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Managing the Integration of 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 complex task for which existing project management techniques have not explicitly catered. This paper examines the strategies employed for managing the integration of an Internet Management System (IMS) into an organisation's virtual private network. Electronic business application integration projects are inherently complex because they must conform to an organisation's business rules, procedures, and diverse systems. The study revealed how the systems developers were influenced by technical complexity, the sharing of required expertise and project management issues such as communication, document management, a lack of dedicated personnel impacted on project continuity. This innovative technology had no precedent in the organisation's history, and existing project management models had to be adapted. To minimise risk inherent in such an innovative project the IMS was integrated in parallel with the existing system. The organisation also reduced risk by including IMS agent and vendor representatives on the project team. Furthermore, rather than signing a full contract with an untested supplier the organisation negotiated one initial contract and then another contract to complete the integration. This enabled the parties to assess whether their organisational philosophies, work approaches and conditions were compatible and assisted in establishing an environment where issues were worked through collaboratively. Other lessons learned from this project are also described in this paper.

Keywords

Integration, Management System, Virtual Private Network, Local Area Network, Internet, Intranet, Project Management

1. Introduction

Information made available via a corporate network is the backbone of crucial services of many contemporary organisations. In practice, however, it has become common that many organisations subsidise their employees' entertainment use of the Internet in this process. Managing access so that employees and staff have high-quality online services without assuming the costs associated with personal misuse is a challenge (Sederburg, 2002). The management system at the centre of 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).

This paper examines the strategies employed for managing the integration of an Internet Management System (IMS) into a virtual private network (VPN). 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 article discusses several unique aspects of this management system's technical environment, it reveals the methods used in the sharing of expertise, and covers several project management related issues such as communication, document management, dedicated personnel, and lessons learned. Authentication and web-enabled application implementation is an underdeveloped yet rapidly expanding area. This research contributes to knowledge in this area.

1.1 Technical Environment

An IMS is an e-business application that processes data from internal organisational systems to an authenticated user to access the organisation's online services. In this case the access is obtained through the organisation's network portal. The IMS in this study is a module of the organisation's VPN. The application manages user accounts and provides information on usage to the network user and the organisation's management and accounts staff. The process of implementation and maintenance of a VPN application involves teams of users and IS specialists, and consequently, complex human action and interactions (Alter, Ein-Dor, Markus, Scott & Vessey, 2001). The IMS is a package application (i.e. self-contained); hence, the project was an enterprise application integration effort. The term integration, as used in this article, refers to the linkage creation between different computer systems, software packages, and databases.

There are many VPN products available for organisations to purchase; however an enterprise VPN is still difficult to manage due to the complexity of the architecture (Betts, 2002). Contributing to this complexity is that VPN applications have a number of sub-systems including varying numbers of Web pages, software programs, IT and network systems and which are driven by the organisation's business system (Standing, 2002). Rosemann & Watson (2002) report that contemporary enterprise networks are constructed on a three-tier client-server architecture, in which the database (data storage), business logic, and the presentation layers form three logically independent tiers. The VPN in which the IMS functions includes an extra tier for a web server. The extra layer is required to enable Internet access via the network. The VPN architecture in this case is called n-Tier architecture, which stands for any **n**umber of **tiers** (Chaplin, Faatz, Jajodia & Fayad, 2002).

1.2 Complexity of Managing E-business Projects

Project management in general consists of scoping, planning, staffing, organising, directing, and controlling the development effort at minimal costs and within time constraints (Johns, 2001). Dvir, Raz and Shenhar (2002) have found a significant positive relationship between

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

the effort invested in defining objectives, functional requirements, and technical specifications and the success of a project. Consequently, Dvir, et al. (2002) contends that these elements must be established in collaboration with the client and end-users and no effort should be spared in the initial stages to obtain a consensus. Johns (2001) concurs noting that success is contingent on the initial project planning and the subsequent management of the plan and project team.

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. Web applications must fulfil an extended list of requirements (See Table 1).

