FACULTY OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

SYSTEMS INTEGRATION :
A TOOL FOR PROJECT MONITORING
IN THE PUBLIC SECTOR

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Abstract

Many computerized systems today, operate within organizational boundaries. In the Malaysian public sector, early systems were developed to solve organizational business functions. In the course of developing application systems to resolve specific needs, these organizations hardly look beyond the boundaries of their business domain. This phenomenon led to the existence of islands of information systems within the government sector.

In this study, the researcher proposed to look into the issues of systems integration (SI) within the public sector, in general, and subsequently proceed to an area where SI is deemed to be appropriate.

Project monitoring for the government, in Malaysia, is an important matter. It is vital to ensure projects that are planned for the development of the country, is implemented according to schedule. Proper management and monitoring of these projects are essential to their success. In compliance with procedures, several government departments are involved in the course of a project development. As such, the handling of project information across these departments, is an area where the researcher feels SI could be effectively deployed.

To provide the researcher with a broad perspective of SI in the public sector, a survey is conducted amongst departments deploying information technology (IT) in their daily operations. This survey looks into methods of data-sharing amongst government bodies and measures the extent of SI adoption amongst them. It also looks at issues surrounding SI within the government sector.

Literature study is done to lay the ground work in applying SI solutions to these information islands. It provides the researcher with some theoretical framework in order to progress, including getting information on works done on this subject and current trends.

Discussions on the case study are illustrated through a prototype of a project monitoring system, developed during the study. This model system serves to demonstrate the researcher's proposed tool for project monitoring in an integrated environment. In order to further support the proposed solution, an assessment of the prototype was conducted among users familiar with the subject of project monitoring in the government.

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Chapter 1

Area of Concern

1.1   Introduction

In the last decade, a lot of focus has been put on making better use of data residing on computerized business systems. Data collected during business transactions may be useful for purposes beyond the respective business areas. Information obtained from such systems are used for making guided management decisions based on business patterns. These data are also used in early warning systems to assist decision makers. Information has been seen as invaluable assets to organizations in pursuing the level of excellence in their services to their clients.

Faced with old legacy systems that were developed in disparate business areas, efforts are made to enable these data sources to merge into more organized network of interrelated data, easily accessible for each business needs. The advent of information technology (IT) has provided us with the necessary infrastructure to connect data sources irrespective of their locations. Systems integration (SI) has become a necessity in order to cope with demands of the borderless world.

This study proposes to go into the subject of SI in the perspective of the public sector of Malaysia. As it is the aim of the public sector to reach a degree of excellence in its services to the corporate sectors and the public at large, this topic is deemed relevant. It is only appropriate that a study be done on how to improve data management within this sector.

This chapter gives an overview of the researchers work on the subject of SI in the Malaysian public sector. Before focussing into the findings of this

study, it goes into some definitions of SI, works done in the subject, trends and some general issues. It also describes the research methods used in the study.

1.2 Information technology (IT) in the Malaysian public sector

Early uses of computers in the public sector of Malaysia were in the areas of data processing. They were used to process data for the national census by the Department of Statistics, for processing payroll by the Accountant General's Office (AG) as well as to process answer papers at the Examination Syndicate. These systems were mostly used to automate tasks involving repetitive, high-volume processes, that were labour intensive.

Growth towards management information systems (MIS) was seen in the 80's. Data from these systems were used to help management make better decisions through scheduled reports. Reports were also produced on demand or triggered through exceptional events. An example of a management information system was the SETIA system of the Implementation Coordination Unit (ICU) of the Prime Minister's Department. Through this system, data from various government agencies are captured to facilitate the monitoring of the country's development projects. Information from this system are used by several central agencies to ensure proper implementation of projects.

Decision support systems (DSS) are not very much in use in governments. DSS which support decision making, for making assisted decisions or suggest alternatives are mostly used in the industries. One of the few government bodies that deploy such systems are the Waterworks Department. The system is used to monitor water-levels at dams to control water-gates.

Through the years, most computerization projects were focused towards providing automation to the respective government bodies. Systems were planned to service users within the organizations and their respective clientele. Any report that needed to be sent outside the departments was done through hardcopy documentation. Few agencies began sharing data through exchanges of tapes. Such practices were exercised between the Ministry of International Trade And Industries and the Central Bank (Bank Negara), and between the AG and the Employees' Provident Fund (EPF).

With the introduction of personal computers (PC's) in government departments, data exchanges started to be done through diskettes. These exchanges were done periodically, or, as and when they were required. Data were transferred from branch offices to their headquarters through diskettes. Such practice was done between the ministries and the ICU. Diskettes were either hand-carried or mailed through the postal service.

As networks were established between headquarters and their branches, data started to be transferred electronically through telecommunication lines. Most transfers were done in batches, periodically, using file transfer facilities. Online access was sometimes provided from remote terminals connected through leased lines or dial-up facilities. Connectivity between different platforms were sometimes achieved through gateways, to provide for file exchanges. Connectivity was also achieved through terminal emulation from PC's to mainframes and through using common interface facilities. But, integrating application to application are hardly done. Until today, the Election Commission's means of access to the National Population Database at the National Registration Department (NRD) is through remote terminals linked to the NRD's host system. Reference from the Immigration Department to NRD's records are done through the same method.

With all the infrastructure available today to support data-sharing, application systems are designed with little or no consideration for integration beyond the organizational boundary. Standards, at least for the public sector, are yet to be established, to facilitate future integration. For example, even coding standards for states or districts in the country, are yet to be established, even though many agencies are using these codes in their internal systems.

