INTEGRATING AN INTERNET MANAGEMENT SYSTEM INTO A VIRTUAL PRIVATE NETWORK

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ABSTRACT

Integrating significant e-business applications into an established environment is a task for which established project management techniques and development models have not explicitly catered. We investigate the strategies employed for managing the integration of an Internet Management System (IMS) into an organisation's virtual private network. This innovative, mission critical technology was unprecedented in the organisation's history, and existing project management models had to be adapted. Furthermore, the integration of this system into a local area network had no precedent in the vendor's or developer's history. With many unknowns, effective risk-management was therefore required. Our case study reveals how the project was impacted by technical complexity, the sharing of required expertise and project management issues including, communication, document management and lack of dedicated project personnel highlighting some lessons learned.

Keywords: Application Integration, Project Management, VPN

1. Introduction

Information made available via a corporate network crucially underpins the services of many contemporary organisations. In practice, however, it has become common that many organisations subsidise their employees' personal use of the Internet in this process. Managing access, authentication and billing so that legitimate users have high-quality online services without assuming the costs associated with personal misuse is a challenge (Sederberg, 2000).

Moreover, the *integration* of innovative network applications for the management of online services is an important development for contemporary organisations (Cohen, 2002). Between 2002 and 2005, the numbers of consumers using online account management will more than double (McCoy, Morello, Miklovic, Earley, Nicolett, Fulton & Stone, 2002). The internet management system in this research was integrated into an organisation's (MU's[1]) local area network (LAN), to enable the elimination of the costly dilemma of escalating expense while leveraging its services as an Internet Service Provider (Digiquant, 2002).

We discuss several unique aspects of this management system's technical environment, revealing the methods used in the sharing of expertise, and covering several project management related issues such as communication, document management, dedicated personnel, risk management and lessons learned. Adding uniqueness to this project was the fact that the particular IMS product chosen had never been previously implemented into a local area network.

This research examines the strategies employed for managing this project including a) purchase and implementation of off-the-shelf technology, adapted to MU requirements by internal and external personnel; b) implementation of the IMS in parallel with the old system; c) use of contingency strategies to minimise risk; d) use

[1] The organisation is a large multicampus Australian university, designated as MU for present purposes

of consecutive incremental contacts with the vendor; e) inclusion of a vendor representative as a project manager and f) outsourcing of external (foreign) technical expertise. The use of non-dedicated personnel on development teams was another strategy adopted due to conflicting resource demands.

2. Research Approach

An **interpretive approach** was adopted for its relevance to the specifics of this case. In contrast to positivism, interpretivism does not impose predefined dependent and independent variables on the research process, but focuses on the complexity of human sense making in a particular setting (Klein & Myers, 1999). An interpretive epistemology enables the researcher to understand human thought and action in social and organisational context from the actor's perspective not just external or observable behaviour (Johnson & Duberley, 2000). The objective of interpretivism is to learn what is meaningful or relevant to the people being studied and to increase understanding of the phenomenon within the cultural and contextual boundaries (Trauth, 2001).

Qualitative inquiry was the chosen strategy employed to collect, and represent data for this study. Amaratunga et al. (2002) proposes that the major feature of this approach is that it focuses on events in natural settings to obtain a realistic perspective. Such data provide vivid, rich descriptions in real life context; and have strong potential to reveal complexity.

Moreover, a **case study** approach was deemed appropriate as the research addressed a domain where theory is underdeveloped (Winegardner, 2001). A case study approach enables investigation of contemporary phenomena, and is useful when the boundaries between phenomena occurring and the context are at times not clear (Yin, 1994). As the study aimed to explore 'how' and/or 'why' the organisation uniquely developed the VPN, and the researcher did not always have control over events, the case study approach was particularly appropriate.

The **unit of analysis** is a critical factor in a case study (Yin, 1994, p. 20). The unit of analysis in this research was the project, which is broad enough to include management, system development procedures, and communication processes.

The research questions were designed to address factors acknowledged in literature as being critical to the success of systems development projects. The most common measures of success are: a) project finalisation within the allocated timeframe, b) project costs within budget, c) achievement of specified technical performance, and d) attainment of quality standards as defined by client or users (Kerzner, 2000]

The **primary question** asked "*How do Information Systems Developers integrate an innovative, yet mission critical, Internet Management System into a virtual private network within a complex organisational environment?"* and its purpose was to direct the inquiry of how the integration was managed, the problems encountered, and lessons learned. The secondary questions focused on specific elements of the case. **Secondary:** (1) How did the organisational context (policy, resource management and work practices) impact on the IMS project? (2) How did the team collaborate with stakeholders in the development of the IMS? (3) How did the developers draw on their skills and technical body of knowledge to develop the IMS? (4) How were systems development and project management models utilised in the IMS project?

In theoretically underdeveloped areas, where phenomena are new or largely unknown, it is premature to quantify these at the outset. Strauss and Corbin (1990) claim that in contrast to quantitative methods, qualitative methods convey intricate details of phenomena more effectively. A qualitative inquiry strategy analysing the project as a whole, was therefore chosen, which was also suited to investigate the social phenomena relevant in the project.

Initial interviews were conducted with six key stakeholders from the IMS project team and one additional staff member. Each of these stakeholders represented a critical area of the project and organisation. For example, the program and project managers, the Associate Director or corporate technologies infrastructure, technical personnel who worked in key areas of the VPN (meta-directory & telecommunications network) and IT call centre help desk personnel. Therefore, the **type of sampling** utilised was non-probabilistic sampling and more specifically expert sampling which is a subcategory or purposive sampling (Mays & Pope, 1995 & Trochim, 2002). The purpose of which is not to establish a random or representative sample but to select respondents who can be identified with the social phenomenon being studied. Moreover, the respondents were selected because they had access to important sources of knowledge relevant to the research and were experts in their individual fields (Mays & Pope, 1995).

Involvement in the interviews was voluntary which conformed to a fundamental ethical principle of social research (Neuman, 2000). Six of the interviewees were members of the IMS steering committee. The interviewees included:

Interviewee 1. – Director of MU's Information Technologies Department.
Interviewee 2. – Associate Director of MU's Information Technologies Department.
Interviewee 3. – MU Program Manager.

Interviewee 4. – Internal Project Manager.
Interviewee 5. – External Project Manager.
Interviewee 6. – IMS Software Engineer (meta-directory & telecommunications network)
Interviewee 7. – MU Call Centre Representative.

