, micro changes continue to be made to the functionality of the software to ensure that is offers maximum benefit. These changes arise from feedback from the users, both staff internal to the organisation and future customers external to the organisation. There is scope for eCourier to sell their system to other companies by offering franchise opportunities, which would provide another method of obtaining feedback to initiate change. However, rather than this being scope creep, this is an adaptive responsive to genuine needs to sustain their innovative and competitive marketing position.

4.8. Similarities and differences between the two projects

Comparing an overview of the two projects helps to identify common success factors and the challenges of complex IT projects. The similarities and differences of the two projects are discussed below:

Similarities

LogicaCMG and eCourier are both first movers of new combinations of existing technologies within their respective industries, arising from innovative ideas. They combined the existing technologies to create an innovative product and/or service to their customers to solve an existing need and market. LogicaCMG's new prepayment solution combined SMS messaging and prepayment metering to enable energy suppliers to cut operational costs, gather information easier and have more control over energy service provision. The end customer who has the meter in their home benefits from added convenience of using the new Smart Meter. eCourier uses interactive mapping technology, to make them the first courier company who allow clients to zoom, pan and track a courier with their parcel on a street-level UK map in real time.

Both of the companies studied have experienced, knowledgeable and ambitious managers to manage the projects. In LogicaCMG's Instant Energy project, the project manager has over 13 years experience of working with Utility companies and has an extensive knowledge of energy markets. He expects to change the utilities sector and to roll out the project into different market. At eCourier, the project manager has a solid background in IT, in addition to comprehensive knowledge of technology and business. With his business partner, the company founder and trigger for the initial idea, there is a strong business ethos, fuelled by a strong ambition to expand the business globally.

Both projects had a small project team, LogicaCMG had 10 people involved in the project and eCourier had 15 people who contributed to the development of the project. All team members had a shared vision and were passionate about their products and services through effective communication. They all have extensive and a full range of skill sets and experience, and open communication was embedded in both projects. In addition, both project team members' skills were compared against Business Change sub-category and Systems Development Industry Model in the BCS SFIAplus framework. They both have project management, web site specialisms and business change skills in the teams for development projects.

LogicaCMG and eCourier both had good planning and research in the pre-implementation stage; they all had deliverable milestones to aim for, and broke the project down into smaller stages and focused on short-term deadlines. Meanwhile, they were willing and flexible to make changes when learning occurred. Both project teams understood the importance of making business changes because of macro environmental changes.

Differences

LogicaCMG is a large international organization, and has a virtual team created from internal resources being based in four places: Leatherhead, Manchester, Edinburgh and London. Communication mainly occurs through email and telephone, with regular update conference calls. The project was able to draw upon more expertise if needed. eCourier on the other hand was initiated as a new company by setting up a new project and team members were brought in to the company during different stages. All team members are located in their London office, where full-time face-to-face communication is easy to conduct and encouraged.

The two projects have different success criteria, LogicaCMG regards success as generating positive cash flows and has a method by which they can make money for the company in the future. eCourier is more concerned about the functionality of the

website and how to attract more clients to use their services in the longer term, measuring success by the percentage of transactions conducted .

By the nature of the energy industry LogicaCMG would want to attract larger clients. eCourier on the other hand, due to the nature of the courier industry would aim to attract more, but smaller clients.

5. Part III: Critical Success Factors

Butler and Fitzgerald (1999) define critical success factors (CSFs) as the areas or functions where things must accomplish to achieve its mission. Summarised, this definition includes things that must go right in the project in order to ensure project success. Project managers make use of critical success factors (CSFs) to identify the important elements of their success and define what success would mean for their particular project. A number of critical success factors for complex IT projects have been identified through academic research and interviews. These factors are embedded in the stages of pre-implementation, implementation and post-implementation. (See Figure 3)

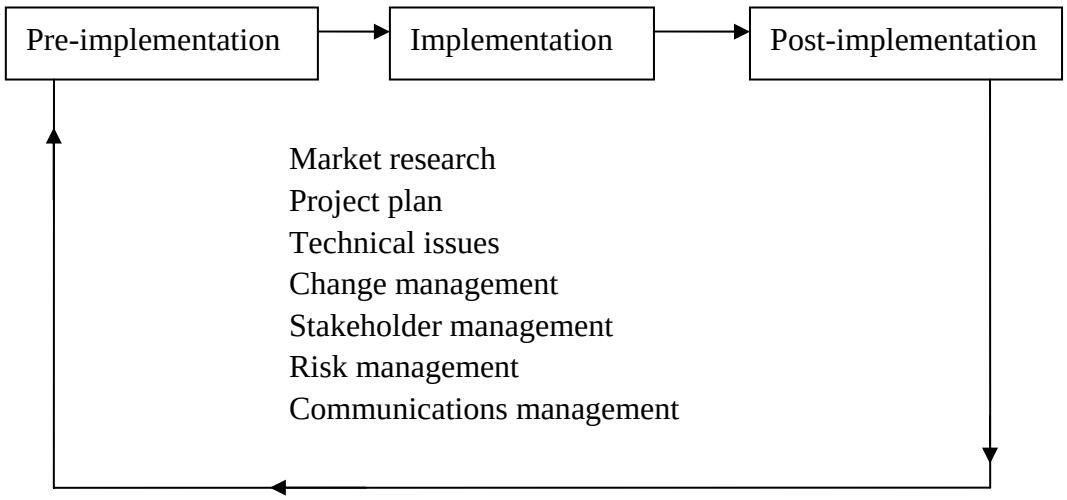

Figure 3 General critical success factors

Market research

Before the commencement of an IT project, a project manager must be responsible for accurate and timely market research, to establish predicted market demand and the potential of the project. Once this is conducted it can be used to clarify the mission

and direction that the project would need to take to ensure achievement of the predetermined critical success factors.

Project plan

The project manager must have a well defined project plan, in terms of estimated time of completion, dedicated financial budget, project quality, other resources needed and the scope of the project. The project plan is a day-to-day control aid for the project manager and should list all action steps required for successful project implementation.

Technical issues

The team working on the complex IT project needs to have a full range of technical skills to allow them to design, develop, implement and evaluate the system that is created. When technology issues arise, the project team needs to be adaptable enough to prioritize tasks and manage their own time to complete the project to the original time and financial budget where this is appropriate. This may be undertaken by having a clear framework that is specific to the IT project. Overall, the technical issues must not just remain within the technical department, but must be understood and shared across the organization and where required. This would help ensure that unreasonable demands are not put upon the technical team by the departments uninvolved with technical design and implementation, such as the marketing team demanding certain functionality that is unrealistic and unfeasible to produce.

The systems created as part of the complex IT projects have to fit the original purpose. If for example it can not help customers to complete tasks, this can lead to low customer satisfaction. In this case, the project team also needs to consider the user interface in order to meet these user requirements.