Table 1 - Extended 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.
(Schultz, 2002, pp. 1-2)	

Furthermore, 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, Visual Basic, HTML, and Oracle's Developer 2000 maps PL/SQL) (Standing, 2002). The complexity of this process is heightened in an environment where stakeholders are heterogeneous (Gumport, 2000). In this project, there were nineteen distinct stakeholder groups involved in the integration; sixteen internal to MU and three were external technical specialist groups. Hence, the increased complexity in e-business projects is fundamentally a product of the need to extend functionality beyond an organisation’s boundaries and therefore diversity in system users, application compliance and technical functionality is increased.

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. As e-business projects have new and unique demands, much of the knowledge associated with them must be adapted from other experiences, or has not yet been discovered. To the extent that an e-business application integration provides a new context, the phenomena of project management will require a new understanding. Furthermore, there is no consensus on a development model for web enabled applications.

From the 1950s the waterfall model or classic systems development life cycle, has served as a standard for the critical design activities in systems development (Allan, 1997). Such development models typically cater for numerous proprietary variants, and these form the typical basis for system implementation practices. A 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 many innovative IS/IT 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.

Mathiassen and Purao (2002) 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’ (Mathiassen & Purao, 2002, p. 83).

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 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).

Akkermans and van Helden (2002) conclude that interdepartmental communication and collaboration within the project team are the core processes for project progress. Effective collaboration between system developers and relevant stakeholder groups is essential to create a comprehensive understanding of requirements (Garner & Raban, 1999). Collaboration with organisational members will enable the development of a realistic understanding of, the work and political processes, and the communication structures within the organisation (Kerzner, 2000).

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

Pinto (2002) notes that frequently novice project managers assume that only they need full project status information. Keeping all team members aware of the project's status is important for rallying support, gaining commitment, and fostering communication among team members (Lientz & Rea, 2002). Pinto (2002) advocates the use of a Project Management Office for the coordination and management of the project portfolios. This provides important support for all project related departments and project teams when implementing innovative technologies. The functions of this office may include:

- *"Creating and maintaining a clearinghouse for all project documentation.*
- *Storage and retrieval of project records and case histories of past project efforts.*
- *Serving as a resource centre for the training of project managers and team members.*
- *Providing auditing services for project teams.*
- *Establishing and benchmarking best practices for project teams.*
- *Developing and overseeing risk management and other support services.*
- *Tracking and controlling the organisation's updated project portfolio"* (Pinto, 2002. p. 33).

Ribbers and Schoo (2002) purport 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 (2001) highlight, project, coordination and control of development personnel and users as being of importance in addressing project complexity. They contend that regular project meetings and both formal and informal communication channels are important in the achievement of this goal.

Project control implies the systematic monitoring of a project's progress to determine if factors such as, costs, schedule, and technical performance are planned and taking corrective action where necessary. An important control topic is change control. Change control, refers to the monitoring of changes to the initially specified requirements during the project that will contribute to scope creep (Jurison, 2002). 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).

The termination phase of a project can include a post implementation review and documentation of lessons learned for future technology developments (Morrison, 2001). Tompkins and Hall (2001) argue that the post-implementation review is the only proven method for determining if a system has delivered what is was intended to deliver. While the literature has stressed the importance of conducting formal post implementation reviews to improve information system performance and development, research by Palvia, Sharma and Conrath (2001) found that over 60 percent of responding organisations indicated that they conducted evaluations on less than half of their projects.

The **Pr**ojects **IN** **C**ontrolled **E**nvironments (PRINCE2) methodology outlines processes for post implementation evaluations (APM Group, 2002). Projects are evaluated on criteria that are established collaboratively between the project manager and senior management and then signed off by senior management. A 'lessons learned' or 'post mortem' exercise is prescribed in this process. Lessons learned is a way of providing team feedback, and share experiences that can enhance knowledge for later projects (Lientz & Rea, 2002).