The **interview technique** used was semi-structured, combining in-depth (open-ended questions) and questionnaire based (formal questions) interviews. In-depth interviews tend to be used when subjects are relatively few in number, and when information obtained from subjects is expected to vary considerably and in complex ways (Ticehurst & Veal, 2000). The technique enabled multiple interviews with the same respondent to either clarify ambiguity or for seeking new information (Amaratunga, Baldry, Sarshar & Newton, 2002).

The follow up research, one year later, entailed interviews with key project personnel to explore if improvements had been made to work practices in response to the knowledge gained from the lessons learned in the IMS project. Once again the form of sampling utilised was expert sampling as the respondents had access to important sources of project and technical knowledge and were experts in their individual fields.

In addition, a small sample of 21 typical users (13 males and 8 females) was also surveyed to gain insight into user perception of the service. Eight were in the 16-25 year age group, 10 in the 26-35 year age group and 2 were in the 36-45 year range. For the survey, non-probabilistic, purposive sampling was utilised (Mays and Pope, 1995 & Trochim, 2002). Survey respondents were selected because they were current users of the system and not MU staff or project members. That said, the criterion-selected respondents were then randomly chosen on a convenience basis. They could therefore present a perspective from a group of users who were not involved in system development, and would have less reason to exaggerate the utility of the IMS system.

The user data gives an external indication of eventual system implementation quality. The multi-perspective analysis provided by the different data sources is a validation method typically employed in case studies to enable **triangulation**. Questions of subjectivity/objectivity, validity and reliability in this research are dealt with by means of triangulation, and in-depth work (Yin, 1994).

Data collected and research findings were consistently fed back to participants throughout the course of this research to check for accuracy, consent for use, and for comments on the interpretation and drafts. Many reviewers consider '**respondent validation**' of qualitative research to be a mark of quality, and as a way to demonstrate rigour (Lacey & Luff, 2001).

3. The Case

The case was selected as being of intrinsic value, epitomizing an unprecedented and unique integration project for both MU and the vendor in an unknown area, and with implications for e-service implementations more generally. It promised to highlight issues arising, and solution strategies taken, in a context where an estimated 70% of projects fail due to a new project management environment.

3.1 Case Description

MU provides Internet access via their virtual private network (VPN) to approximately 3,500 staff as part of their work and a further 27,500 registered and paying members. The activities of MU are located over six geographically separate sites and all sites have direct access to MU's VPN and online services.

MU had experienced an exponential increase in Internet usage costs .The inadequacy of the previous time-based quota system to assist in the recovery of these costs was the catalyst for MU management to change to a new management system. The functionality sought of the application included, electronic accounting, user authentication and tracking, and tightening security on the organisation's VPN.

At the time of the project, MU was engaged in multiple concurrent projects. These projects were administered by a program manager under the direction of a steering committee. For the purpose of the IMS project, MU outsourced an external project manager from the IMS agent who managed the project in collaboration with an internal project manager. The external project manager was a certified project manager, and therefore held specialist project management expertise. The internal project manager had technical and organisational network expertise. Accordingly, the internal project manager had overriding authority on all technical decisions relating to this project. The sharing of authority between project and operational managers as reported by Kerzner (2000) is a technique that is used in many successful IS projects.

MU's escalating costs had increased from $900,000 in 1999, to $1.6 million in 2001, with further increases projected for 2002 onwards. These increases in expenditure were occurring at a time when telecommunications rates, which is part of the total network operating cost, had been reduced. Of the $1.6 million costs in 2001, only $1 million of usage was recorded and therefore were accounted for by the previous logging system. The remaining $600,000 was not recorded by the existing system (which logged time rather than download volume, and did not capture FTP or ICQ traffic) and thus could not be charged to relevant organisational sub-units. In addition, MU was in the process of implementing a PeopleSoft®[2] enterprise system, a meta-directory, and a new e-mail system, all of which contributed to the requirement for a new authentication system (Interviewee 4).

3.1.1. Alternative packages

The search for a potential Internet management application began with the development of a request for offer (RFO). The meaningful responses to the RFO were short-listed and vendor interviews conducted. Only two other vendors responded to the RFO. One of these packages was a niche product, for which it was considered that it would not be scalable to MU's requirement. The other was being used in a similar situation by another Australian company: negotiations had begun with the vendor but ceased due to inflexibility concerning MU's specifications in regard to price and licensing agreements.

4. Technical Environment

An intranet is an interconnected information space, commonly belonging to a single corporation with well defined security boundaries that supports exclusive sharing of information with a prescribed user community (typically organisational members) (Karlsbjerg, Damsgaard & Scheepers, 2003). Conversely, extranet technology is typically used to support communication and data transfer between members of a value chain (e.g. partners or supplies) (Zinkhan, 2002).

The IMS supports and secures exclusive information sharing with MU members. Furthermore, the IMS has been deployed on MU's LAN. Therefore, the network in this case study would be classified an intranet. However, it also provides a gateway for product delivery from a number of MU's external suppliers. The product in this situation is information (i.e. electronic documentation, graphics and video). Hence, the term virtual private network (VPN) has been utilised.

Since ready-made intranet technology and support has become more accessible, intranet implementations have become less problematic. However, when the architecture incorporates disparate applications as well as Enterprise Resource Planning systems and multi-services the complexity increases (Alter, Ein-Dor, Markus, Scott & Vessey, 2001).

4.1. Innovation

IS innovation covers a range of activities involving new products or services, new forms of technologies and new forms of organisational management and service delivery. Conceptually, this may involve technological aspects (hardware & software) and new forms of organisational work, methods and business processes. Each type of innovation may involve these elements in differing proportions and the innovations generally act to reshape organisational IS tasks (Swanson, 1994).

The innovation inherent in this case is primarily of a technical nature due to the assortment of disparate network technologies that had not been previously used together. Accordingly, the implementation process called for a unique set of work practices and the technology produced new management and service delivery processes for the organisation. Although the particular process forms utilised themselves were not new, the management of the technical innovation required adaptation of existing practices and a certain amount of dynamic decision making given the unprecedented nature of this type of project in either the organisation's or the vendor's history.

5. Project Management

5.1. Technology acquisition

In network development projects, the choice of acquisition strategy (make or buy) remains a complex management decision enhanced by the ubiquity of available technologies. Rand (1993) suggests that make or buy decisions need to include both *strategic* (investment or divestment in capacity) and *tactical* (optimisation of current capacity) considerations in the decision framework (Karlsbjerg, Damsgaard & Scheepers, 2003). Such decisions involve tradeoffs between control over technical knowledge and economic exchange with external providers (Gumport, 2000).