1.3   Why integrate?

One of the success factors for today's organizations have been identified as having the right information at the right time. Business decisions are made based on facts rather than theories. The availability of data is important to support decision making and to help business forecasting. These data that normally reside on disparate systems that correspond to functional divisions in an organization, should be made easily accessible. Information available in a timely manner can be very valuable to the organization. The degree of integration between related systems strongly influences future business options.

In providing services to the private sector or the public at large, government organizations, need to have reliable information sources that are available whenever required, in order to help the nation progress. Information on economy or trade are useful for the private sector in coming up with business strategies that can help the nation develop. Information on social development are important for the government, to provide relevant services to the public. The security sector has to be well-informed to ensure stability of the nation. In all these aspects, systems need to be established where data can be made available to the right people in a timely manner. It is insufficient, to have data residing on separate

systems that are difficult to access. By the time these data are compiled, their values are of little significance.

Government bodies have to address their role in helping the nation progress in this competitive age. They have to play the role of the steerer rather than the rower towards development [1]. In order to do this, the public sector have to rethink on their strategies for developing their information resources in the most efficient and effective manner.

While strategies on standardization of IT tools are slowly being promoted, more efforts should be put into linking business systems among government departments. Studies should be conducted to cross-link business systems that are related to each other. Systems that make frequent references between each other should be designed to have connectivity established. Application bridges should be developed to allow systems to talk to each other in an automated manner rather than waiting for human intervention. As an example, in checking the authenticity of a citizen from the Immigration Department, the process should automatically refers to the National Population Database. Such linkages should speed up the process of approving passport application at the Immigration Department. So does the checking of a license plate by the police. By having online connection to the system at the Road Transport Department (RTD), the police will be able to identify the owner of a vehicle, fast.

SI should also be looked at, in terms of the benefits to the government itself. Besides general improvements in its service to the public, SI should be used as a tool to improve resource utilization amongst government establishments. By having information systems that have linkages among each other, data gathering would not be such a big task. The time needed to obtain information that normally reside on different platforms, will be

very much reduced, once the infrastructure to bridge data resources are established. Systems that are built to serve different business functions keep data relevant to their respective needs. The same data when needed elsewhere are replicated, thus causing redundancy in storage resources as well the manpower supports. Inconsistencies between these data sources also occurs as they may be updated at different times through different processes. The issue of accuracy of information gathered from different sources at any point of time will arise. All these factors give rise to the question of why SI should be a worthwhile subject to be looked into, when the public sector strives to improve itself.

Some of the objectives of SI in the public sector are :

i)   To facilitate data sharing among organizations dealing with inter-related data;

ii)   To avoid data duplication among organizations that require similar data;

iii)   To avoid data redundancies due to replicating data on different sites;

iv)   To optimize the utilization of hardware resources such as storage space and processing units;

v)   To optimize manpower resources required for the maintenance of data repositories;

vi)   To ensure data consistencies;

vii)   To provide faster access to information.

1.4   Definitions of systems integration

The term 'systems integration' may be interpreted differently by different groups of people. Some of the definitions obtained from different sources are described in this section.

According to P. G. W. Keen [2], SI refers to providing a technical solution to a business needs that involve fitting together the relevant technical components (including existing incompatible hardware, software and data bases as well as new systems).

In the article "Systems Integration" [3], James Y. Bryce chose SI to mean assembling a diverse collection of computer software and hardware to accomplish the goals of the client.

D. Richard Kuhn in his paper [4] defined systems integration as a practice of joining the functions of a set of subsystems, software or hardware, to result in a single, unified system that supports some need of an organization.

In summary these definitions, take SI to mean putting together systems that support diversed but interrelated business functions, using relevant hardware and software, so that they can be treated as one, irrespective of where they are located. The unison of such systems depicts a seamless environment.

The advent of IT today, was prompted by business needs. Now that technology is available to support changes on business demands, the focus on SI has shifted from technology issues to business issues. The questions today are mostly on how the concept of integration can be successfully carried out in order to meet its intended objectives.

1.5   The problem statement

Systems Integration (SI) in the public sector context is not a new phenomenon in Malaysia. The Government's move towards achieving Electronic Government status is a clear target for SI. Providing *hard* infrastructure to link existing systems in a network, and making it accessible to all, is hardly sufficient. SI has to be thought of not just in terms of making separate components of a technology base work together, but, also in terms of joining business services into a harmonized environment.

In this study, the researcher proposed to look at SI from the implementation perspective. Some of the research questions to be addressed in this study are :

     i.   *Is there a need for SI in the Malaysian public sector?*

    ii. *What is the extent of SI implementation among public agencies?*

  iii. *What are the problems faced in adopting SI?*

  iv. *How should SI issues be addressed?*

    v. *Can SI be a tool in the management of development projects for the government?*

Despite the awareness on the benefits of integrated systems, the implementation of SI has taken a slow start. Government policies and recommendations on IT practices has set the path towards integration. Recommendations on the adoption of open system standards and client-server strategy are examples of the government initiatives towards

promoting integration. Questions lead to why SI has not taken off well in solving business issues.

Some of the reasons for the slow progress on SI adoptions, observed during the research period are :

- Organizations are too busy to consider anything beyond their functional areas;
- Weakness in the organization of SI project management;
- Difficulty in getting commitment among participating agencies;
- Lack of empowerment for project committee to make changes in business processes;
- Existing laws and regulations binding business rules;
- Failure to address pertinent business needs, thus, not able to convince users on the benefits of such solutions.

In the context of this study, the researcher intends to focus on the last issue, due to time constraints. However, the research questions stated earlier are discussed at length in subsequent chapters.