Research Methods

The research methodology in this study was idiographic. Idiographic methods such as case studies attempt to provide an understanding of phenomena in context (Burrell & Morgan

1979). The research questions were proposed to obtain an understanding of the phenomenon in its context. The interests served in this research included information systems developers, project managers and information systems academics.

Utilising a case study approach enabled investigation of contemporary phenomena, and was useful because the boundaries between phenomena occurring and the context were at times not clear (Yin, 1994). They were drawn upon because the study explored ‘how’ and/or ‘why’ the organisation developed the VPN and the researcher did not always have control over events. Additionally, the method was deemed appropriate as this research area is in a domain where theory is underdeveloped (Winegardner, n.d.). All of these factors were relevant to the IMS case.

The chosen strategy employed was a qualitative inquiry. In contrast to quantitative approaches, which examine components of phenomena, qualitative approaches reveal how the components work together (Winegardner, n.d). This approach analysed the project as a whole. Furthermore, Strauss and Corbin (1990) claim that in contrast to quantitative methods, qualitative methods convey intricate details of phenomena more effectively. Therefore, qualitative research was the preferred strategy to investigate the social phenomena of this project.

2. Case Study

2.1 Research Approach

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. The specific type of sampling utilised in this study was purposeful sampling (Ticehurst & Veal, 2000). This means that interviewees were selected purposefully because they had expertise in a specific and relevant area of the project. 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.
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. A semi-structured approach to in-depth interviews allowed the researcher to cover a specific list of topical questions, with the allocated time for each question left to the interviewer’s discretion (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). Interviews were conducted over a period from March 2002 to

September 2002, beginning approximately one month after the IMS began its formal operation in late January 2002.

2.2 Case Description

The organisation studied (MU) provides Internet access via their 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 and 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. This initiative was proposed by the company's Director of Information & Communication Technologies to establish an effective system for managing traffic routed through MU's VPN. 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. Hence, the external project manager had to become familiar with organisational policy and work practices. The external project manager was a certified project manager 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.

This IMS's project hierarchy was structured as in Figure 1. The onsite technical project team met on a weekly or daily basis depending on the needs of a particular project stage.

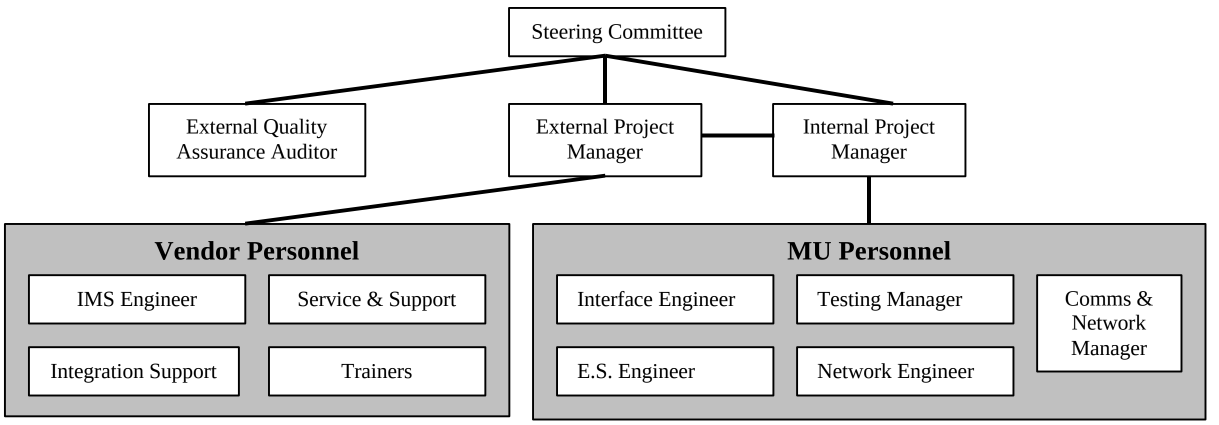

Figure 1 – IMS Project Hierarchy

MU’s escalating costs had increased from $900,000 in 1999, to $1.6 million in 2001, and further increases were 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 and could not be charged to relevant organisational sub-units. In addition, MU was in the process of implementing a Peoplesoft enterprise system, a meta-directory, and a new e-mail system, which all contributed to also needing a new authentication system (Interviewee 4).