Change management

Effective change management is a crucial factor to the project success. Change is driven by knowledge, technology and business environment. In the IT project, change management includes managing and monitoring changes in the project, in order to maintain control, reduce the risks and optimize the potential benefit of the project. Change management is very important and should be carefully conducted, because no project can be expected to run from initial plan to final completion without some changes occurring. To ensure a project is successful, it may involve many micro-changes, which can vary from continuous improvement to radical and substantial changes, involving changes to the initial scope and company operations.

Stakeholder management

In complex IT projects, many stakeholders are involved with diverse interests in the outcome of the project. Many success factors of the project are dependant on these heterogeneous stakeholders which causes great uncertainty and opportunity for project outcomes. Because each stakeholder has at least some different views, interests, capabilities and contribution to the project, they also see the project differently. The project manager has to consider, take advantage of, and balance these varying stakeholders' interests in order to satisfy individual and collective needs.

Risk management

Risks are inherent in all IT projects regardless of the size and technical complexity of the project. The project risks vary in nature, and include: technical, resource, operational, strategic and financial risks. Therefore, an appropriate risk management system is desirable for all IT projects; the project manager must identify potential risks and adopt appropriate actions to manage risk effectively. It could provide guidance to the project manager for the development of a risk management plan and for deciding which risks are worth taking and which are unreasonable and beyond project capabilities.

Communications management

Communications management is regarded as the essence of project management, especially given our previous discussion of stakeholders. It helps to determine whether, when and how messages are used to determine and achieve project objectives. All the stakeholders share information through a communication system, which also helps to create the organisational culture and ethos of the project. This would be influenced by whether or not there is regular and organised communication, and also whether and when leadership and decision making is democratic or authoritative.

Overall, following academic literature research and interviews with two companies, change management, stakeholder management, risk management and communications management are four of the most important success factors in complex IT projects. In the ‘Findings’ section, change management, stakeholder management, risk management and communications management were chosen to be a core focus for analysis.

6. Part IV: Findings

This section examines the management of change, stakeholder management, risk management and communication within the two case examples studied. For these topics theories are examined, and compared to the practical findings at LogicaCMG and eCourier.

6.1. 1. Change Management

6.1.1. The significance of change management

It was found that changes affected both social (management of people) and technical (hardware and software) issues when existing practices were modified to accommodate these complex IT projects.

Change is necessary when IT and management become integrated, and as was the case in these two projects, correct change management procedures, undertaken at the right time, can help prevent IT project failure. This would be especially prevalent in projects that succeeded based on non-IT related factors, for example complete requirements specifications and the avoiding of late changes to specifications. Change management is an important topic to study when examining these organisations as they have a clear pattern of organisational and industry development.

Paré (2004) indicates that the management of change will never be optimal, so there is always scope for improving the process and outcome of projects. The question is therefore where project managers should focus their attention to detect and reduce complexity to increase success. Referring to the implementation of an ERP project implementation, it was considered a success when the project achieved a substantial

proportion of both its planned and unplanned benefits (Umblea, 2003). This is an important definition as it acknowledges that success can occur even if the project did not go according to original plans. As Paré acknowledges, there will always be changes in the objectives, produced through learning experiences from small failures. At LogicaCMG for example small cost or time overruns would be tolerated as long as the overall outcomes were not jeopardised, and that both planned and unplanned outcomes still produce a successful system. This is why the identification of critical success factors (See Part III) would be essential to be able to evaluate whether or not a project could be regarded as a success. Carnall identifies these as 'key success factors' (Carnall, 1991) and includes such factors as establishing a management structure to implement changes, using effective leadership, and the application of extensive planning for implementation. The model in Part III shows how these factors interrelate.

From a review of current academic literature, the salient areas concerned with change management are changes to people, technology and the industry. This has been confirmed by the case studies, and these are discussed in more detail below.

6.1.2. Existing Framework

Dawson (2003) set out a framework, which can be applied to and confirmed from the cases studies, as they have the following set of characteristics (given in brackets), termed the 'organisation development' approach:

- Considers all members of the organisation (stakeholder analysis)
- Top management support (The project leaders have clear passion for the project and strive to ensure success)
- The objective of the change is to improve working conditions/organisational effectiveness (the functionality of the meter was changed to future proof the organisation, and pay restructuring for the couriers was to improve working conditions)

- Amongst members, the emphasis is placed on aiding communication and problem solving amongst members. (communication was the driving force to ensure successful change)
- The focus of change is on the whole system
- An acceptable level of employee commitment is required for organisational change so that the change is not forced. (this is achieved by involving and educating team members at every stage and hiring employees who are open to change)
- Change needs to occur as slowly as required in order to allow for the continual assessment of change strategies (changes are discussed and feedback mechanisms are in place at both companies)
- Confirm that organisational changes need to be made based on data rather than assumptions, for example tests of software at LogicaCMG, and data about pay details at eCourier.
- Achieve lasting rather than temporary change to the organisation. (the micro changes were permanent, which confirms the feedback cycle)

There is a theoretical framework for a change process, involving unfreezing, moving and refreezing (Paré, 2004). Applying this framework to eCourier, unfreezing occurred when the company founders realised they could make a courier company and started to act upon their idea, acquiring the necessary start-up resources. They recognised that the market had a need for such change in the industry and they could provide a solution to this problem. Stage two, ‘seeing things differently’, was completed when the company founders assigned the help of an academic, one of the world’s top IT experts, to help with the business start-up, thereby identifying a new business mentor. The final step, refreezing, occurred when the new approaches were adopted as the new status quo of the company. This framework cannot yet be applied to LogicaCMG as their project is in an early stage of development, so the refreezing stage has not been conducted with their clients. The previous stages can, however, be

mapped against LogicaCMG, indicating that this framework may be consistent with industry best practice.

6.1.3. People

Both cases regard people as fundamental to the success of projects. Hagel et al (2005) state that teams should be assembled with people who have differing perspectives, presumably to gain a wider range of opinions and resources, thereby offering a better chance of success. eCourier took extreme measures to assemble a team with people they believed would bring the most business and technical benefit to the project, including sending gift baskets to attract the attention of an academic with the background and expertise that they were lacking and also headhunting specific employees who were experts in their field. They hired people with complementary skills so that there was no duplication of role within the organisation which may have brought potential issues and conflict.

The companies studied do not have typical change management strategies. eCourier for example was an organisation that started up with the use of a new combination of technologies rather than moving from the use of an old to a new system. Change at both companies arose from formation, by collating numerous individuals who had never worked together, with a broad range of skills into a new organisation, then having to overcome the issue of shaping these people into the emerging organisational practices for the two projects. This was managed by building a corporate culture that is focused on providing a good service to employees that will allow them to provide a good service to the customer.