1.6   Research methodology

To address the research questions stated above, the researcher chose to deploy several research methods. A survey is conducted to address questions (i), (ii) and part of (iii). A questionnaire is used during the survey to obtain some measures on the need for SI in the public sector and to what extent SI has been adopted. The quantitative measures are used to support the researcher's hypothesis that there is a need for SI to be executed, in order to facilitate data sharing as well as to increase efficiency in how data are managed between government organizations. The survey is also intended at finding out from the people concerned, of their

perception on the reasons for the slow adoption of SI in their respective organizations. Chapter 3, describes the findings of this survey. The subjects of the survey are government departments that are currently using computers in their daily operations.

Part of Question (iii) and Question (iv) are discussed, based on the researcher's observation during the conduct of the survey as well as through interviews with relevant people involved in computerization projects. Besides that, some findings are from written documents, obtained from these departments. As stated in Section 1.4, there are several reasons for the slow adoption of SI in the public sector. One of the reasons of which is the failure to address pertinent business needs of the participating agencies. This reason is the focus of the next research method chosen for this study.

Several case studies were taken on government agencies, where SI may be or is being practiced. One case is chosen as a sample for exercising SI, which is the Project Monitoring System that is being implemented by several agencies, including the Implementation Co-ordination Unit (ICU) of the Prime Minister's Department. In order to illustrate the researcher's arguments on the use of SI as a tool in project monitoring, a model integrated system is developed. This model illustrates the working of multi-level users' work scope in an integrated environment.

The use of multimedia in the model adds value to the data generated by the respective agencies. It also demonstrates the concept of tool integration as described in the Chapter 2.

Chapters 4 and 5, describe the case study and the proposed SI model, respectively. Measures on the usability of the tool are obtained through

some evaluation tests conducted among officers with experience in the area of project monitoring.

Stated in the paper *Qualitative Research in Information System* [48], case study research is the most common qualitative method used in Information System [Orlikowski and Baroudi, 1991; Alavi and Carlson, 1992].

1.7   Deliverables

Deliverables from this study shall be in the forms of :

a) a written thesis on the subject

b) a survey report (included as in Chapter 3)

c) a prototype data-capture system for project monitoring in an integrated environment.

A Review Of Systems Integration

2.1   Introduction

In pursuing the study of *systems integration*, the researcher chose to organize the research work into a number of subject areas. Several methods were engaged in reviewing the subject. One of the methods of obtaining knowledge in the subject, was through literature research. Other modes of study were through observations of current works and trends in the IT scene, and the researcher's own experience in the field. These methods provide a theoretical framework of the study in SI.

This chapter describes some of the findings of the research work. Some of broad topics covered during the research are :

a)   Research Designs and Methodologies

b)   Governments' use of IT in Malaysia & worldwide

c)   Information Systems Evolution

d)   Systems Integration state-of-the-art

e)   SI related topics such as data-sharing, enterprise systems, interoperability, data security, client-server technology, open systems, networking, standardization etc

f)   Business Process Re-engineering, Business Process Improvement etc

g)   Technology trends in systems development like Object-Oriented Analysis & Design, Object-Oriented Programming etc

h) The Internet/Intranet Technology

i) Application Development tools & DBMS

j) Documentation on Case Study.

k) Statistical methods.

2.2 Information systems evolution

Information systems have evolved from mere automation of routine tasks to being a strategic tool in businesses today. Information has been identified as a valuable asset in acquiring the leading edge in this competitive world. The use of information systems has improved significantly with the advancements of information technology. Most information systems today rarely contain static information that gets updated occasionally. Instead, they mainly cater for dynamic data gathered through business transactions, whose data are used for management planning and interventions. The term *informate* rather than *automate* [2] have become the new watchwords of the IT profession. Recent years see the move of IT from being a backroom activity supporting mainly administrative functions, to becoming a tool in the front line of the business [6].

Islands of IS have been developed through the years to address separate business needs of organizations. Government departments were developing systems to serve their internal needs. Many of these systems are still operating within their separate environments. Cross-boundary data sharing are in some cases necessary to complement data values. Many of current researches in IT address the issue of integrating these systems. Subjects like data-sharing, open-systems, interoperability, data-portability, networking, business process reengineering, information engineering, object-oriented technology aim at achieving efficiency in data

In both areas of work, the evolution in technology is focussed on making the best use of IT to achieve integration at the business functionality level. Efforts into such areas reflect the demand for SI.

In the area of application software integration, the purpose is to put together individual application softwares, each of which is performing only a small function, to satisfy the requirements of problems which are multidisciplinary, very large scale, and geographically distributed.

Zemel and Rossak [7] introduce the term mega-system to identify a new type of system that has more than one purpose, is developed by more than one group, and not always having a specific group of users as opposed to the traditional systems that were developed for one purpose, by one group, and for a very specific user group. Many systems are synthesized from existing systems, forming large distributed systems with a heterogeneous environment. The synthesis of these systems is accomplished by using reuse technologies and integration strategies.

2.4   Systems integration objectives

SI serves users and developers of information systems in many ways. It benefits parties providing services through IT as well as users receiving the services. The development of SI is spurred on through the recognition of these benefits.

In order to achieve the benefits of SI, its implementation should be geared to meet two types of objectives, namely the business as well as the technical objectives.

Business objectives :

a. New and/or enhanced customer services involving faster service and/or more accurate responses to customer inquiries;

b. New and/or customized products with more rapid product introduction to the market, and tailored or customized products to fill market niches;

c. Productivity improvement through more effective workflow support; reduced cost of labor, materials, and facilities through improved capital budgeting and cost management; and real-time assignment and allocation of labor and equipment to the workflow.