The reason for the ineffectiveness of the previous system was its time-based measurement of Internet usage. Conversely, the Internet Service Provider (ISP) charges were based on download quantity. Accordingly, one user could realistically be charged equally for being connected to the Internet for an hour reading a journal article or download only 60 kilobytes of data, whereas another might be connected for the same time but download 6000 kilobytes of video material. The previous system would only account for one hour of use per user regardless of download volume. Furthermore, the previous system did not capture FTP or ICQ traffic. Consequently, the previous system only accounted for approximately 60-65 per cent of all network traffic. Betts (2002) contends that if organisations are not carefully monitoring VPN traffic and telecom bills they could be paying thousands of dollars unnecessarily.

3. Issues and Findings

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

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 Group representatives involved in stakeholder meetings and their input was critical to the project. Moreover, the IMS project was initially viewed as a networking solution and the business aspects of the system were not given adequate priority. Hence, some of the personnel that should have been included in initial planning sessions were not. The IMS Program Manager stated that,

> “*In order to make critical project decisions the ideal process was to write position papers and then discuss and debate issues. Ideally, this would happen every month but when relevant team members were called away to other projects, these decisions would be put on hold*”.

Systems project personnel are influenced by issues within the organisational context. In this case existing policy, work practices, available resources; and the development and project management methodologies were explored and therefore were important factors for consideration in this projects planning and management (Nandhakumar & Avison, 1999).

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, disadvantages were that members were called away to other projects during the IMS integration and that this situation impacted on the integration and project communication processes and continuity of the project. The strategy 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 project, which had time restrictions, gave rise to a number of problems. The problems quoted by the External Project Manager were:

- Some decisions had to be made without the time to adequately evaluate alternatives.
- System related testing was often left to the last moment.
- It was more difficult to keep technical personnel informed of project changes.
- 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. 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. Effective communication procedures for the timely dissemination of any deviations from these plans were also critical. Keeping all team members aware of the project's status was important for rallying their support, gaining commitment, and fostering communication among team members (Lientz & Rea, 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. Hence, when issues arose during integration, personnel had difficulties communicating with the necessary people.

As previously mentioned, the IMS project was an enterprise application integration effort (EAI). 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, 2001). The lack of standardisation meant that the technical expertise required to integrate products from multiple vendors was sparse and therefore proved to be costly (McCoy, 2001). Furthermore, application integration efforts raise significant challenges because of the diversity of available technologies and because the existing EAI frequently cuts across departmental and business boundaries (McKeen & Smith, 2002).

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. 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.

Due to the element of uncertainty in the project, the project scope (time horizon, cost & human resource) could not be accurately established and requirements could not be frozen. This meant that there was the potential for the project to extend beyond the feasible commitment for the organisation. Bronzite (2000) found the major reason for system failure was the inability to establish accurate requirements. No organisation has an unlimited resource of finance, time or human capital (Robbins, Bergman & Stagg, 1997). This study conforms to this theory.

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 two part contracts. On the successful completion of the first part of the project 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.

Project **M**anagement **B**ody **o**f **K**nowledge (PMBOK) and **P**rojects **IN** **C**ontrolled **E**nvironments (PRINCE 2) were the two project management standards used for management of the IMS project (Schwalbe, 2002; APM Group, 2002). Both of these were used in conjunction with the Waterfall Model for the construction of the Project Management Plan and thus were influential in decisions for the processes utilised in this project. PMBOK is not a methodology in itself, but a knowledge-based approach that covers the vast subject of project management (Wideman, 2002). PMBOK is widely accepted as the sum of professional knowledge in project management and is considered in America and the United Kingdom as the international standard for project management (Dvir, Raz & Shenhar, 2002). PRINCE2 is a project methodology or process-based approach that focuses on nine key risk areas in project management (See Figure 2). PRINCE2 is highly prescriptive on process structure and is highly compatible with PMBOK (APM Group, 2002). However it was necessary for the MU organisation to adapt these methods to successfully integrate the newly acquired IMS into their VPN.