At eCourier people-related change involved change to customers, couriers and employees. Customers had to be changed to make them acknowledge that they had a

problem with their existing courier services that would be overcome by using eCourier's service. Couriers had to change away from the unruly practices of courier deliverers -- drug taking, dishonest stereotypical image of couriers in the industry. Finally, employees had to be wiling to change. Because eCourier brought in the best staff, they had a full range of good quality skills. An example of this was within the sales department, experts in telesales, door-to-door sales and face-to-face negotiations were hired. The specific sales skills used by each employee were different, and each employee could learn from the skills of their colleagues. Staff therefore needed to be open to change and willing to learn. Even though the term stakeholder refers to anyone with a vested interest in the company, Beer (1990) indicated that successful IT projects are ones that focus on the employee first and foremost. This finding was confirmed by the two cases as both have a heavy focus on the people side of the operation, even though at eCourier in addition to employees the organisation uses self-employed couriers. eCourier focused on employees, acknowledging them to be a service resource and this has created seemingly never-ending possibilities for improved customer service.

As suggested by Umblea (2003), project implementation may trigger profound changes in corporate culture. At eCourier, couriers were hired with knowledge of couriering, in addition to extensive knowledge of how to navigate London to be able to provide high levels of customer service. They were also willing to be shaped to fit the ethos the approach to courier delivery, using a new system of e-enabled transactions. They were motivated by the financial and organisational gain of working in a new company that was different from the norm in the courier industry. Change was controlled by a member of staff hired for their wealth of experience, genuine passion for the project and a real sense of care towards people. The company had to be formed after these fundamental changes had been made to avoid the threat that the direction of the company would have been predetermined in a way that could not be used to fulfil the requirements of eCourier.

Change needs to be regarded as a two-way process. The changes at eCourier may not have been so successful if they had not put in place a mechanism that would reward change. To the end user, the eCourier office may appear to be unimportant, considering the only contact they have with the company may be through the website and the courier. The office space, however, reflects the eCourier image, of transparency, openness and being something different and innovative. Working in such an office space appears to help to confirm the business culture, and encourages good working relationships. This helps encourage change to the people side of the business. Because the first-class sales team work together, they can share knowledge and experiences. It is this ever-changing tacit knowledge that is helping the competitive position of eCourier and is contributing to erecting high barriers to entry for potential competitors because the business practices, supported by technology, are difficult to replicate.

The difference between hard and soft factors associated with organisational change has been analysed by Sirkin (2005). He states that organisations should focus on hard factors first, then soft factors, but that it would be a grave mistake to ignore the soft factors. Hard factors have three distinct characteristics.

1. Measurable (directly or indirectly) – these include the % of transactions conducted online at eCourier, and the number of times during the trial, customers could top-up the prepayment energy meter with credit on the Instant Energy project.
2. Importance can be easily communicated within/outside organisations – this includes justifying further funding for the project, which was a concern for both projects.
3. Businesses can influence those elements quickly, and include such factors as time necessary to complete a transformation, the number of people needed to execute it, and the financial results. Both LogicaCMG and eCourier can buy in staff as and when needed, and recognise that running over the time budget in

the short term would be negative for the project, but may help to ensure longer term success.

Soft factors are defined as culture, leadership and motivation (Sirkin, 2005) and do not directly influence the outcome of a change project, but are nevertheless as important as hard factors. Both companies considered soft factors but did not have measures for them, suggesting that soft factors were important in these case studies. In a potentially large scale project such as at LogicaCMG, even if the softer issues such as motivation were in abundance, the project may still fail according to financial or time deadlines if there were not enough people to execute the change during it's critical stages.

6.1.4. Technology

Software requirements go through a series of changes before the final version of the project. This may occur after the launch of the system, for example at eCourier the system is continuously updated as areas for improvement are identified, often by customer requests. However, software requirements also change as and when the organisation makes changes to the scope and nature of the system. This shows that the software team need to remain flexible and open to change. At the two organisations studied, the software teams both had extensive relevant experience and tacit knowledge, which could be applied to these specific projects. Richards (2006) goes on to suggest that IT employees should be part of a body of knowledge to promote best practice and to ensure they are as skilled and as experienced as the management team in driving business change. This theory was confirmed by the two case studies where success was driven by the practical experience of the technical teams.

Both projects grew from a concept, and the technical team worked towards making that vision a reality. At eCourier the system originally was required to cater for deliveries within London, but as the business grew, they needed to expand their

deliveries from London to any geographical location. Therefore, technology must be able to change and support change, so that the organisation can adapt to changing business practices. On the other hand, technology can also be a driver for change. With the recent technological improvements to real-time tracked maps, changes to eCourier may occur – for example placing real-time traffic information onto the map.

At eCourier, technology changes had some overlap with risk management. Due to the financial and time cost of new technology, it is important to assess what to change. On the other hand, technological changes are necessary to ensure that the companies remain innovative and can sustain first mover advantage, assuming that changes to technology put the company ahead in terms of research. At LogicaCMG technological changes were made to the initial specifications, often upon the recommendations of project team members, who were trusted to make these decisions in the best interests of the project. Therefore, from the two cases studied, it was found that a fundamental element of change management was managing the complex risks of both social and technical change and potential failure. This involved changes being made to the people involved with the project at input (couriers, technicians, designers and sales teams to name but a few) and output (customers, clients) to change their attitudes. Technical failure was guarded against by having specific risk management strategies in place, and by continually improving the technology utilised, suggesting a complex ‘merry-go-round’ of change’ that will be discussed below.

6.1.5. Industry

Micro-changes contribute to a ‘change merry-go-round’ as industry changes are radical and have a large impact on external stakeholders. There is a danger of scope creep. The organisations avoided scope creep by remaining focused on their original broad objectives, and the critical success factors which allowed micro changes in action to produce alternative means of reaching these goals. This is shown in a diagrammatic form below. At eCourier, industry changes needed to be made before

the project was introduced, so that a platform of honesty and transparency was ready to be built upon. The couriers had to go from working in an industry where dishonesty was the norm into working for a company who had built a computer system that could track where they were at any given point. They were told of these changes and any future micro changes from the earliest stage possible.