Technical Objectives :

Resource sharing, reduce redundancies, reduce duplication, streamline processes, reduce cost of system management,

2.5   Aspects of Systems Integration

Several definitions of SI were mentioned in the previous chapter. These definitions may be interpreted in different ways by different groups of people involved in information technology. Works are done at different levels in order to facilitate the utilization of SI in information systems today.

Nilsson, Nordhagen & Oftedal [10] gave a breakdown of aspects of SI to 4 main levels :

- *Integration technology* - addresses the mechanisms which allow transfer of data between systems and for initiating actions in other systems. Some of the strategies taken to allow integration are through the use of common databases and through process to process communication. A high level integration technology facilitates the implementation of IS.

- *Integration architecture* - focuses on systems design to achieve easy and safe sharing of data and functionality between systems. Examples of strategies taken are through common or distributed data storage and controlled redundancy.

- *Semantic integration* - addresses the semantic content of data in different systems. If systems are to share data and functionality, they must have a consistent set of concepts. It is important to have an agreement and understanding of the schema to be used. The least they should have is a common concept for common parts of the integrated system.

- *User integration* - looks at SI from the user point of view. It encompasses all the requirements of users at various levels. User integration may be addressed through application oriented systems or task oriented systems.

Figure 2.1 illustrates the connections between these different aspects of SI.
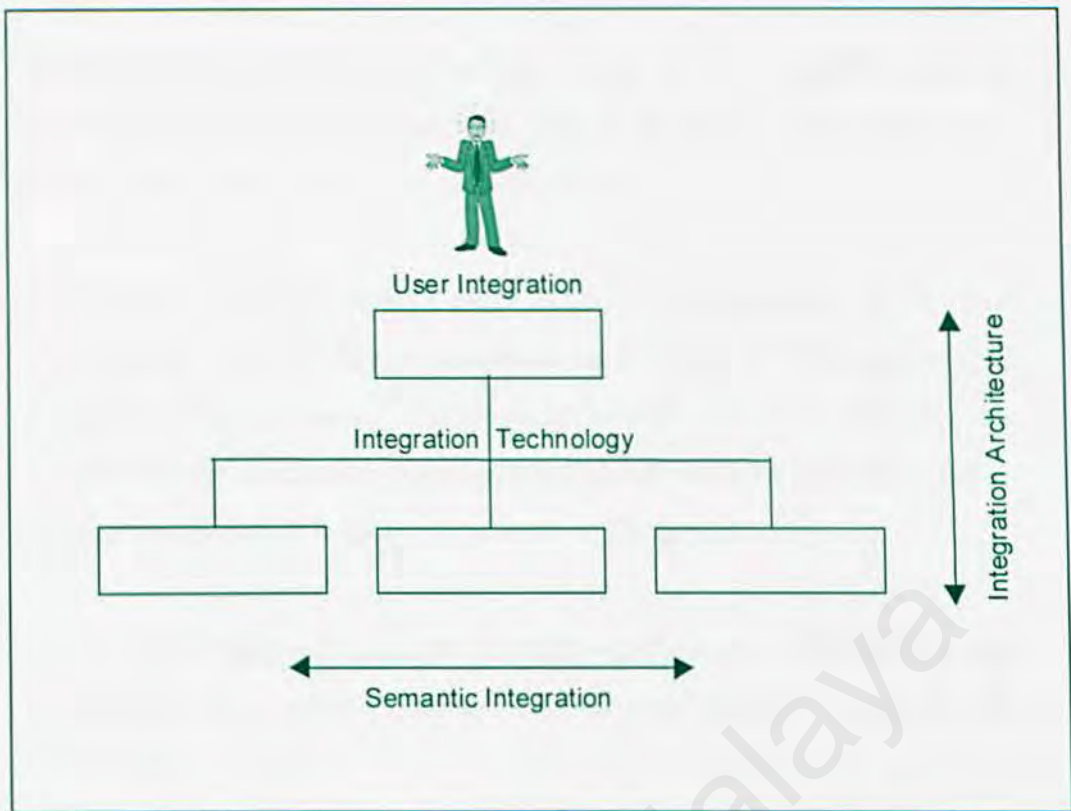
Figure 2.1: *Connections between aspects of SI*

2.6 Key elements in systems integration

The first step in an automation and information systems integration program is the identification of clear and measurable business goals and objectives that are to be supported and/or enabled. Where the intent is to develop automated business processes, the entire business process should be re-examined and redesigned with both business objectives and the capabilities of the automation technology in the forefront.

The technical content of an information systems program involves the mix of equipment, computer hardware, application software, databases, and telecommunications equipment that must be engineered and integrated to meet performance specifications. This technical system must be integrated into the business to meet top-level business objectives. Unfortunately, this

is often neglected and has been the prime source of the strategic failure of information systems. They may work well in the technical sense, but may not be used effectively or at all in the business.

Information Systems Architecture (ISA) is recognized as a key management tool for SI, as described in Hoffman's "Management of Enterprise-Wide Systems Integration Programs" [8]. ISA describes all elements of the IS infrastructure that are required to serve business users or to perform a mission. Major components of the ISA include :

- The Business Process Architecture - outlines product workflow and information transactions among internal and external units of the enterprise ;

- The Application Architecture - describes the form and structure of all software applications organized into managed clusters to support business operations ;

- The Data Architecture - indicates the data storage locations and methods to support both applications and end-users for decision support ;

- The Infrastructure Architecture - describes the style and design of computing platforms and networks used to access applications and data (including computer and network operating systems, protocol stacks, resource and user accounting systems, and performance monitoring/reporting systems essential for the operation of the information utility).