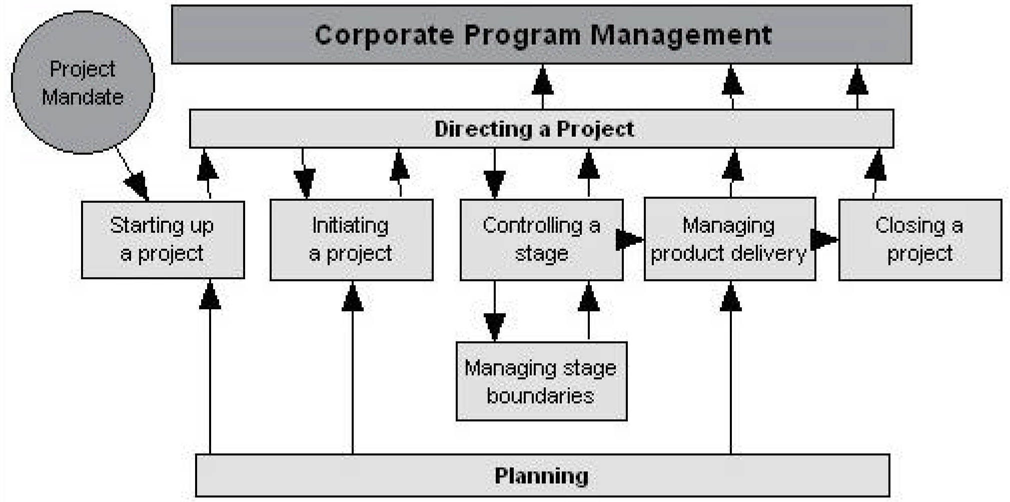

Figure 2 - PRINCE 2 Process Model - Sourced: APM Group, 2002

Traditionally, the project management process does not distinguish between different project types (Kenny, 2003). The PMBOK 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).

In the development of Web applications there is no consensus on a general systems development model (Fraternali, 1999). 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 (Jerva, 2001). Successful IS development in this case required the development team to go beyond the prescribed traditional methods associated with waterfall (Mathiassen & Purao, 2002).

4. 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).