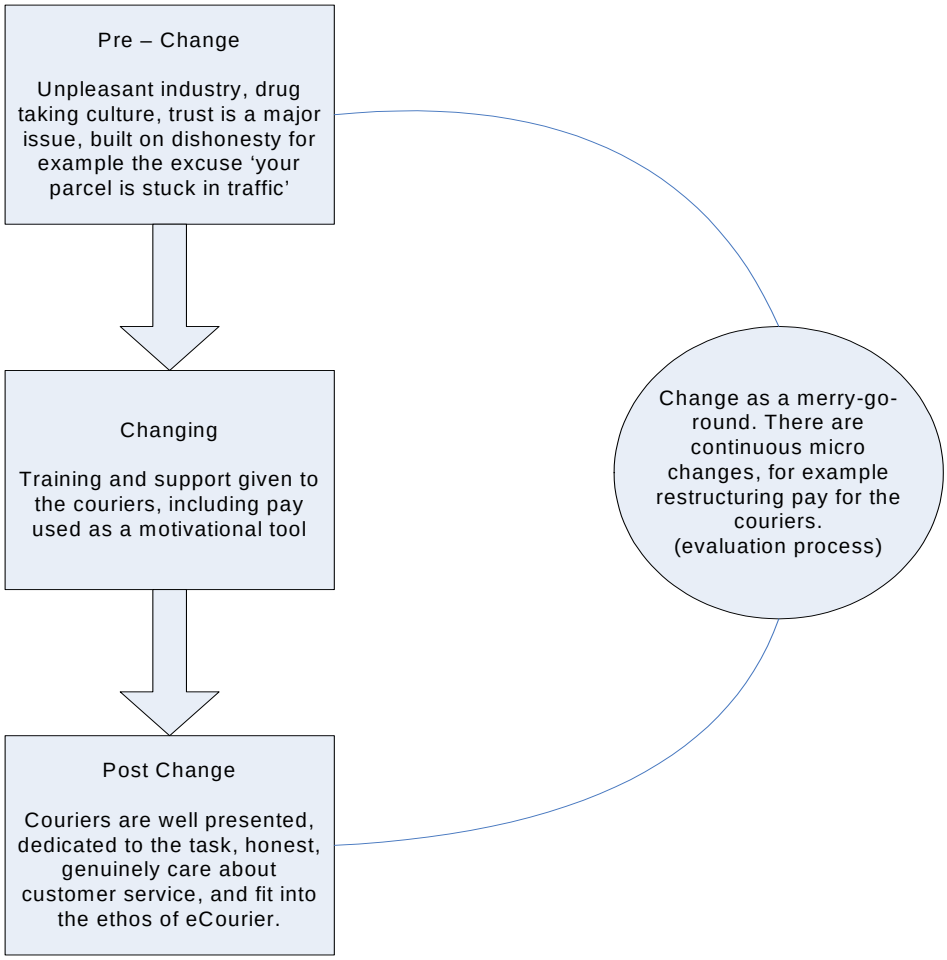

Figure 4 Merry-Go-Round of Change

The critical success factors change throughout the project depended upon the external environment of the project. This further indicates that a culture accepting of change is necessary, as goals may need to be realigned as the project matures. Throughout their projects, the organisations studied have made small but continuous changes. eCourier had to change courier attitudes, and Instant Energy had to make changes to the

functionality of their system throughout its development. The projects by their very nature are complex, and these changes had to be handled carefully. To manage this, the scope for each of the projects was set, and this helped to minimise complexity by giving clear direction.

Change management concerns the companies determining what to change. In the companies studied this was by examining technological requirements, reflecting on the software utilised and developing working practices that are supportive of change. The basis of success or failure may be in the original conceptualisation of the project. Both of these cases fulfil a genuine need or a problem, with a technologically advanced solution. Micro changes have been pivotal to the success of these projects, from technical changes to the functionality of the system, people changes – either bringing in a new person with a desired set of skills, or changing people to fit the desired ethos. Additionally, the industry to which the projects hoped to address, were meant to trigger demand and market acceptance. Harris (2001) argues that a customer's need for 'things' is real, but they may not realise their need. This is especially relevant in such innovative environments because the end customer may not be able to trigger innovation by demand. Therefore, market research to determine what customers want may have been difficult and uninformative. Arguably, eCourier had a strong argument to assume that their customer may desire a GPS enabled courier service because the company founder was a customer who saw a gap in the market. However, in situations where the customer may not be fully educated about the capabilities of a new technology, they may need to be convinced they want this service, and this change would need to be considered.

Both companies were undertaking a complex IT project affected by change. Changes do not only occur within the project environment, there is a wider impact onto the macro environment. Some of these changes were radical, the organisations had to create an environment that was ready to accept and nourish the outcome of the project, which involved industry changes in addition to project team/customer's

mindsets. Managing the change within organisations is not simply a technological shift, but a process of managing the rather more delicate behaviour of stakeholders. In addition, effective change management may have helped to mitigate the project risks, through effective communication with the project stakeholders, as discussed in a later section.

Change had to happen to both the technical and the people side of the courier industry, simultaneously. This change does not just impact on the project, but has a potential global impact by changing industries. The courier industry has become more transparent and trustworthy. At LogicaCMG, the ability for customers to remotely top-up their prepay energy meter with credit may have a wider impact than within the organisation if the project is scalable and can be used globally if it changes the way in which customers interact with companies.

6.2. 2. Stakeholder Management

6.2.1. The significance of stakeholder management

Stakeholders are taking a significant role in any projects because their satisfaction indicates how success a project is. (Boddy, 2002; Harrison & Lock, 2004, Frame, 2003, Hartman**,** 2000, Cleland, 1988). Hartman (2000) claims that a successful project is one that makes all stakeholders happy.

E-courier measures its project success based on end-users' feedback about their product. The project manager claimed that he identified the project as successful when the customers were happy. LogicaCMG also recognized that their project success is based on the customer feedback: questioning whether they feel happy about the new system and do customers actually get value from it.

Stakeholder management is one of the essential critical success factors for projects. By properly managing stakeholders, their cooperation can be achieved, which leads to project objectives achievement (Cleland, 1988). Failure to recognize the stakeholders' power and requirements and manage relationships with them will cause hassles during project implementation stage and even post-implementation stage. Cleland (1988) pointed out that the objective of project stakeholder management (PSM) is to encourage stakeholder support and curtail stakeholders' adverse effect.

The project manager of eCourier identified the project team and stakeholder requirements management (especially end-users' requirements) as the critical success factors of his project. LogicaCMG's project manager mentioned that the critical success factors vary during project implementation. But in general, he identified several critical success factors relating to stakeholder management: communication, project team, customer involvements. It is shown that stakeholder management is taking a significant role in this project: communication is a strategy in stakeholder management; the project team members are internal stakeholders of the project; customers are the external stakeholders.

Stakeholders are different in terms of their interest, power, attitude, and requirements. And they have different point of views of project success. The complexity of stakeholder management is based on managing and balancing the differences, managing stakeholder relationship to ensure their cooperation.

6.2.2. Identifying key stakeholders

The stakeholder of a project is defined by Buttrick (1997) as those "*who are affected by the project. All those involved in the project are, therefore, stakeholders. However, there are also those who take no direct part in the project as team members, but whose activities will in some way be changed as a result.*" There are many kinds of

stakeholders for a project and they can be categorized into different groups in terms of their power, attitude, influence, etc.

The first step in managing stakeholders is to identify stakeholders. In most cases, the primary targets are the project team, senior managers in the organization, managers in other departments or organizations, and staff (Frame, 2003).

Both eCourier and LogicaCMG identified project team and the end-users of their deliverables as key stakeholders. eCourier also recognized external investors as the key stakeholders. LogicaCMG put senior management team in an important place in the project because they got support from this group of stakeholders. Due to the importance of external stakeholders, it is also essential to identify external stakeholders at the very beginning, but contribute to consider new stakeholders and new roles throughout the project. The project manager of LogicaCMG recognized the external stakeholders are important to the project: the meter manufacturer; Telco; and six main utility companies in UK.

The two project managers both clustered their stakeholders into internal and external groups, in order to make them manageable. Since different group of stakeholders are of different power, interest, attitude, the project managers developed different strategies to manage them.