Several management objectives were identified, in the design and implementation of a complex enterprise-wide SI programs:

- Build consensus around the architecture among operations managers, information system users, and information technology service staff;

- Develop the program organization around a user owned information service philosophy;

- Manage implementation of the architecture, justify and control exceptions;

- Evaluate and select technologies against business benefits, cost, and risk criteria;

- Plan, monitor, measure, and control progress toward the business objectives of user and customer services in a climate of risk and uncertainty;

- Migrate a business system or operation from the current baseline condition through the implementation to the operation of the new system;

- Manage human resources to prepare for operation, and allocate those resources across projects so as to achieve maximum efficiency of the program resources. Prepare for culture change ;

- Update the architecture to meet new business objectives and to exploit new technology.

Another vital point raised in the management of such integration program is that SI management should be separate from the MIS organization having day-to-day information support responsibilities, as failure to

separate system implementation functions from MIS operations risks serious misallocation of resources to the detriment of both.

2.7 System integration methodology

Research on the methodologies for SI reveals that not many are in place for adoption. One methodology found is the GenSIF model promoted by Wilhelm Rossak and Vassilka Kirova, Systems Engineering Laboratory, Department of Computer and Information Science, New Jersey Institute of Technology, Newark, USA. GenSIF model divides the development of systems into projects based on two levels of management, namely the meta-level management and the project level management.

- The *meta-level* is responsible for coordination, control, and definitions of goals and directions of such efforts.

- The *project level* management is responsible for managing the actual development of software.

2.8 Reasons for failures of systems integration :

Understanding the reasons for failures of SI would help one avoid the pitfalls in the course of achieving integration. Problems would be appropriately addressed when there is understanding and commitment from all parties. Some of the reasons for failures identified [4] are:

- Business requirements were not well defined in the early stages, or were forgotten in the latter stages of development and implementation;

- Technologies were not properly selected or specified;

- The many projects, tasks, and activities that affect the information infrastructure of an enterprise were uncoordinated and led to 'islands of automation';

- Components and subsystems were not properly integrated and did not work together as a system to meet technical performance objectives;

- Business operations managers and users were not able to apply the system effectively in their environment.

In meeting the business objectives of a systems integration program, considerations must be given to the followings [4]:

- The mix of manual and automated business processes
- Islands of automation
- Millions of lines of undocumented software code
- A heterogeneous mix of equipment
- Multiple standards and proprietary systems
- An existing business culture with a lot of baggage
- A mix of skills based on historical requirements
- A number of ongoing projects

Some major risk categories that are faced in managing IS programs as stated by Hoffman [8] are :

- *Management risks*

  - Lack of commitment by the executive management and program management,

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- Objectives may not be sufficiently bold in addressing business issues or may not be attainable, realistic, and therefore credible,

- Micromanagement may interfere with program management authority, and may limit responsibility and accountability.

- *Program and project risks*

  - Moving requirements can sometimes be arbitrary and go beyond real business needs,

  - Schedule slippages may be compounded by the cascading effect of interrelationships and interdependencies between projects,

  - Contractor performance that may be compounded at the program level,

  - Acquisition policies and procedures that limit program flexibility and responsiveness.

- *Technical risks*

  - Component obsolescence or degradation may constrain system performance,

  - System performance is affected by individual component performance,

  - Integration may be complicated by component product limitations,

  - Software interoperability.

- *Resource risks (financial and people)*

  - Budget instability may reduce momentum of project,

- Life-cycle management, related to budget or staffing constraints, may limit attention to long-term viability or maintainability of project,

- Capital investment constraints may impact lifecycle management,

- Turnover can be detrimental to program objectives.

- *Human and organizational risks*

  - Culture change is a major challenge in exploiting an information system to achieve new targets,

  - Workforce impact which must be addressed prior to and throughout the program,

  - Organizational constraints caused by protectionist and preservation instincts.

- *Business operation risks*

  - Payoff, which is the ultimate measure of success of the program may be met, due to improper definition of initial business objectives and/or the lack of clear and unambiguous measures to prove success,

  - Staying ahead of competition requires strategic business objectives that guide the program.

The use of program metrics would be useful to provide some quantitative measures during the management of SI programs. The metrics should cover project activities, budget and schedule, technical and customer satisfaction. The purpose of the disciplined use of program metrics is to :

- Monitor progress against program objectives and measure the effectiveness of program management,

- Provide clear and measurable project objectives,

- Provide decision support indicators, and

- Develop an early warning for risk management.

The management model and Information System Architecture templates described above can be applied to the definition and design of a newly defined program, or as an audit approach for an existing system.

2.9 SI in governments worldwide

A study was done to determine the extent of SI utilization by governments worldwide.

A study by a team within the G7 Government Online (G7GOL) group, found that information sharing and re-use among government organizations had already been initiated by some nations [12].

The general idea of information sharing and re-use is to store information once rather than many times across government departments. A customer (a citizen or a business) should not be asked by different departments for the same information. Through information sharing, data is obtained once and used many times.

Re-use and sharing of information is an essential underpinning element to allow the 'one stop shop' concept to be implemented across all government services. Also, it constitutes one component that enables re-engineering of

the government. This can be achieved only when there is an interoperable infrastructure across the whole of government, such that information can easily be accessed or exchanged by all departments.

A look at the steps taken by some countries will further illustrate the status of SI adoptions by governments worldwide.

2.9.1   The United States has been making consistent efforts to make government more efficient and client-oriented, by utilising information technology.