5.2. Models and techniques

Integrating significant e-business applications into an established environment is a task for which established project management techniques and development models have not explicitly catered. One industry analysis estimates that 70% of integration projects have failed to meet their original targets (Dwyer, 2000). As e-business application integration projects have new and unique demands, much of the associated knowledge must be discovered, or adapted from other experiences.

[2] All trademarks are hereby acknowledged.

Since the 1950s the waterfall model or classic systems development life cycle, (SDLC) has served as a standard for the critical design activities in systems development (Allan, 2002) encompassing numerous proprietary variants and house styles. Despite considerable critique of its limitations, and the emergence of evolutionary, iterative and rapid application development approaches, SDLC development models nonetheless form the typical underlying basis for many system implementation practices. One weakness of this model is that the completion horizon for the entire system is assumed. In complex systems with independent modules that are affected by volatility to different degrees this assumption is invalid (Seilheimer, 2000). In the IMS project, as with other projects where there is little or no precedent, unknowns such as application compatibility and functionality prevent an accurate determination of project related liabilities in terms of finance, human resource and time. In keeping with MU's house policy however, a particular SDLC-based approach was initially adopted in guiding the implementation.

5.3. Critical success factors

Mathiassen and Purao (2002, p. 83) suggest that competencies of a development team may vary during a project. However, the top five critical success factors they have identified across the SDLC are: 'business knowledge, good communication skills, technical expertise, analytical skills and good organisational skills'.

5.3.1. Business and organisational knowledge

The embedded nature of an integrated system such as the IMS requires focus on organisational structures (i.e. mechanisms for communication & negotiation, process committees, mechanisms for relaying information, business liaisons and project managers, written methodologies) that influence the process of integration as well as technical functionality. It is important to understand the organisational structures because they can define, control and inhibit the integration process.

E-business projects are inherently complex because they impact on multiple organisational areas for example, policy formation, operational procedures, transactions, business rules, diverse applications, and technical infrastructure (Lientz & Rea, 2002). Schultz (2002) states that even experienced project managers struggle with e-business projects because they bring new and unfamiliar scope. Simply passing acceptance tests to determine system errors is not enough. The requirements that Web applications must fulfil consist of the following (See Table 1).

Table 1 - Requirements for Web-enabled Applications over Client/Server Applications

Requirements	**Definition**
User Acceptance	Web-enabled applications cater to a more heterogeneous user base with the addition of external users. Internal staff will often use an application because they have no other option but external users are less forgiving of application deficiencies. Therefore, must meet extended criteria for user acceptance. Furthermore, to achieve effective visual design, navigation and superior customer service web project managers must manage graphic designers and copywriters who were not previously part of the IT landscape.
Robust Security	Web applications must be deployed behind a firewall and support encryption for sensitive data transmission. Creating user profiles for authentication is a requirement. The additional security and functionality required for e-business systems adds scope to the development and testing environment.
Infrastructure Capacity	Many existing infrastructures have insufficient capacity, recovery capability and not enough storage capacity. Web applications demand faster performance, much higher operational time (often 24/7), and thus lower down time.
Multiple Browsers	Applets and pages must execute and display on multiple browsers therefore Web application project managers must plan to write and test their web application for multiple browsers.
Service Speed	Accelerated service speed is an additional expectation of Web applications which cannot be met by a batch approach used in client server environments. A web application must be linked into the enterprise system for the authentication of users, and validation of credit status. The performance of credit card transactions is a complex process even with the assistance of banks.
Increased Pressure	Project managers contend that the demands in Web application projects are more intense than in Client/server software development. Some address this pressure by executing the project in several releases or conducting concurrent projects.

Adapted from Schultz (2002)

In addition, Web-enabled systems interface with a range of applications external and internal to an organisation. Thus, competence in a variety of languages is often required. Application development and delivery languages are varied, ranging from a single development language and multiple output formats (e.g. Java, and Visual Basic, HTML, Oracle™ Developer 2000 maps PL/SQL) (Standing, 2002).

5.3.2. Communication and collaboration

Integrating new enterprise systems necessitates integrated organisational change and attending to technical and human aspects of IT concurrently (Roberts, Leigh & Purvis, 2000). Akkermans and van Helden (2002) conclude that interdepartmental communication and collaboration within the project team are the core processes for project progress. The complexity of this process is heightened in an environment where stakeholders are heterogeneous (Gumport, 2000). In this project, nineteen distinct stakeholder groups were involved in the integration; sixteen internal to MU and three external technical specialist groups.

Building effective communications between developers and users has been another recurring theme in IS literature (Keil, Tiwana & Bush, 2002), and collaboration between IT and business stakeholders is equally crucial, with business setting the strategic direction and IT specialists assessing feasibility (Clarke and Doherty, 2004). Effective collaboration with an organisation's operational departments will enable the IT specialists to develop a better understanding of the functional requirements for a system and help provide more complete and accurate requirements (Roberts, Leigh and Purvis, 2000). These authors also contend that active participation will assist in promoting more realistic system expectations, create a spirit of ownership and reduce potential resistance.

The management of documented communications is also critical for project success (Tompkins & Hall, 2000). Larger projects tend to require much more administrative effort in document management, handling requests, communicating upgrades, and tracking work (Schultz, 2002). Focusing on document management, consistency in documentation, effective usage and storage enables an organisation to indirectly improve project performance (Eleranta, Hameri & Lahti, 2001).

5.3.4. Technical expertise

To acquire the technical knowledge needed for large enterprise system endeavours, strategies such as outsourcing specialists or making vendors an integral part of project processes are often recommended. This form of participation can function to lower knowledge barriers associated with the deployment of specific systems development techniques, technologies, and methodologies. In order to enhance knowledge transfer vendors and/or consultants must form an integral part of the project team (Ravichandran & Rai, 1999/2000).

5.3.5. Project control (organisational skills)

Ribbers and Schoo (2002) claim that project failure is generally attributed to ineffective project management and control, incomplete goal specifications, communication and an underestimation of project complexity. Butler and Fitzgerald (Butler & Fitzgerald, 2001) highlight project, coordination, and control of development personnel and users as being of importance in addressing project complexity. Statistics from the Standish Group's indicate that IT projects exceed their budget by 90% and slips off its schedule by 120% on average (Keil, Tiwana & Bush, 2002).