Stakeholder analysis is essential before taking any action to influence them. Johnson and Scholes (1999) introduce the idea of analyzing not only the power of stakeholders, but also their interest in an organization’s strategy. This idea is also relevant at the level of the project, as it indicates what kind of relationship the manger needs to establish with each group.

Frame (2003) indicated that to manage stakeholders, project managers should influence in four directions: managing the team, managing up, managing across, managing staff and users.

6.2.3. Managing the team

Both project managers have recognized that project team is crucial to their project success. So project team management is an essential task of the project manager.

eCourier claimed that it was important to make the team understand their responsibilities and benefits of the project to them. Before implementing the project, the manager communicated with the team to ensure they understood what the project team was supposed to do, how they were going to work and what would be the benefits.

The project team in LogicaCMG is geographically separated and with various ages. To manage such a team, the project manager pointed out communication is crucial. In order to prevent conflict and increase the working effectiveness, the project manager ensured the team members understood their responsibilities clearly, with the purpose of motivating team work. In addition, agreements were achieved before making any decisions, and sometimes the team members were given autonomy and authority to make project decisions. Empowerment is another motivation method used by the project. By doing this, the project team is working very effectively, which in turn helps to achieve project success.

6.2.4. Managing up

Internal stakeholders do not only include project team, but also “top management, boss, colleagues, managers controlling internal resources, internal customers, etc.” (Frame, 2003) This group of people also takes an interest in the project and the project

manager need to exert influence in the processes of shaping goals, negotiating for adequate resources, or seeking other forms of commitments and support.

Managing up was a challenge for LogicaCMG. The project manager admitted that, as a project manager, one of the most important parts of his job is “selling internally”, and he recognized that internal stakeholders are often more important than industry stakeholders. One and half years ago, the project was awarded investments from the management team. The key to the project team’s strategy was communication, in order to influence this group of stakeholders. The key to success was understanding the reasons why they would not support the project. The project manager could only know how to influence them by understanding the actual reasons for their resistance.

6.2.5. Managing across External Stakeholders

Most projects depend on the cooperation of other departments or external organizations. External stakeholders include “prime contractor, subcontractor, competitors, suppliers, and financial institutions, etc.” (Cleland, 1988). Internal stakeholders are often supportive of project strategies, while external stakeholders may be unsupportive and become enemies of the project in some cases (Cleland, 1988). In addition, it is hard to control their deliverables. As a result, managing external stakeholders is a challenge.

eCourier managed external stakeholders, such as couriers, by letting them know the importance of the project, as well as the project progress. Investors were one of the most important stakeholders in the initial stage. To influence them, eCourier communicated with them using multiple communication channels: newsletter, website with updated content, emails, etc. Formal and structured contracts were also the key strategies for external stakeholders. Besides contract management, in order to manage risks brought by external stakeholders, eCourier did SWOT analysis of those potential stakeholders to decide whom to work with.

External stakeholders produced the most uncertainty and complexity to LogicaCMG. The meter manufacturer brings the most complexity to the project as they have high bargaining power to make changes that would affect the project such as not meeting time deadlines or demanding changes to the specification of the meter. The project manager employed dual-sourcing strategy to reduce the risk. It was indicated that project managers should manage such stakeholders by formal contracts and informally by building trust. Building trust with stakeholders is a challenge, especially with third-parties, but it can be developed using effective communication. As a result, it will be much easier to manage their requirements and control their deliverables.

6.2.6. Managing staff and users

Deliverables of both projects are not for internal staff, but to be marketed to outside customers. For customer stakeholders, the most important issue is when and where to involve them in the project. The purpose of incorporating stakeholders is to understand their current and future needs (Buttrick, 1997). Managing stakeholders' requirements is an essential task in stakeholder management, since their requirements specify what the project deliverables should look like (Frame, 2003). After need identification, the project team should transfer those statements of requirements (SOR) into functional and technical requirements, in order to produce the project deliverables.

The customer is the most important stakeholder for eCourier, not only in the project implementation stage, but also at present. There are two reasons for this: the customer's requirements determined what the functionality of the IT systems should be and eCourier measures the success of their project in terms of customer satisfaction.

To understand customers' requirements, eCourier continuously communicated with them, demonstrating the website and highlighting the potential benefits of using the website. The communication was two-way: transmitting the information to the client, and actively seeking out valuable information from them. eCourier for example tried to understand stakeholders' requirements, while letting them know more about the project. Obviously, the key strategy for all groups of stakeholders was communication.

The functionalities of the deliverables were decided by the end-users' requirements. Most of the online functions were designed in order to improve customer experience. This has produced a user-friendly website. Examples of this include one click address auto fill, ability to arrange multi-drops and easy booking of advance deliveries. eCourier invested heavily in the technical side, but also in the aesthetics of the websites to make it easy for the customer to use, to help the company achieve their target of a number of business transactions conducted online – making people actually want to use it. Now they satisfy customers not only through this objective functionality, but also with soft issues, such as improved online customer service. The future plan of eCourier is to constantly think about ways to make customer lives easier and productive.

For LogicaCMG, the project manager recognized that customers are taking a role as "external driver" of the project, because they may vary the product created slightly, bringing in extra features if the client's requirements change. While delivering the product, the company focused extensively on customer experience and it attempted to approach what the customers really need. They have conducted customer focus groups in order to understand their customer's requirements better. They also collected information online to gather customer feedback. The project manager indicated that understanding and managing the stakeholders' requirements is important. But it is also a challenge, because those requirements are always changing. By gathering feedback constantly, they can ensure client needs are met.

6.3. 3. Risk Management

6.3.1. The sources of risks

Chapman and Ward (1997) define project risk as “the implications of the existence of significant uncertainty about the level of project performance achievable.” In other words, risk can be any factor which affects project performance: it arises when this effect is both uncertain and significant in its impact on project performance. Project risk management is a continuous process that depends on the changes of the internal and external environment of the organisation. The Instant Energy project manager stated that the project was driven by managing around the risks and the strategy is to mitigate failures.

Risk management is important in the overall project management and helps to improve project performance, reduce threats, and increases successful outcomes and the exploitation of opportunities and possibilities. The implementation of an IT project is characterized by many risks. It gives major challenges for project managers. Project risks vary in nature and can arise from many different areas of the project, across all stages of the project lifecycle. Tchankova (2002) states the sources of risks can be represented depending on the environment in which they arise as follows.

- Physical environment

The environmental influence on the people, and people’s influence on the environment are important aspects of this source of risk.

- Social environment

The changes in human behaviour and social structures are another source of risk, for example, strike action.

- Political environment

The political environment can affect projects in different ways and sometimes present opportunities as well. If the government, for example, increases energy prices, more people may switch to prepay energy supply for budgeting purposes. Therefore, there would be more demand for Smart Meters as energy suppliers would need to equip customers with a prepayment meter and would prefer the innovative Smart Meter over the relatively outdated token meters.

- Economic environment

Changing market conditions can largely influence the success of the project. If the UK faces economic recession and depression, it would largely influence both projects. The demand for prepay meter and courier services would be affected by that.