One of the efforts that is closely related to the theme of information sharing and re-use is the development of integrated electronic access to government information and services [68].

The government's primary mission is to provide quality services to the public in a timely manner. However, access to government services is cumbersome, uncoordinated, and not customer-friendly. If more than one agency is involved, a customer must go through two or more rounds of inquiries, with frequent routings from one government employee to another. Several government initiatives involving various information access methods are improving service to citizens by making information more readily available. Kiosk Access is one of these initiatives. Federal and state governments are developing approaches to providing information and services through interactive, customer-activated terminals called kiosks, which are modeled after automated teller machines (ATMs).

The Social Security Administration (SSA) is developing a new customer service initiative using kiosk technology to provide a

wide range of services. This pilot program, begun in late 1993, provides information (retirement and disability benefits information, Supplemental Security Income eligibility requirements, etc.) and direct services (processing of entitlements, status of pending claims, etc.).

In conjunction with this initiative, SSA, the U.S. Postal Service (USPS), and the Department of Veterans Affairs (VA) are developing a combined government services kiosk. This kiosk will be a single access point to services provided by the three agencies. Since these three agencies represent a significant share of the federal government's contact with the public, this partnership will have a dramatic effect on decreasing costs by reducing duplicate efforts and improving service by providing public access from more locations.

2.9.2 In the United Kingdom, a government strategy paper." *Government Direct : A Prospectus for the Electronic Delivery of Government Services* " [18], set out, among others, the strategy on streamlining and integration of processes across the boundaries between government departments and agencies.

2.9.3 The Australian Government focuses attention on a vision for government providing direct services to clients that are transparent and seamless. Implementation of this agenda involves the use of interconnected tools and shared solutions and information through the development of a standards-based electronic information infrastructure. This consists of common information, applications, technology platforms and networks. In the longer term the review considers that such a vision is appropriate for the future of the Australian Public Service [32].

2.9.4   In Canada, a report titled "*Blueprint for Renewing Government Services Using Information Technology*" was published by Treasury Board of Canada in 1994. The Blueprint provides the direction of future government services, and several action programs based on the Blueprint have been accomplished [68].

The Blueprint takes a fresh, enterprise-wide look at government services using a client focus. It recommends creating, managing, and prudently sharing information electronically among departments and their different services in a way that protects the security and privacy of the information. It envisages the use of a government-wide electronic information infrastructure to simplify service delivery, reduce duplication, and improve the level and speed of service to clients at a lower cost to the taxpayers.

The Blueprint describes an integrated approach to improving the delivery of government services while significantly reducing associated costs. The integrated approach means that the activities in five different but interrelated areas - government businesses, associated work processes, information, system applications and technology - must be integrated in support of the renewal of government services.

The vision, the architectural principles, and the service delivery scenarios in the Blueprint are founded on the importance of having a client focus, sharing resources, developing standards, facilitating access to critical information and, above all, recognizing people as key to business renewal.

A report by another team in the G7GOL group described various government strategies in promoting Information Societies.

A study on government use of the Internet by G7 Government Online (G7GOL) team and ICA [14] shows rapid growth in the use of the Internet by governments, businesses and individuals in recent years. Sixteen member countries were surveyed. All that participated utilizes Internet almost exclusively for publishing of information, and only in a broadcast rather than in a tailored way. In some countries the web is used to support public consultation. The study projects that the future for government Internet service lies in the development of truly transactional service. A high degree of cooperation and cross-agency working, with appropriate safeguards for the protection of personal data, will be necessary to tailor government's services more precisely to the customer's need.

Electronic forms are starting to be used in Germany, UK and the Portugal, for the public to transact. In the USA, approximately 40% of government forms are available electronically. Government one-stop shops and information sharing offer a gateway to transactions that require the participation of more than one governmental organization.

In *Governance: The New IS Agenda*, [15], Strassman discussed the democratization of information, as IT becomes more ubiquitous and distributed systems gain wider acceptance. This concept requires information management to be looked upon in the context of allocation of control over the creation, distribution and use of information.

2.10   Information technology in Malaysia

The central government is making every effort in promoting the use of IT in all sectors. The setting up of Multimedia Super Corridor (MSC) proves

the government's seriousness in utilizing its full potential in pushing the country ahead in its vision towards becoming a developed nation by the year 2020. Realizing IT as an enabling tool in order to achieve this vision, a concerted effort is made to promote its usage at all levels. This includes exploiting IT within the public sector, thus leading to the move towards Electronic Governance.

For the Seventh Malaysian Plan , some Flagship Applications have been identified to spur the country into the information era [66]. One of the test-bed applications under Electronic Government is the Project Monitoring System.

Policies and standards are developed to serve as a guideline for government agencies in the utilization of IT. The Electronic Government Information Technology (EGIT) Policy And Standards Document is enforced, in adhering to the government vision to promote IT usage in its services to the public.

2.11   SI in project monitoring

No materials were found in the application of SI concepts in the subject of project monitoring, elsewhere in the world. A study into the case of project monitoring systems in Malaysia, shows that the use of computerized systems started as early as in the late 70's. Government agencies have their ways of handling information on projects through systems built internally. An awareness of the need of SI soon developed. The concern arose due to difficulties in consolidating information from too many sources to form a picture on the current status of projects. Quick actions to remedy problems were hampered. The issuance of **Directive No.1** [refer Chapter 4, Section 4.2], was a result of this awareness.

Efforts were made towards achieving SI through the development of the **SETIA** Project, the project monitoring system for the government of Malaysia. But, the successful adoption of this concept is yet to be achieved. This is evident in the way the system operates. Issues on this are discussed in Chapter 4.