5.3.6. Non-dedicated project teams

Kerzner (2000) observes that the use of non-dedicated IT teams is a predicted direction for project management except in very large organisations that can afford dedicated teams. However, in organisations where non-dedicated project teams are built from IT personnel who are spread over concurrent projects if the personnel are not managed effectively (e.g. updated regularly on project status), it may result in an unfocused team and ultimately an inefficient project and/or poor system quality.

5.3.7 Stakeholders

Nineteen stakeholder groups were involved in this project. Stakeholder thinking proposes that, for successful design, development, implementation and use of a system to occur project management must accommodate the diverse interests of heterogeneous stakeholders (Adelakun & Jennex, 2002). A progressive evaluation of business expectations, technical requirements and user views is indicated, with specific groups of stakeholders critically relevant at each phase. In final project evaluation, without the commitment and support of these stakeholders, a project may not be considered a success even if the agreed time, budget and scope are met (Bourne & Walker, 2004).

5.4. Risk Management

Applegate, Austin and McFarlan (2003) outline criteria for assessing sources of risk in implementation projects. They identify that the three important dimensions that influence risk are project size, experience with technology and project structure. From their research they have developed a matrix for assessing the inherent risk (See **Figure 1**).

		Low Structure	High Structure
Low Company-Relative Technology	Large Project	Low risk (very susceptible to mismanagement)	Low risk
	Small Project	Very low risk (very susceptible to mismanagement)	Very low risk
High Company-Relative Technology	Large Project	**Very high risk**	Medium risk
	Small Project	High risk	Medium-low risk

Figure 1 - Project Implementation Risk
Adapted from: Applegate, Austin & McFarlan, 2003, p. 582

There is no agreed universal method to manage different projects. However, Applegate et al. (2003) suggest that, the general methods for managing projects consist of four fundamental types. *External integration* - various tools (organisational & communication) used to link users at managerial and lower levels. *Internal integration* - devices such as personnel control to ensure the team functions as an integrated unit. *Formal planning* - tools to help structure the sequence of project tasks, and estimate their related time, cost and technical resources. *Formal results-control* - mechanisms management can utilise to evaluate progress and identify potential discrepancies. On analysis using this framework, this project fell into a very high risk category.

6. Issues and Findings

The process of integrating innovative and disparate applications (from unrelated vendors) into a VPN as in this case is complicated because of unknown compatibility issues. Much of the available enterprise software was built on technology that failed to address the realities of a multi-vendor world (McCoy, 2002). The lack of standardisation meant that the technical expertise required to integrate products from multiple vendors was sparse and therefore costly (McCoy, 2002). Furthermore, application integration efforts raise significant challenges because of the diversity of available technologies and because the existing enterprise application integration frequently cuts across departmental and business boundaries (McKeen & Smith, 2001).

The IMS integration process incorporated a range of organisational departments and operational areas, requiring information from a broad cross section of stakeholder groups and technical personnel. Stakeholder meetings were arranged as required, for example, if business policies that impacted on system integration needed to be determined relevant business and technical staff were convened.

To define user requirements, at the beginning of the IMS project the project team identified the key stakeholders. These groups were then represented in workshops (semi-formal meetings). Project strategies were determined via brainstorming sessions and design documents were developed from these sessions.

Initially, the project team proposed to have all relevant stakeholders represented in project meetings but as the project evolved, priorities in other projects took stakeholders away. There were oversights where stakeholders were not included in meetings. For example, the team realised part of the way into the project that there were no Oracle™ representatives involved in stakeholder meetings and that their input was critical to the project. Moreover, although the IMS project was belatedly conceptualised as an enterprise application integration, it was initially viewed as a networking solution and the business aspects of the system were not given adequate priority. Hence, some personnel that should have been included in initial planning sessions were not.

The nature of the work practice at MU dictated that operational staff also performed their usual operational jobs as well as project work. With a variety of concurrent projects running, project team members were required to work on the most immediately critical project issues. MU's internal work force was not big enough to accommodate dedicated teams for each project.

One advantage to this approach was that team members had the necessary expertise and understanding of the organisation's environment and had vested interest in ensuring that the most appropriate solutions were implemented as the individual team members would become responsible for different technical aspects of the subsequent support. However, a disadvantage was that members were called away to other projects during the IMS integration and this impacted on the integration and project communication processes and continuity of the project. The tactic employed to help refocus team members was to utilise a checklist, which was reviewed and updated from daily to twice per week with every task being assigned to a team member.

The use of a non-dedicated team on this, time-restricted project, gave rise to a number of problems. The problems noted by the External Project Manager were: (1) Some decisions had to be made without the time to adequately evaluate alternatives. (2) System related testing was often left to the last moment. (3) It was more difficult to keep technical personnel informed of project changes. (4) The part-time nature of the team slowed the progress of the project.

The description of these problems supports Kerzner's (2000) argument that in organisations where non-dedicated project teams are used, if the personnel are not updated regularly on project status, the potential result would be an unfocused team and ultimately an inefficient project and/or poor system quality.

Effective team communications in this case was critical to the collaborative effort (Akkermans & van Helden, 2002). This function became more complex when specific project team members were working on concurrent projects and therefore these team members were not consistently available for team meetings. Therefore, a common project plan and production support plan was needed to be owned by all project team members for all associated project activities. Moynihan (2000) found that project managers viewed a lack of project ownership as being more detrimental to project success than requirements uncertainty. Furthermore, keeping all team members aware of the project's status was important for rallying their support, gaining commitment, and fostering communication among team members (Schultz, 2002).

A carry on effect of the non-dedicated project team was that project personnel struggled to document project activities and then manage this resource. This situation created serious problems in the development process because when problems arose during the integration, technical personnel had difficulties communicating with the necessary people (Interviewee 4). Furthermore, because not all team members had access to up-to-date documentation situations arose where development continued while following incorrect requirements. A project team must be able to adapt to changing circumstances without losing sight of the organisation's strategic goals.

A plan for communication management was included in the project management plan as a project deliverable to be signed off as a milestone in the project schedule. Additionally, a communication management role was detailed in the plan. However, although these criteria were prescribed and a central repository for project documentation was available, there were no dedicated personnel appointed to administrate this resource.