- Legal environment

The legal environment creates risks and presents opportunities as well. eCourier also uses registered patents to protect their technologies and business systems.

- Cognitive environment

The project managers cannot understand and evaluate risk perfectly, there are always questions of how to evaluate the effect of uncertainty on the project and how to understand whether the perception of risk is real.

6.3.2. Risk management processes

Project managers can use risk processes to ensure that risk is mitigated. Simon and Newland (1997) point out risk management consists of six processes, each process is discussed below:

1. Define the project

Defining the project is an initial step, because without a clear project objective, it is difficult to identify what risks may arise. In fact, having an unclear project is a strategic risk in itself. Shared understanding of all relevant key aspects that the project has to achieve is vital to understand project risks. LogicaCMG and eCourier both clearly defined their project objectives with all team members at the pre-implementation stage.

2. Focus the project risk analysis and management effort

Risk analysis can diagnose difficulties and identify a need for changes in the project. The project manager can use a probability-impact grid (See Figure 5) to score each risk in terms of probability and impact of occurrence, in order to find out the highest, intermediate and lowest risks respectively. Each risk would then be treated differently based upon its unique characteristics. In the Instant Energy project, the probability-impact grid was used for analyzing risks and it provided good results.

		Probability		
		Low - score 1	Medium - score 5	High - score 10
Impact	Low - score 1	1	5	10
	Medium - score 5	1	25	50
	High - score 10	2	50	100

Figure 5 Probability-impact grid (Ward, 1999)

3. Identification of risks and possible responses

Project managers need to identify all the foreseeable project risks both internally and externally. They also need to consider which risks could have the largest impact upon the project. For example, the Instant energy project constantly considered four key risks. These were: would it work, will customers use it, would anyone buy it, and will we make return on investment?

After identifying all the risks, the project manager has to have appropriate risk management strategies to deal with different risks. According to Baccarini, Salm and Love (2004), strategies for managing risk cannot be separated from strategies for managing project objectives. Four main strategies have been identified for responding to project risks, they are avoidance, reduction, transfer and retention.

- Avoidance strategy is eliminating the likelihood of specific risk events occurring.
- Reduction strategy is trying to reduce the probability of the risk event occurring.

This strategy is the most common of managing risks strategies. It had been used in both projects to control risks.

- Transfer strategy is to transfer risk in whole or part to another party, in order to avoid undertaking the project risks.
- Retention strategy is to accept risk consequences. Acceptance can be active or passive. The project team can develop a contingency plan to execute if the risk event occurs and accepting a lower profit if some activities overrun.

4. Assessment involving structuring and ownership of risks and responses estimation of uncertainty and evaluation of implications.

In the assessment phase, it helps to improve the understanding of the risk responses by considering how much time and other resources need to be invested in developing responses to particular risks, and who should allocate risk responses. At eCourier, the project manager carried out risk assessment every quarter, helping them to refine existing responses and prompt the development of new responses based on new situations.

5. Risk Planning recommended proactive and reactive contingency plans.

Contingency plans are a second level of plan, and are used for responding to threats or opportunities associated with an original plan. They may never be used, but are available if an event occurs. According to the interview with eCourier, they had massive contingency planning. They had backups of their backups, and they considered scenarios such as power outages, for example. As part of their disaster recovery plan, their office is backed up by generators to ensure that systems never go down, which had been done since the start-up of the company, acknowledging that the items they deliver are important to the customer.

6. Management of planned responses, monitoring and controlling developments and revising plans as necessary.

In the last process, it involves managing, monitoring and controlling the risk management plan. Risk monitoring not only evaluates the performance of risk-reducing measures but also serves as a continuing audit function. Controlling also involves responding to threats and opportunities, and revising performance. At Instant Energy project, the project team monitored and updated risks regularly, in order to keep risks as smooth as possible.

After the interviews with two projects managers, the data shows that both projects had good risk management practices, by identifying, analysing, evaluating and monitoring procedures, and identifying problems hidden in every task. Both project managers mentioned many projects fail because of the late recognition and management of risk. For this reason, they were very careful about risk management.

6.4. 4. Communications Management

6.4.1. The significance of communications management

Project communication commonly has two goals. The first goal is to inform the stakeholders about their tasks, plan and information about the project. The second goal is to create a cooperative and supportive culture within the project. Therefore, having effective communications is an essential part of the part of the project.

Duncan (1996) states project communications management includes the processes required to ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information. It provides the critical links among people, information and ideas that are necessary for success. The general management skill of communicating is related to, but not the same as project communications management.

Communications management is a broader subject, which includes many factors such as the flow of communication and communication channels. The flow of communication has different categories, which include: formal and informal communication; internal and external communication; upward, downward and horizontal communication. Each communication is carried out for different reasons and in different ways. For example, internal communication should be done more regularly, in order to share ides, and make decisions. Although LogicaCMG's team members are located in different offices, they have weekly conference calls to discuss the project progress.

In terms of communication channels, there are numerous types of media available these days. However, the choice of media must be appropriate to the required objectives of communication. The importance of the message and the time taken to receive and reply to it are crucial factors in deciding which approach should be used. At eCourier, they communicated organisational information with their clients mainly through the updated website. For investors, the organisation sent regular emails to inform them what happen in the organisation.

In the pre-implementation stage, the project manager should plan the communication system. It involves determining the information and communication requirements of each stakeholder, who needs what information? when will they need it? how will it be given to them? and how to get feedback? It is necessary to analyse all stakeholders and develop logical view of their information needs and sources to meet those needs, in order to avoid wasted resources on inappropriate technology and unnecessary information.

The project needs to keep records, which may include reports, correspondence and documents describing the project. Project team members also need to keep personal records. At LogicaCMG and eCourier, they both had good records about the projects and shared these within the teams.

In general, having an effective communication system is extremely important for managing project complexity. It consists of the communication channels used, the information contents, the rules of communication and the relationship between these and project objectives. The functioning of a communication system is a process that handles messages in similar and different ways to achieve project goals – a form of communication culture. One of main reasons why both projects could succeed, were due to their project communication systems which provided stakeholders consistent and clear communications which enabled them to build trust, support relationships and provide a fast and easy to understand each other.

6.4.2. Communication for change management

Confirming the work of Sirkin, the people side of managing change is influenced by the management of communication between stakeholders, and whether there was agreement on the nature of project success and what would signify the completion of the project (Sirkin, 2005). At both eCourier and LogicaCMG the team members were

tolerant and encouraging of change, and willing to be moulded to fit the needs of the company. The change process was fully transparent, with those involved being kept constantly informed. This was recommended by Clarke (1994) who states there should be no 'springing surprises' when there are to be organisational changes that affects people, as this would increase the risk of resistance. At LogicaCMG and eCourier, employees felt responsibility towards the success of their project, and were results driven, having clear targets and agreement about what would be regarded as 'success'. This did not only need to be an overall measure of success for the project, but also personal targets consistent with these objectives – for example an 80% closure rate for the marketing team at eCourier, or the number of successful transactions during the Smart Meter trial. In addition to this, the companies illustrate that top management support was of utmost importance, to set clear goals and having the flexibility to be responsive to necessary changes when in the planning stage, in order to ensure that the overall target of the project was on the constant focus.