2.12   Conclusion

The review reveals that a lot of efforts have been put into promoting SI world-wide. Studies have also been done in approaching the subject of SI. Identifying aspects of SI and issues surrounding its implementation, are major tasks in any SI program. The organization of an SI project is vital to its successful implementation. With the present technology available, problems in SI adoption are more likely to be on the organizational rather than technical aspects.

SI adoption has to be viewed very closely according to each individual case. The appraisal of SI program success level has to be done in accordance to its meeting both the business as well as the technical objectives.

A Survey on Systems Integration
in the Public Sector of Malaysia

3.1 Introduction

This chapter describes findings of the survey on SI status among government agencies. The survey is conducted to form the background of the study. The purpose of the survey is to get a picture on current status of application systems in government establishments, the extent of SI adoption, and the applicability of SI concept among them. The survey also looks at the extent of data-sharing between application systems, current method of data exchanges and communication infrastructures being deployed. Problems pertaining to SI adoptions, are also gauged through the questionnaire, in order to identify issues surrounding this topic.

This mechanism is used to measure SI potentials in the context of the public sector of Malaysia, before proceeding further into this study.

As recommended by Pervan and Klasss [17], surveys provide a rich base of numerical data and are often used in association with other research approaches.

3.2 Background of the survey

The survey was conducted among government departments and agencies that utilize information technology in their operations. It was designed to ascertain the need for SI in government services. The practices of data-exchange between systems were reflected through the number of application systems that provide output, for use by other systems within or

external to their organizations. Also depicted in the study was the frequency with which such exchanges occur. The existence of suitable infrastructure to support SI is also examined. Several issues on the subject of SI were also asked through the survey.

Generally, the survey findings provided basis to support the hypothesis that there is a need for SI in the public sector.

3.3 Survey objectives

The objectives of the survey were determined as follows :

i.   To explore the status of systems integration in the public sector

ii. To identify the problems faced in the implementation of SI;

iii. To evaluate the potential of SI in the public service.

3.4 Survey organization

3.4.1 The Questionnaire

The questionnaire was divided into 2 sections.

Section A - designed to collect some background information on the use of computers in these departments. The respondents were asked to list application systems that were running in their respective departments. Information such as how old the current systems were, how they were developed, their operation mode, the extent of data-sharing as well as how frequently data were exchanged, were asked. Feed-backs on the current network

infrastructure for each department and the extent of internet utilization were also asked.

Section B - directed at finding out the status of SI, if any, in the respective departments and to identify problems in its implementation . Questions were also asked on plans for SI for the organization, the respondents' opinions on reasons why SI was not implemented as well as other factors affecting the success or failure of SI.

A sample survey form is shown in **Appendix A**.

3.4.2 Survey respondents

The respondents were chosen based on the presence of a computerized system in their organizations. This however, does not necessarily mean the existence of an IT unit within the organization. The list of departments that responded is as in **Appendix B**.

3.4.3 Distribution and collection

The distribution of questionnaires was done through mail on 12 May 1997. Deadline for feed-backs was set for 16 June 1997. Follow-up calls were made to ensure the receipt of questionnaire by each department. Additional copies were either faxed, hand-delivered or mailed to the respondents when earlier copies were not received.

Feed-backs were received either through mail, fax or hand-delivered.

3.5   Survey findings

Out of **60** questionnaires sent out, **39** were returned. This makes about **65** % of departments that responded to the survey.

3.5.1   Number of applications per organization

Out of the **39** agencies that responded to the survey, **34** listed out the application systems in use at their respective departments. A total number of **274** application systems were identified. The distribution of application systems used in government organizations is shown in **Table 1**.

Table 1 : *Distribution of the number of applications per organization*

No. of Applications	No. of Departments
1	3 (8.8%)
2 – 10	24 (70.6%)
11 – 20	6 (17.7%)
> 20	1 (2.9%)

The number of applications in each organization surveyed, ranged from just 1 for small organizations like the Ministry of National Unity And Community Development and the Department of Veterinary Services, to as many as 29 in big organizations such as the Ministry of Education. More than **90 %** of the 34 organizations that responded have more than one application systems running. This denotes that computers in these organizations serve several functional areas. These systems serve administrative areas as well as business functions of these departments.

Application systems were mainly developed to tackle departmental main businesses such as the National Population Record System of the National Registration Department (NRD) and the Traffic Summon System of the Police Department. However, administrative systems to support organizational operations such as Personnel Systems or Inventory Systems are commonly used by government organizations. Some use common systems developed by a central agencies such as the Personnel System (SISPEN) developed by the Public Services Department and the Vote Book System developed by the Accountant General's Office, but many are using customized systems, developed separately, for their organizational needs.

3.5.2 Operations mode

Table 2 : *Distribution of application systems according to operation modes*

Operation Mode	No. of Application Systems
Batch	128 (47%)
Real-time	146 (53%)

More than **53%** of the systems run in real-time mode, as shown in **Table 2**. This shows the time critical nature of data captured through these systems. Real-time systems are found in services that deal with the public, daily, such as the Road Transport Department (RTD), the Immigration Department, the Police Department and many others providing counter services. As soon as transactions are done at the counters, data from such systems get updated immediately into the departmental database. These data are then made available for others to refer, or to enable further transactions.

Batch systems make up to just under **47%** of the systems reported. These are normally the non time-critical systems or systems that are doing background processing jobs. Data from such systems do not need to be accessed immediately. Examples of such systems exist in the Statistics Department, the Examination Syndicate of the Ministry of Education and departments dealing with analyses of data for the government.