Digiquant™ (formerly Belle™) is the developer of the IMS. Digiquant is a Danish company whose agent in Australia is Getronics™ (a Dutch company). The fact that an IMS had not been previously implemented into a LAN environment dictated the need to outsource some of the required technical expertise. Digiquant was familiar with the use of the IMS via dial-in connections but not LAN based connections. LAN based connections enable much faster response times (Digiquant, 2002). Getronics in Australia was not familiar with the application but they did have access to technical expertise in Singapore and Denmark.

Initially, teleconferences were established for communication between the IMS project team and Digiquant specialists in Singapore. Communication was hindered because of language barriers, causing delays in resolving technical issues. Therefore, Getronics had experts from the application development team brought to Australia from Singapore and Denmark for a six-month period. In addition, the aid of a Cisco™ specialist was employed to assist in solving technical issues with the Cisco component of the IMS system. The assistance of these experts hastened resolution of integration issues. This form of participation can function to lower knowledge barriers associated with the deployment of unique systems development techniques, technologies, and methodologies (Ravichandran & Rai, 1999/2000).

In the MU case, sub-components of the IMS system development were interrelated. Thus, progress in IMS development was restricted by the findings of subsequent component and module tests. Accordingly, a highly flexible status was put on the scope and functionality agreements, which were later, moved to medium flexibility when the project team and the vendor had a better understanding of the situation. Therefore, it was necessary for the team to use an iterative version of the waterfall model for software development and in the construction of the project management plan.

Accordingly, the project scope (time horizon, cost & human resource) could not be accurately established. Therefore, requirements could not be frozen. This meant that there was the potential for the project to extend beyond the feasible commitment for the organisation. It is a truism that no organisation has an unlimited resource of finance, time or human capital (Robbins, Bergman & Stagg, 1997). Bronzite (2000) found the major reason for system failure was the inability to establish accurate requirements, and the present study corroborates this finding.

To a large degree, risk was reduced by integrating the IMS in parallel with the existing system, and testing the integration incrementally in the small test environments. This ensured that MU could continue to operate while in the integration progressed. Furthermore, MU reduced its risk by including vendor specialists and agent representatives on the project team, and by negotiating consecutive incremental contacts. On the successful completion of an increment the follow up stage was initiated. Stage one entailed the scoping of requirements detailing any additional activities that might be required of the agent. This enabled both parties time to feel each other out and assess whether their organisational philosophies, work approaches and conditions were compatible and assisted in establishing an environment where issues were worked through collaboratively. Stage two covered the finalisation of the project.

When the elements of the project implementation risk matrix (Figure 1) are applied to this case the IMS project falls into the very high risk category. It was a large project because it had a high relative cost for MU, impacted on most organisational units and incorporated external expertise. The project was low structured due to the many technological unknowns (a high flexibility status was issued). It had a high degree of company-relative technology. The IMS was technically complex, integrated with many of the organisation's critical systems and itself was critical to the mission of MU.

Applegate et al. (2003) suggest the following principles for projects of this nature. Firstly, they propose intensive external integration, which would consist of comprehensive technical expertise, the ability to communicate business needs effectively, and user commitment to a set of design specifications. In addition, high internal integration and strong technical leadership is required. Accordingly, this project type requires highly experienced project leaders and supportive users. Formal planning and results control tools are useful in cases in this category but contribute little to reducing uncertainty in the early project stages. Furthermore, due to the uncertainties tasks may be difficult to plan and scope.

These principles were applied by IMS project management with different degrees of effectiveness. For example, in areas where MU did not have adequate expertise it was acquired externally. Experienced project managers and technical leaders were appointed tasks within their field of expertise. The communication of business needs was addressed via stakeholder meetings and represented in design specifications. Nevertheless, at times during the project the operation of this task was less than ideal. Technical specifications were developed collaboratively between MU and the vendor. These were drafted and signed off as they were completed. Also, user trials were conducted with small user communities, which contributed to the attainment of user commitment.

A Guide to the **P**roject **M**anagement **B**ody **o**f **K**nowledge (PMBOK® Guide (Sheasley, 1999),) and **P**rojects **IN** **C**ontrolled **E**nvironments (PRINCE2) were the two project management standards used for management of the IMS project (The Office of Government Commerce (OGC), 2003). These were used in conjunction with the Waterfall Model to construct the Project Management Plan and thus were influential in decisions for the processes utilised in this project. PMBOK® Guide is not a methodology in itself, but a knowledge-based approach that covers the vast subject of project management (OGC, 2003). PRINCE2 is a project methodology or process-based approach that focuses on nine key risk areas in project management (See **Figure 2**). PRINCE2 is strongly prescriptive on process structure and is highly compatible with PMBOK® Guide (Wideman, 2002). However it was still necessary for the MU organisation to adapt these methods to successfully integrate the newly acquired IMS into their VPN.

Traditionally, the project management process does not distinguish between different project types (Kenny, 2003). The PMBOK® Guide states that the basic processes can be adapted to most projects (Project Management Institute, 2000). However, fundamental differences have been found between some projects and the choice of which specific processes to employ is left to the judgement of project management. Unlike projects that are based on known facts, new and untried system development is laden with unknowns. Hence, the management styles for projects that involve high degrees of technological uncertainty are progressively more flexible as the complexity increases. Because of the nature of innovation (discovery) it has largely remained outside the conventional project management domain (Sheasley, 1999).

Increased communication channels, with periodic time-based reviews, are elements proposed for projects that contain high levels of uncertainty (Sheasley, 1999). These processes ensure accountability from the project team to stakeholders and help facilitate frequent updates of what has been done, what has been learned, and what changes are required to the project plan (Kenny, 2003).

Traditionally the predominant model for large development projects has been the waterfall model. However, in this case the waterfall model in its formal state did not adequately address the project needs (see also Jerva, 2001).

Successful IS development in this case thus required the development team to go beyond the prescribed traditional methods associated with waterfall (Mathiassen & Purao, 2002).