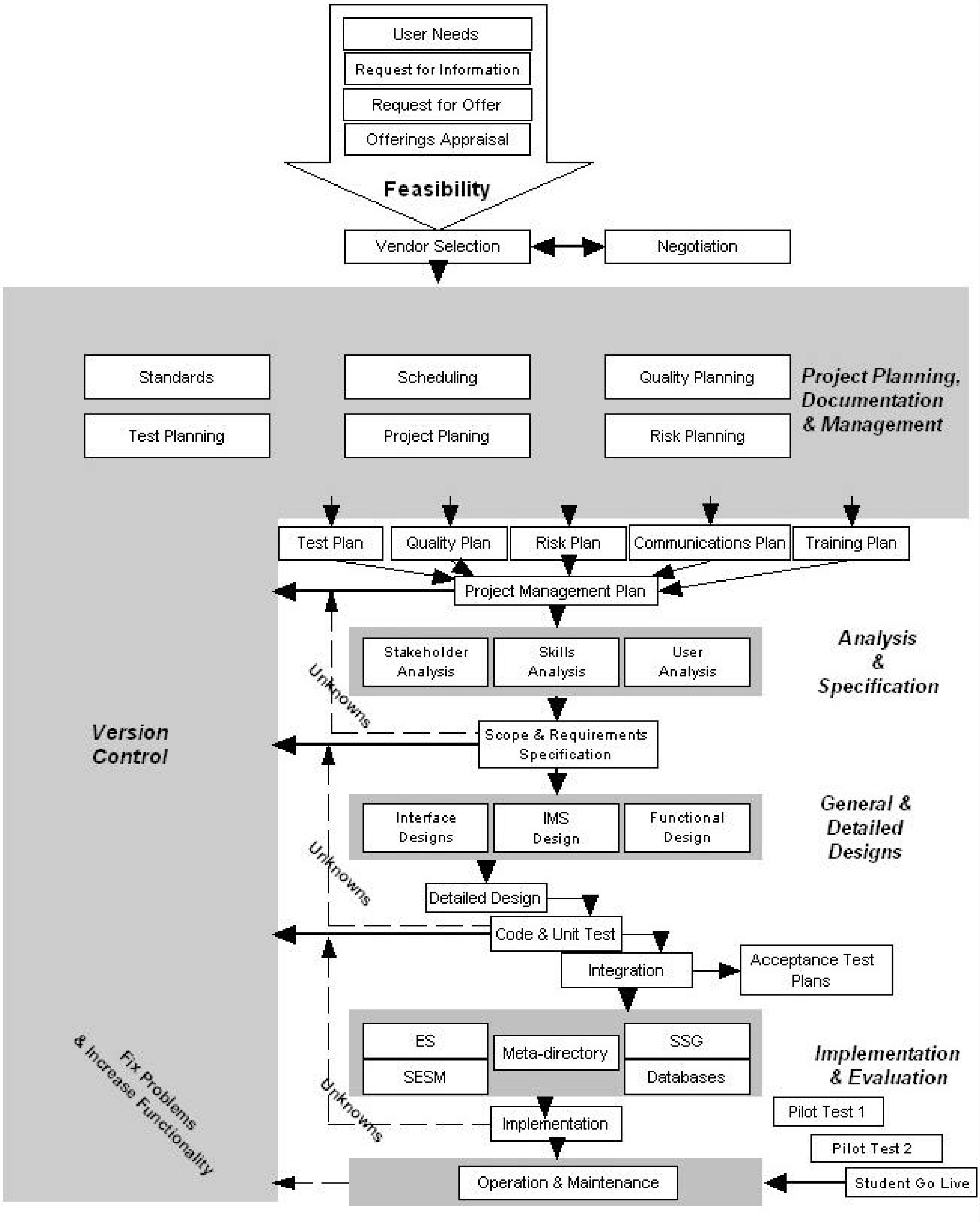

Figure 3 - IMS Project Processes Model - Sourced: Lowe & Hall, 1999

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).