Communication therefore is an important element of change management. Not only does it allow change procedures to happen smoothly, it helps trigger change by effective communication networks that encourage two-way communication about the project goals, and innovative proposals and actions to meet these objectives. It helps all of the stakeholders understand the changes that are being implemented, regardless of whether these changes are within the project, or in the macro environment.

6.4.3. Communication for stakeholder management

Cleland (1988) raised 7 steps in stakeholder management process: identify stakeholders, gather information on stakeholders, identify stakeholders' mission, determine stakeholder strengths and weaknesses, identify stakeholder strategy, predict stakeholder behaviour, and implement stakeholder management strategy. This theory has shown that to implement a stakeholder management strategy, a project manager must understand their stakeholders well and this is fulfilled by communication.

Understanding stakeholder requirements through effective communication is pivotal to project success.

The communication should be two-way, which means the project manager should transmit succinct messages clearly and make the effort to listen actively. Internal communication leads to all internal stakeholders understanding their responsibilities and how to progress the project. External communication means communicating across project boundaries to manage external stakeholders, and develop external relationships. Project managers can only develop a proper stakeholder management strategy by communicating with them.

6.4.4. Communication for risk management

Risk management is the overall process of analyzing and addressing risk. It should involve as many stakeholders as possible to manage and mitigate risks. Each stakeholder has different interests and experiences on the project success. They can help the project manager to identify risks in different angles and recommend responses. Meanwhile, different stakeholders have different tolerances for risks. The project manager has to balance stakeholders' relationships and work closely with them. For example, LogicaCMG collaborate with Iskraemeco ECL (the meter manufacturer), they worked very closely and talked through many details about Smart Meter features and units in management and technical levels of communication. Ultimately this collaboration ensured the development of an ideal Smart Meter. Overall, better communications management between the project stakeholders is essential for managing risks.

7. Part V Recommendations and Conclusion

This section outlines general recommendations for the IT project managers, in order to help them better manage the projects and achieve good results. At the end of this section, it also concludes the whole case study and outlines results found.

7.1. Building a well structured team

Building a well-structured team with the right mix of skills, experiences and strong commitment is extremely important to project success. The project manager needs to select the right team members, to take advantage of each member's skills, to allocate the correct responsibilities to each member and to motivate them to help in achieving the project's objectives. The project can benefit from using the SFIAplus standard, when recruiting project members, managing the project members' skills and planning development activities. It helps the project manager to identify the project team skills, plan relevant training and develop activities.

7.2. Defining success criteria clearly with stakeholders

The common criteria for project success are for it to be delivered on time, within budget and to meet quality requirements. However, the criteria for success should be much wider. Different projects may determine and measure varying degrees of success and diverse objectives for success, in order to manage difference in stakeholder definitions. Some projects can still be considered a success even if they only meet the quality requirement, while failing to deliver the original time and budgetary objectives. The project manager must continuously obtain and check for agreement with all stakeholders on the success criteria and it helps them to focus on the same direction of success and avoid conflict.

7.3. Understanding market needs

Before defining a product or a service, it is important to understand the market needs and potential, because innovative products and services depend on customer acceptance. In order to stand out from the market and attract more customers, a differentiated product or service that is understandable and determine in concert with a sample of customers is the key to success.

7.4. Understanding and managing technical issues

In order to achieve a high quality specification, low cost and less time, the project manager must understand and manage technical issues properly. Technologies need to be found and tested to ensure that it will achieve project objectives. In some cases, this testing of technology may reveal new business possibilities that had not been previously considered. The project manager also needs to be aware of technological development, adopt these in the project whenever necessary, and ensure they maintain a healthy step ahead of their competitors.

7.5. Managing the project through the proposed control cycle

From the two cases studies, a model has been created to show current best practice in the IT industry. The control cycle (See Appendix 2) consists of distinct and recognizable stages, which are planning, monitoring, reporting, decision-making, corrective actions, and revising. Communication is taking a role as driving force in this cycle. Internal and external environment both can influence the control cycle. The project usually starts from the planning stage and then monitoring the project performance, reporting to internal and external stakeholders and the making of decisions by the project manager and the team. Corrective actions must be adopted if it is necessary. The project manager also needs to keep revising the project plan, in order to ensure the performance of the final deliverables. Overall, all the critical

success factors (See Part III) are involved in the control cycle. The project manager should manage those factors whilst implementing the control cycle. Activities in each stage are listed in the following:

Planning

Identifying project objectives, scope, risks, stakeholders

Market research

Monitoring

External environment:

Political, social, technological, environmental, legal (PESTEL)

Industry environment

External stakeholder, such as suppliers, customers

Risks

Internal environment:

Internal stakeholders: project team, management team

Project performance: cost/time/quality

Risks

Reporting

To external stakeholders: suppliers, investors

To internal stakeholders: project team, management team

Decision making:

By project manager

By project team

Corrective actions

Change management

Risk management

Revising

Initial project plan

8. Conclusion

This report sets out to study the two successful cases of IT development awarded by BCS -- the eCourier project and the Instant Energy project – to study their critical success factors and to generate recommendations for other IT projects.

Sources of complexity are studied in order to seek for the reasons of project failure. It is concluded that for all IT projects, the sources of complexity are based on the project environment: macro-environment, micro-environment, organizational environment, and the project's internal environment. The complexity is from managing issues in these environments, coping with change to these issues and managing relationships among the entities within the environments. Handling complexity leads to high success rates.

The two cases are analyzed in details in terms of the internal and external factors that contribute to and reduce complexity. In addition, it was found that there are some similarities about the success factors between the two projects: first-mover advantages, experienced and skilled project manager, a structured project team with a range of skills, and good planning and research. But the two projects have different success measures and target markets.

Based on the secondary research, it is concluded that critical success factors for general IT projects include: market research, project plan, technical issues, change management, stakeholder management, risk management and communications

management. These factors are important during the whole project cycle, but may have differing implications during different stages of the project cycle. Within those factors, change management, stakeholder management, risk management and communications management are important during the entire project cycle. For those two projects, these four areas were researched in detail. Communications management is taken as a linking point, to connect the other three topics.

Based on telephone and face-to-face interviews, in addition to secondary research, it was found that the four areas are significant to project success. If the risk, stakeholders, change, and communications are managed properly, the complexity will be reduced and the chances of success rate will be increased.

Change is inherent in the complex IT projects studies, occurring on both social and technical levels. The two case studies illustrate that correct change management procedures undertaken at the right time can produce IT project success. Both organisations considered the project team and customers to be the most important groups of stakeholders. Managing stakeholder requirements were recognized as the most important part in stakeholder management. It can also be concluded from the case studies that external stakeholders caused the most uncertainties and challenges to the projects. LogicaCMG and eCourier both carried out risk assessments regularly and treated both the risks and the benefits very carefully. Both projects had an effective communication system, where internal and external communication could be conducted easily.