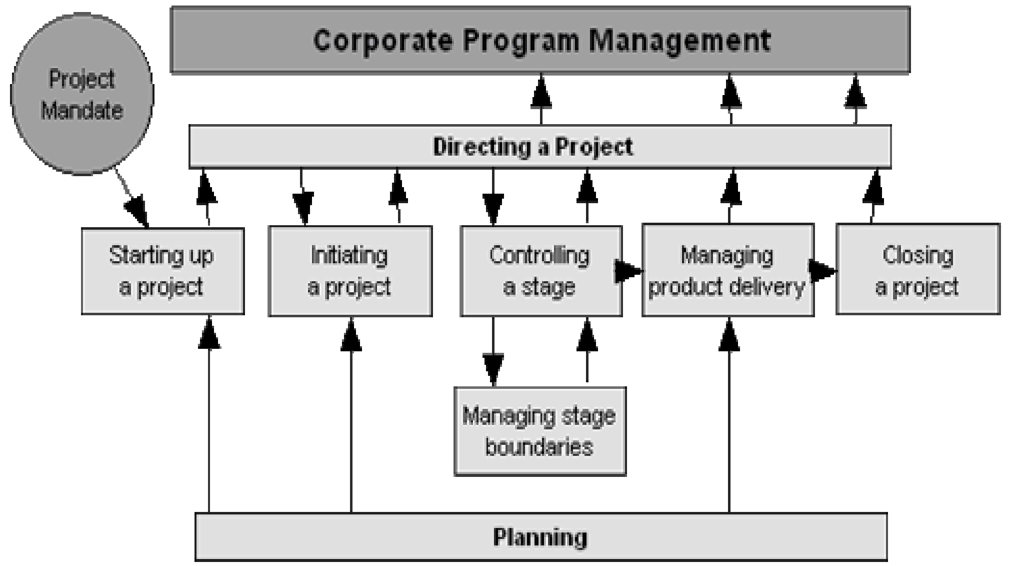

Figure 2 - PRINCE2 Process Model©
Adapted from : The Office of Government Commerce, 2003

7. Project Model

From the project activities identified by this research, a project model has been constructed. This modified project model is based on the waterfall model as used for web site development (Lowe & Hall, 1999). It has been adapted to illustrate the specifics of the IMS project (See **Figure 3** - IMS Project Processes).

7.1. The IMS Architecture

The critical components of the IMS system consisted of hardware from Sun Microsystems™ running the Solaris 2.8 operating system; Digiquant IMS Radius Server and Rating Engine; Silver Stream powered Administration Graphical User Interface; Apache™ web-server; Cisco's Service Selection Gateway, and Subscriber Edge Services Manager software; and two Oracle Databases. One database is used as a Master Database for the IMS and the other is for financial, members, and human resource data that are extracted from the organisation's PeopleSoft administration system (See **Figure 4**).

The IMS is part of a large router, which runs specialised software called Server Selection Gateway (SSG). Every network packet (i.e. all traffic) received and transmitted on MU's network is routed through this software. The SSG is the gateway between the VPN and the Internet and any packet that tries to go through this gateway must be authenticated otherwise it gets rebuffed. The IMS consists of a network layer that users physically log in to, that enables the Internet Protocol, allowing all MU's network traffic to be audited. The other aspects of this system are an electronic accounting system and a management system. The management system provides a helpdesk function for the accounting, tracing, auditing (allocation of quota, personalised purchasing, tracking of utilisation by time, megabyte, input byte, output bytes and modem login services).

7.2. Annual Post-Project Review

One year on, interviews with personnel from MU's senior management of IT revealed the following points. The integration of the IMS significantly dampened spiralling Internet traffic costs for approximately 12 months. Although these costs are continually increasing due to a growing use of the Internet, traffic is now monitored and managed in a comprehensive and coherent manner. For example, electronic billing has been very accurate allowing for effective billing of usage. Moreover, effective user authentication and tracking has enabled a greater amount of user granularity with the system that can aid in more effective service delivery and capacity management (OGC, 2003(b)). This meets a key business requirement motivating the project for this group of stakeholders (Adelakun and Jennex 2002).