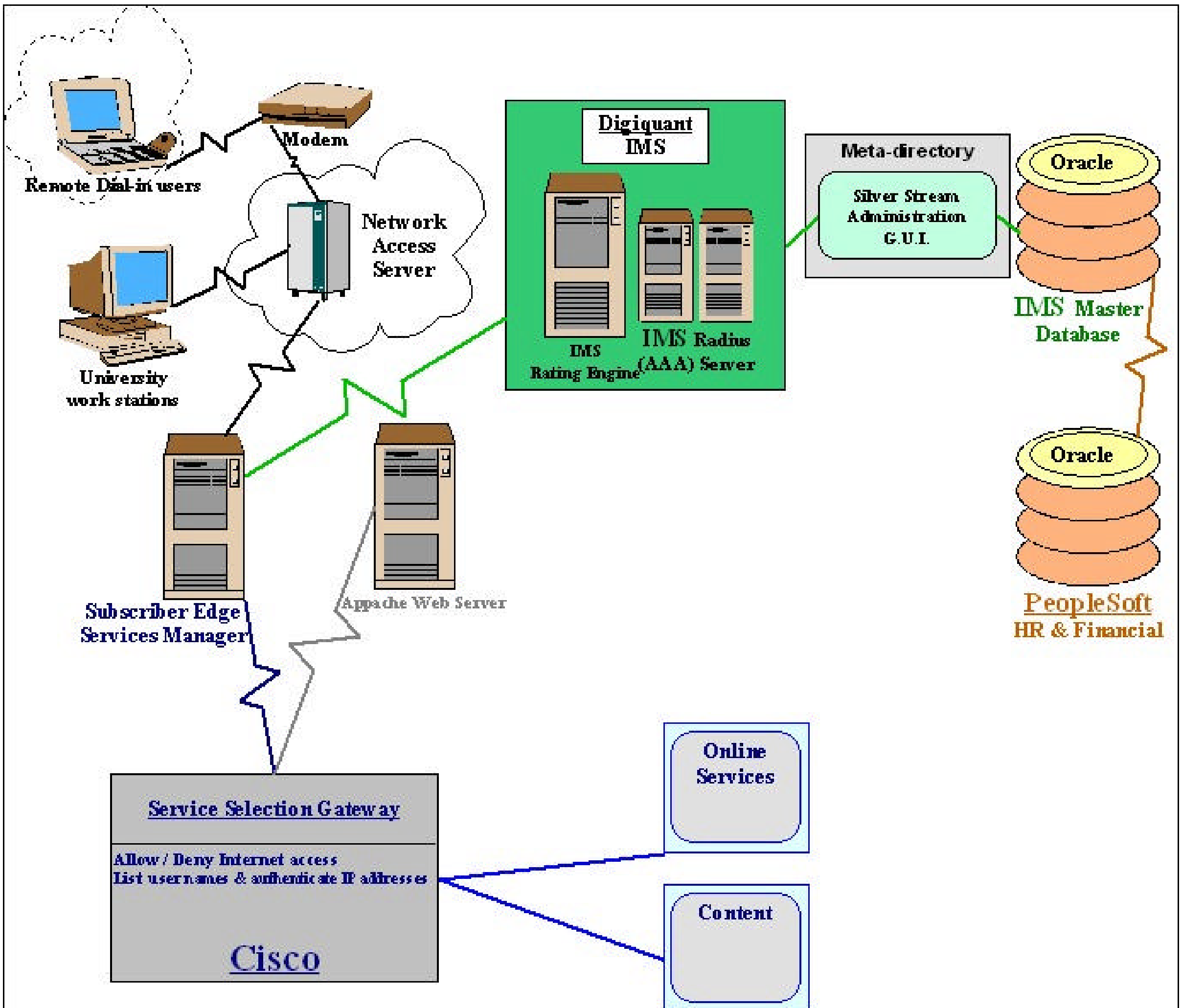

Figure 4 - Critical IMS Network Components

The IMS is part of a large router, which runs specialised software called Server Selection Gateway (SSG). Every network packet (i.e. all traffic) that is 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, which enables all of 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).

The IMS functions in the following manner. Remote dial-in users are connected to the Network Access Server and onsite users connect directly to MU's LAN. In order to gain access to any external services users are required to obtain authentication via the Subscriber Edge Services Manager (SESM). The SESM presents a HTML screen requesting a username and password. Once successfully authenticated, the user can select from four service options associated with their user profile (i.e. the VPN content, Australian Internet sites, international services and a mirror). Upon service login the SESM provides service details (i.e. routing information for a service) to the Cisco SSG.

The authentication process utilises the IMS Radius (AAA) server and IMS Rating Engine with user data from the Oracle databases, then the IMS Radius (AAA) server accesses the organisation's authentication servers via secure lightweight directory access protocol (LDAP) to verify the user's password. The IMS Rating Engine also provides the functionality for rating parameters, quota allocation to end users, the ability to purchase additional quota, and the capacity to provide electronic statements to end users via the web.

Limitations

The timeframe in which the research had to be completed (8 months) was a limitation. At the time of the research (October 2002), the IMS had been configured to allow e-mail traffic to bypass the system, which accounts for a large amount of traffic. Therefore, it was not possible to analyse the system's performance in totality.

The fact that this research was a post implementation evaluation meant that the researcher was 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 attendants' behaviour and communication processes in a project with such a high degree of technical ambiguity.

The case study research method has limitations in that it is restricted to a single event (Winegardner, n.d.). Difficulties in generalisation may make it difficult to acquire comparative data from a statistically significant number of cases (Galliers, 1992).