Five recommendations were provided; building a well structured team, defining success criteria clearly with stakeholders, understanding market needs, understanding and managing technical issues and managing the project through the proposed control cycle. A project control cycle is developed as a recommendation, giving suggestions to project managers about how to involve management issues while controlling the project, in order to achieve final project success.

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10. Appendix 1: Skill Mapping against the BCS SFIAplus Model

10.1. Project Team Skills

The five team members involved in the **eCourier** project were identified as bringing the following Skills (all at generic Level 4 or above) to the project:-

Team Member No.	SFIAplus Skills
1	Management and operations (COPS) and Systems development management (DLMG)
2	Business risk management (BURM)
3	Web site specialism (WBSP) and Information assurance (INAS)
4	Benefits management (BENM)
5	Project management (PRMG)

The seven team members involved in the **Instant Energy** project were identified as bringing the following Skills (all at generic Level 4 or above) to the project:-

Team Member No.	SFIAplus Skills
1	Business analysis (ANAL) and Programming & software development (PROG)
2	Programme management (PGMG) and Project management (PRMG)
3	Stakeholder relationship management (RLMT) and Supplier relationship (SURE)
4	Systems design (DESN) and Programming & software development (PROG) and Web site specialism (WBSP) and Systems testing (TEST)
5	Business analysis (ANAL) and Programming & software development (PROG)
6	Systems Architecture (ARCH) and Systems design (DESN) and Programming & software development (PROG)
7	Consultancy (CNSL)

	Technical specialism (TECH)

10.2. Mapping to the SFIAplus model

The team member skills were highlighted against one relevant sub-category and one relevant industry model.

BCS SFIApus Matrix Business Change sub-category

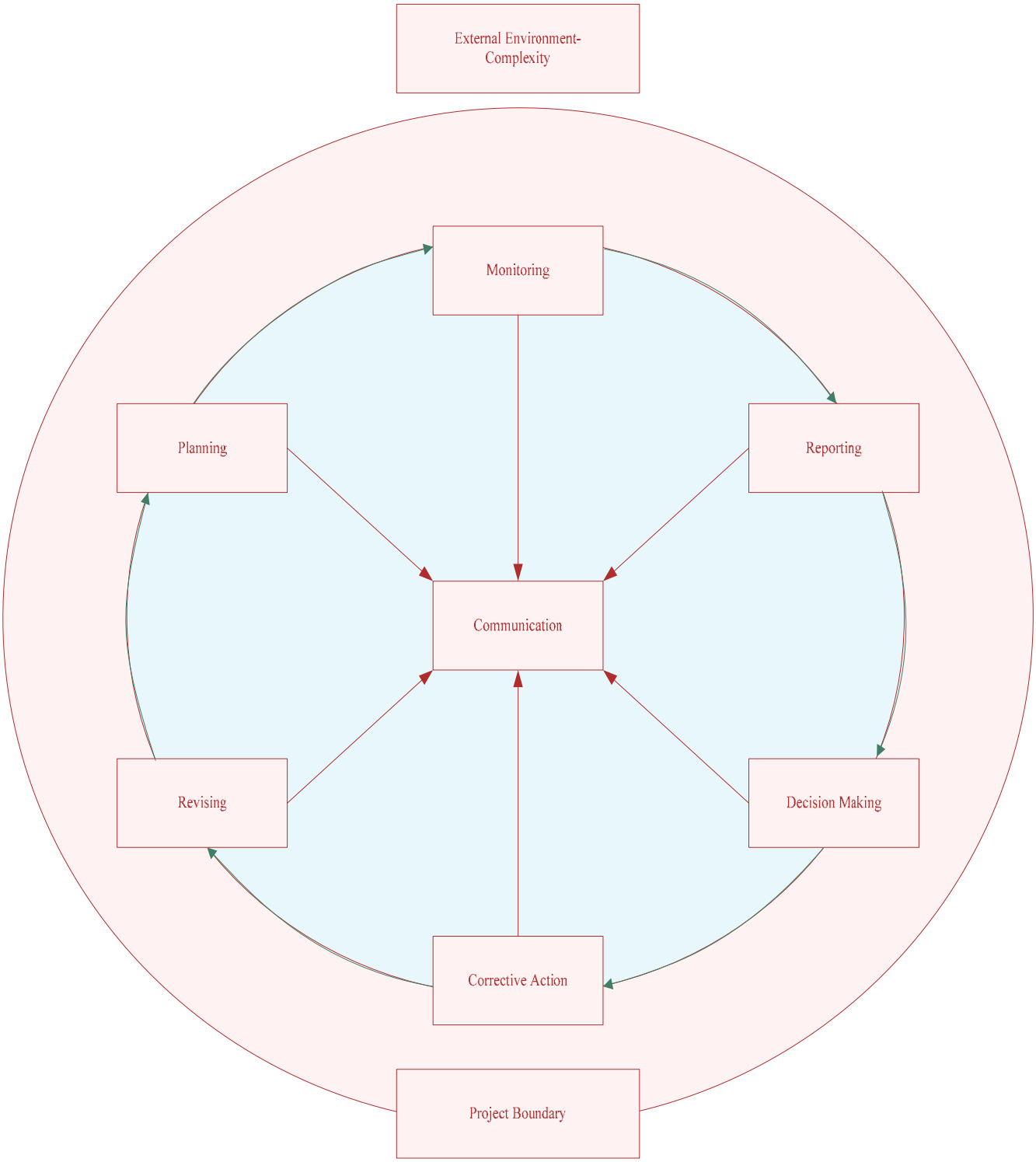
Skill	*Code*	*eCourier*	*Instant Energy*
Business analysis	ANAL		X
Programme management	PGMG		X
Project management	PRMG	X	X
Business process testing	BPTS		
Change implementation planning & management	CIPM		
Organisation design & implementation	ORDI		
Benefits management	BENM	X	

BCS SFIAplus Systems Development Industry Model

Model Area	*Skill*	*Code*	*eCourier*	*Instant Energy*
Feasibility Study and Analysis	• Non-functional needs analysis • Usability evaluation • Business Analysis	UNAC USEV ANAL		 X
Design	• Systems design • Network design	DESN NTDS		X

Implementation	• Programming & software development (Web site specialism)	PROG WBSP	 X	X X
Testing & Imp.	• Systems testing	TEST		X
Maintenance	• Application support	ASUP		
Specialist and Support Skills	• Business process improvement • Data analysis • Database design • Systems Integration • Porting/software integration	BPRE DTAN DBDS SINT PORT		
Project Management and Documentation Skills	• Systems architecture • Systems development management • Content creation • Programme management • Project management • Benefits management • Stakeholder relationship management • Configuration management • Change management • Project office	ARCH DLMG DOCM PGMG PRMG BENM RLMT CFMG CHMG PROF	 X X X 	X X X X

11. Appendix 2: Project Control Cycle



12. Appendix 3: List of researchers

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