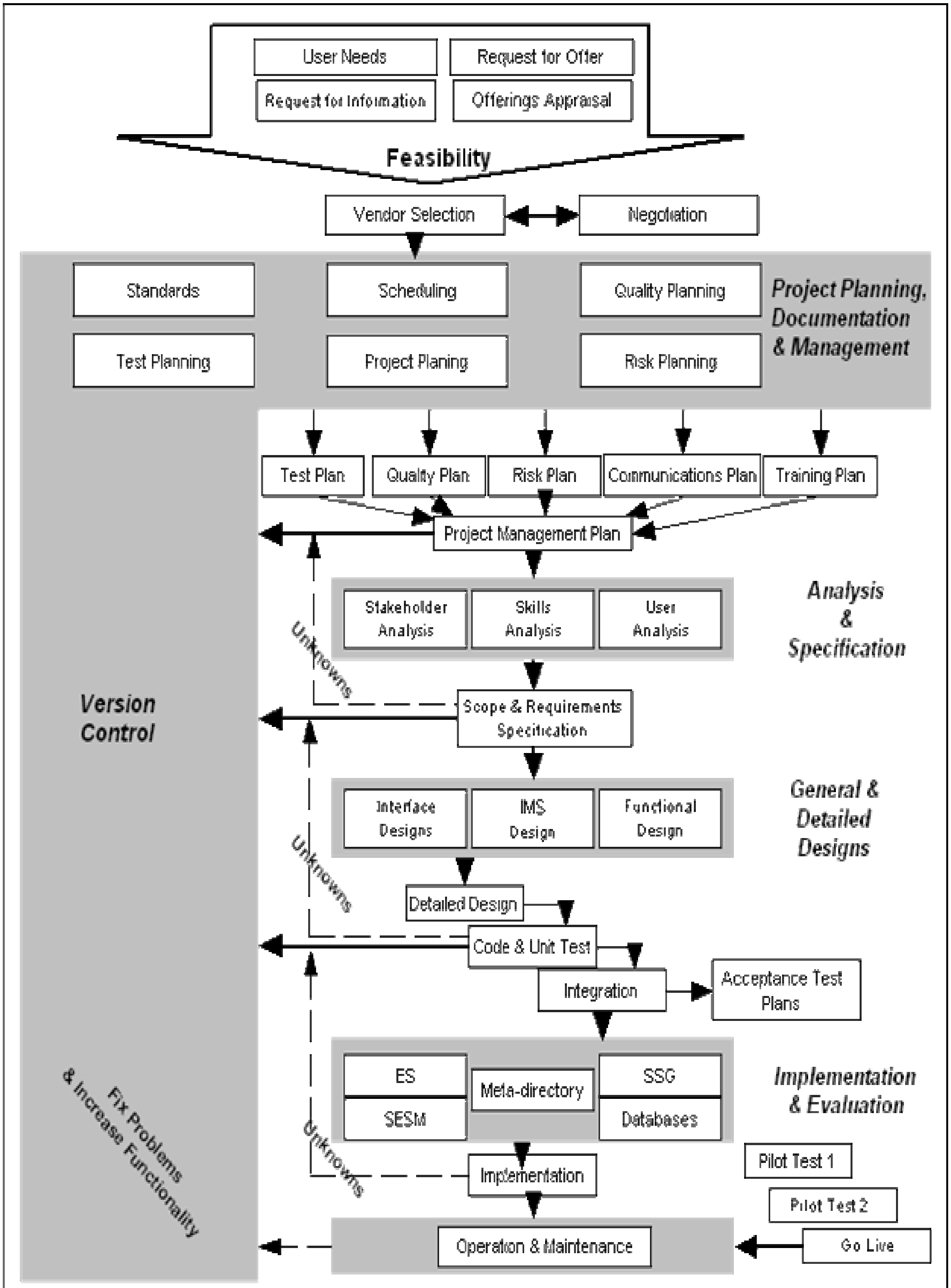

Figure 3 - IMS Project Processes Model - Adapted from. Lowe & Hall, 1999

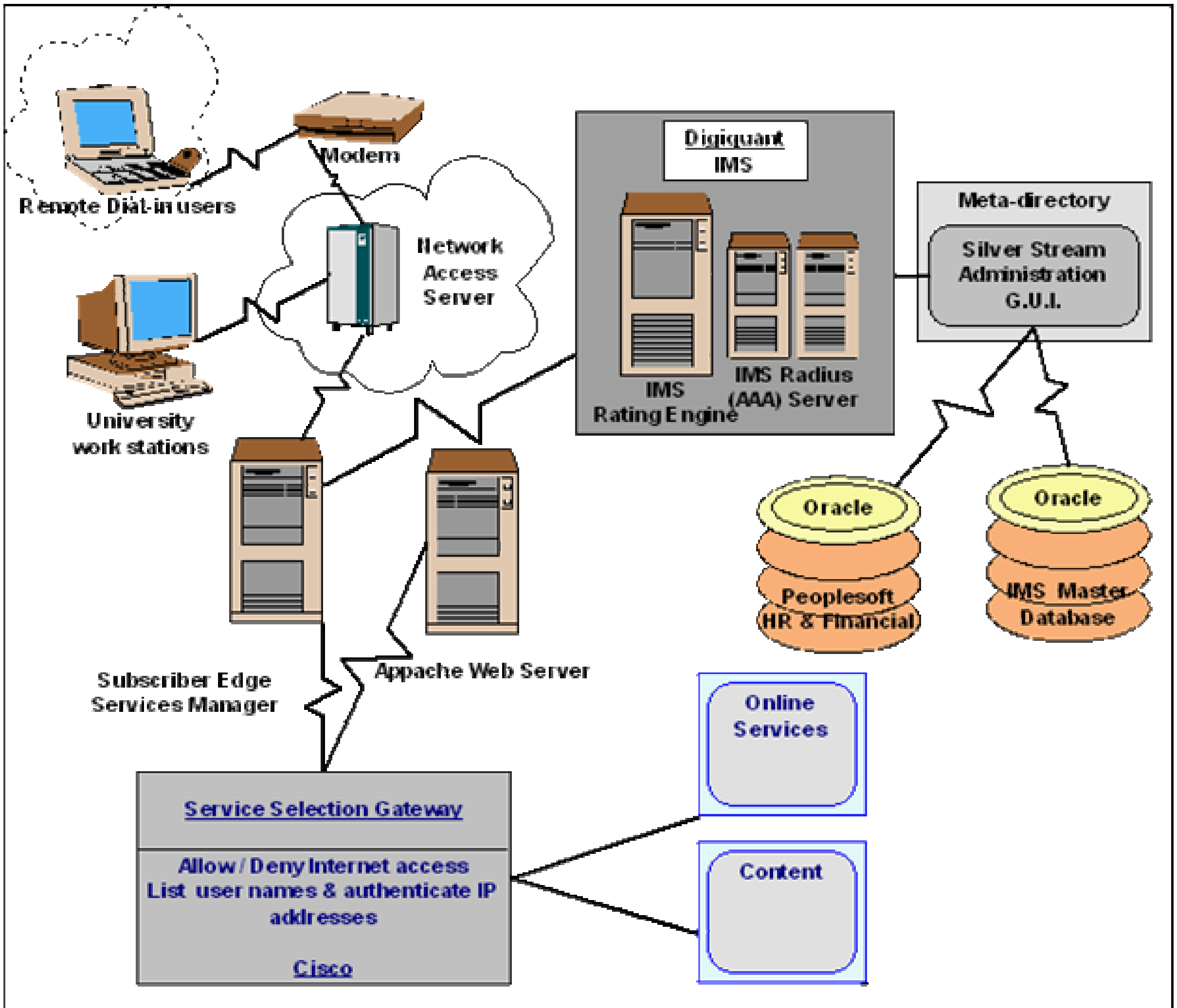

Figure 4 - Critical IMS Network Components

The only major technical issue that has occurred since the integration of the system, has been a need to increase memory on the IMS router. In addition, there was a service disruption caused by a malfunction with the automatic pop-up login page resulting in users having to log in each time they attempted to access a different service (i.e. Network, Internet access & network email). Both of these issues have been resolved.

Users are another key stakeholder group, and a sample of 21 of these was surveyed to evaluate the system following a period of operation. Forty two percent of users surveyed rated the performance of the network as high and 48 per cent rated it as satisfactory. Most respondents considered the network relatively easy to navigate. Seventy one per cent indicated that they had not experienced any difficulties with the inbuilt security features of the system. Forty per cent of respondents rated the quality of services provided in the high range and 42 per cent in the satisfactory range. Forty seven per cent considered the online payments function of the IMS to be in the satisfactory range and 24 per cent regard it in the high range. These results generally indicate satisfaction with the IMS's functionality. However, it should also be acknowledged that over 47 per cent of users surveyed had used the system for less than one year. Interviews with ITS personnel also confirm that the cost management goals for the project have been achieved without inconvenience to users.

As a result of the lessons learned in the project, MU has formally adopted the Stage-Gate® (SG) methodology in conjunction with the PRINCE2 methodology and made changes to work practices accordingly. The SG technique, involves a sequential set of stages (activities) and gates (decision points) for the structuring of new product development projects (Cooper, Edgett & Kleinschmidt, 2002). This has facilitated new processes that ensure that projects are reviewed by all relevant staff and project interdependencies identified along with project sponsors and where the project best fits for implementation.