5. 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. Simply passing acceptance tests to determine system errors is not enough. Web-enabled application projects are more complex that 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.

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 fails to address the realities of a multi-vendor world.

Due to the innovative nature of this project there was ***limited expertise*** available over the duration of the project itself. This lack of expertise necessitated that expertise had to be obtained from outside the organisation. Initially, this expertise was source via teleconferencing with Digiquant specialists in Singapore. However, ***communication*** was hindered because of such things as language barriers; these issues caused delays in resolving technical issues. Therefore, Getronics had experts brought to Australia from Singapore and Denmark for a six-month period. 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 specific systems development techniques, technologies, and methodologies.

Teleconferencing used for the sharing of 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 insuring that the most appropriate solutions are implemented as the individual team members will become responsible for different technical aspects of the subsequent support. However, disadvantages were that members were called away to other projects during the IMS integration and this impacted on the continuity of integration and project communication processes.

Project Management Body of Knowledge (PMBOK) 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 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. Unlike projects that are based on known facts, new and untried system development is laden with unknowns. Hence, the management styles are progressively more flexible as the complexity increases.

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 two-part contracts.

Document management is an element of project management that is critical to systems development and project success. Larger projects tend to require much more administrative effort in document management, handling requests, communicating upgrades, and tracking work. In the IMS project, the specific VPN architecture was very unique and innovative. Hence, many unknown intranet compatibility issues surfaced which resulted in frequent changes to the technical specifications documents. Furthermore, the decisions of specific stakeholder groups often impacted on related stakeholder groups and organisational units. For example, the requirements determined by business related rules affected technical requirements. 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. Hence, not all team members had access to up-to-date documentation and situations arose where development continued while following incorrect requirements.

Accordingly, a ***high flexibility status*** 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. Again in this situation integrating the IMS parallel with the existing system, and testing the integration incrementally in the small test environments reduced risk. This ensured that MU could continue to operate while the integration progressed. Project failure has been generally attributed to ineffective project management and control, incomplete goal specifications, communication, and an underestimation of project complexity. These elements were critical in this project.

6. Lessons Learned

Many of the issues identified in this project have been identified in academic literature but as evidenced by this project critical project processes (e.g. effective document administration) can be overlooked. Therefore, a checklist of the lesson learned has been formed. It is proposed that this list would have similar utility in like projects.

Risk reduction

- The development of a working partnership with the application vendor enabled risk to be shared and encouraged vendor commitment to system success.
- The inclusion of application specialists and vendor representatives on the project team assisted in reducing knowledge barriers.
- Negotiation of two-stage (or incremental) contracts with the application supplier helped reduce risk associated with application compatibility and functionality unknowns.

Project Management

- Soft target dates resulted in a lack of focus. Therefore, adherence to a hard but realistic target date would help focus project personnel.
- Closer project team involvement with business processes and system accounting was needed.
- The acquisition of dedicated key project personnel would enhance project continuity.

Communication

- Information management is critical and thus a strategy for its administration should be included in the project management plan. This process should be formally implemented and monitored for effectiveness.
- A production support plan, business owner and product manager needed to be determined.
- Closer project team involvement with change management and communications issues. Effective communication of any deviations from the common plan is crucial.
- 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.

Training

- The project was initially viewed as a networking solutions project when it should have been treated as a business information system project. A better understanding of the IMS application via effective training may have prevented this.
- Inadequate project personnel attended IMS training. Specifically, meta-directory personnel and an applications oriented resource should have attended the IMS training.

Future Research

This research provides a basis for further research on Internet Management Systems as more research is require on access and authentication systems which is evidenced by their high failure rates.

Interviewees claimed that regardless of how detailed system requirements and specifications in documentation are specified, these documents and related communications are frequently misinterpreted. Since ineffective requirements are a major contributor to information systems failure, future research could be conducted on systems development communication processes. Such research could evaluate the language and terminology used in systems development to determine the general sources of miscommunication in large projects

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