Projects are no longer treated as a technical solution but taken from a holistic business approach. Again, with the formal adoption of SG and PRINCE2, the associated training and knowledge building has ensured a business approach and focus rather than a technical solution. The adoption has also facilitated the introduction of program steering committees rather than individual project steering committees, which have provided a more focused view of associated project dependencies and timeframes.

Project funding now incorporates funding to release key staff for projects. This has been further supported through the establishment of dedicated project teams. This enhances the project group as a community, improves project manageability and thus contributes to the project success. Additionally, SG and Prince2 provide for a production support plan, business owner and product manager and are assisting to reduce the impacts of the project communication deficiencies identified in the IMS project. These changes are maturing along with the newly adopted processes (Interviewee 2).

Limitations

The case study method has inherent limitations in that it is restricted to a single event (Winegardner, 2001). Difficulties in generalisation may make it difficult to acquire comparative data from a statistically significant number of cases (Galliers, 1992). The case itself however is considered of intrinsic worth in highlighting some of the complexities involved in project managing an innovative implementation, which future theory and practice will require to take into account.

The fact that this research was a post implementation evaluation meant that the researchers were not able to experience project team member and stakeholder interactions in steering committee, stakeholder and technical meetings. This may have been a valuable source of information with regard to attendees' behaviour and communication processes in a project with such a high degree of technical ambiguity.

8. Conclusions

In the MU case, several challenges were highlighted from which future considerations in VPN integration can be drawn. Firstly, integrating an ***e-business application*** into a VPN is a complex task. A contributing reason for this is that e-business applications have a number of sub-systems which include Web pages, software programs, IT and network systems and which are driven by the organisation's business system. Furthermore, these projects are more complex than client server projects because they are required to extend functionality beyond an organisation's boundaries and therefore diversity in system users, application compliance and technical functionality is increased.

Due to the innovative nature of the technology in this project there was ***limited expertise*** available over the duration of the project itself. This limitation created a need for required expertise to be outsourced. Initially, this expertise was communicated via teleconferencing with specialists in Singapore. However, ***communication*** was hindered because of language barriers; these issues caused delays in resolving technical issues. Therefore, experts were brought to Australia from Singapore and Denmark for a six-month period. The assistance of these experts hastened resolution of integration issues and lowered knowledge barriers associated with the deployment of specific systems development techniques, technologies, and methodologies. ***Teleconferencing*** used for sharing technical expertise was helpful in this project but not an ideal substitute for the physical presence of an expert. In technically complex projects such as this, experts need to be accessible at critical moments and often the physical presence of an individual can serve to enhance communication processes.

One of the primary challenges in the IMS project was that project team members had operational responsibilities as well as being team members on multiple concurrently running projects. One advantage to this approach is that team members have the necessary ***expertise*** and understanding of the organisation's environment and have a vested interest in ensuring that the most appropriate solutions are implemented. The disadvantage was that members were called away to other projects during the IMS integration impacting on the continuity of integration and project communication processes.

The waterfall model and related project management aspects traditionally predominant in large development projects did not adequately address the complex integration needs inherent in the project. As the project was not an application development, but an enterprise application integration, and had business requirements beyond user satisfaction, a RAD or prototyping approach was inappropriate. Successful IS development however required the development team to go beyond the traditional phased methods towards a more dynamic approach, entailing flexible deadline planning and iterative testing in small environments.

PMBOK® Guide and Projects IN Controlled Environments (PRINCE 2) were the two project management standards used for management of the IMS project. However it was necessary for the MU organisation also to ***adapt***

these methods to successfully integrate the newly acquired IMS into their VPN. Since new and untried system development is laden with unknowns the management style becomes progressively more flexible as the complexity increases. Accordingly, in this project a ***high flexibility status*** was put on the scope and functionality agreements which were later moved to medium flexibility when the project team and the vendor had a better understanding of the situation.

In the MU case, ***risk*** associated with integration was reduced by introducing the IMS in parallel with the existing system, and testing the integration incrementally in the small test environments. This ensured that MU could continue to operate while the integration was carried out. Furthermore, MU reduced its risk by including vendor specialists and agent representatives on the project team, and by negotiating consecutive incremental contacts. This strategy effectively helped reduce risk associated with application compatibility and functionality unknowns and encouraged vendor commitment to system success. Large projects with low structure and high company-relative technology are classified as very high risk. Intensive external integration tools, high internal integration devices, and low formal planning and results control tools are the ***contingency principles*** suggested in literature for projects of this nature. These strategies were evident in the IMS project.

Document management is one element of project management critical to systems development and project success. Thus a strategy for this function should be included in the project management plan, which should be formally implemented and monitored for effectiveness. In the IMS project, the specific VPN application mix was unique, hence many unknown compatibility issues surfaced which resulted in frequent changes to the technical specifications documents. Consequently, effective management of evolving ***project documentation*** was crucial. This was not effectively administered in this case because there was not a dedicated manager appointed to this task.

Increased communication channels with periodic time-based reviews are elements proposed for projects that contain ***high levels of uncertainty***. These processes ensure accountability from the project team to stakeholders and help facilitate frequent updates of what has been done, what has been learned, and what changes are required to the project plan.

During the first year after the IMS integration the spiralling Internet traffic costs were significantly dampened. However, costs, particularly for ISP charges will increase as the user base and their associated Internet usage increases. The system has also improved the effectiveness of user authentication, usage tracking and electronic billing and tracking has enabled a greater amount of user granularity with the system which can aid in more ***effective service delivery*** and capacity management.

The formal adoption of the **Stage-Gate® (SG) methodology** in conjunction with **PRINCE2** by MU has facilitated new processes that ensure that projects are reviewed more effectively. For example, MU now subscribes to a more holistic approach to projects (business-led focus rather than technical). The new processes are assisting to reduce the impacts of the project communication deficiencies identified in the IMS project. The models prescribe the use of program steering committees rather than individual project steering committees and have provided for a more focused view of associated project dependencies and timeframes. In addition, MU's project funding now supports establishment of dedicated project teams and provides for assignment of key staff to projects. This enhances the project group as a community and improves project manageability.

Future Research

This research provides a basis for further research on Internet Management Systems, at technical, project management, and implementation levels. Conceptualisations regarding project architecture, systems alignment, expert and team communication and documentary issues are all implicated. As organisational boundaries are crossed, the extra dimensions of complexity introduced by the increased diversity of users and systems, raises specific technical, social and organisational research issues. Future research is required into effective project management methodologies for complex e-business systems

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