3.5.3 Systems age and developer

Table 3 : *Distribution of applications according to age*

Application Age	No. of Applications
<= 5 years	142 (52%)
6 - 10 years	114 (42%)
> 10 years	18 (6%)

Ninety-four percent of systems listed were developed during the last 10 years, as shown in **Table 3** above. This figure indicates that during the last decade, systems have evolved to meet changing needs of the public sector. Almost **52%** of them were developed in the last 5 years.

The use of computers in handling government business started more than 20 years ago. Some old systems are still being used today. Examples of such systems are those running at the Royal Police Department. They were developed as early as 1976.

Most of these systems have their output shared by other systems, internal or external to the Department. They operate in real-time

mode. This shows that old systems, which have stabilized, are still being actively used.

Table 4 : *Distribution of applications according to method of development*

Application Development	No. of Applications
In-house	185 (68%)
Consultant	37 (14%)
Joint-effort	34 (12%)
Packages	13 (5%)
Vendor	4 (1%)

Table 4 shows how application systems were developed in government agencies. Most applications were developed in-house.

The survey shows that the use of packages is more rampant in recent years. From the systems listed, the use of software packages started only in the 90's. It gets more common during the recent years. This trend came with the introduction of personal computers (PC's) in offices. Packages are normally used in areas where there are standard procedures such as in accounting and inventory control. Early systems were mostly developed in-house. They are systems that tackle very specialized needs of departments such as the Payroll System of the Accountant General's Office. This system takes care of the payroll for all public servants.

3.5.4 Data sharing, mode of data-transfer and frequency of data-transfer

Table 5 : *Percentage of data-sharing amongst applications*

Status of Data Sharing	No. of Applications
YES	98 (36%)
NO	176 (64%)

Approximately **36 %** of applications surveyed, shared their information with other systems, within or beyond the organization. This is shown in **Table 5**.

The number of applications that share output with others were 98 out of the 274 listed. Most of the earlier developed systems still have their output used by others. This is probably due to the well-tested features of such systems. It may also be that data generated through these systems have become a reliable source of information.

However, the trend shows that more of the newer systems operate on their own, without their data being shared by others. These new systems are mainly very specialized systems that serve very specialized needs which are peculiar to the departments, such as the mapping system of the Ministry of Land Development, and the blood bank system or the pharmaceutical system of the Ministry of Health. Others that make up the number are administrative systems customized to the organizational needs such as the personnel systems, inventory systems and filing systems. *It should be noted that where it is indicated that output is not used by other systems, the product of the system whether in documented form or in the form of information published for the public are still produced.*

Table 6 : *Distribution of applications according to mode of data-transfer*

Mode of Data Transfer	No. of Applications
Magnetic Tapes	28 (43%)
Diskettes	18 (28%)
Electronic File Transfer	17 (26%)
Electronic Data Interchange(EDI)	2 (3%)

Tapes remain a common medium for data transfer, making up more than 43 % of the 65 applications reported, as shown in **Table 6**. Almost 28% used diskettes while the rest utilized file transfer facilities (ftp) between systems. Only 2 applications indicated communication through electronic data interchange (EDI).

As shown in the **Table 7**, data transfers were most commonly done monthly. Almost **31%** of the systems listed produced monthly output for others. Daily exchanges of data constituted up to about **20%** of the application systems. The remaining systems had their output shared by others, weekly, quarterly or annually. Some outputs were supplied on ad-hoc basis. Examples of systems whose daily outputs were used by other systems are the Finance & Accounts Management System of the Accountant General's Office and the Contractor Registration System of the Ministry of Entrepreneur Development.

Table 7 : *Distribution of applications according to frequency of data-exchanges*

Frequency of Data Transfer	No. of Applications
Daily	13 (20%)
Weekly	9 (14%)
Monthly	2 (3%)
Quarterly	20 (31%)
Annually	11 (17%)
Ad-hoc	8 (12%)
Others	2 (3%)

3.5.5 Network infrastructure

Table 8 : *Breakdown of organizations according network infrastructure used*

Network	No. of Departments
WAN	1 (3%)
LAN	9 (24%)
Both	24 (63%)
None	4 (10%)

Thirty-eight departments responded to this question. One department did not give any response to this question on communication network available for its organization.

As shown in **Table 8**, **90%** percent of responses indicate some form of network connectivity, either using wide-area network (WAN), local area network (LAN) or both. About **63%** have both WAN and LAN established for their organizations. This shows that

the need to connect between systems exists. However, at this stage, they are mostly done within the same organization, connecting branch offices to the headquarters, fulfilling specific needs of agencies.

3.5.6 Use of the Internet.

Table 9 : *Use of the Internet according to departments*

Use of Internet	No. of Departments
YES	35 (90%)
NO	4 (10%)

At the time of the survey, as indicated in **Table 9**, 35 out of the 39 agencies (ie **90%**) that responded had access to the Internet. Most of these organizations indicated electronic mailing, as well as information search as the main use for the Internet, while other uses were for information publishing and file-transfer.

Three out of the 4 agencies that had not subscribed to the internet, were in favor of getting connected.

This finding indicates the widespread use of Internet technology among government agencies. Nevertheless, not many have deployed this technology in their daily business transactions. Most departments do not go beyond providing web-sites for publishing information on their respective organizations.

3.5.7 Number of I.T. personnel and I.T. funds

Almost **95%** of the departments that sent in their responses indicated that they had insufficient IT personnel. This is shown in **Table 10**.

Table 10 : *Number of I.T. personnel according to departments*

No. of IT Personnel	No. of Departments
<5	11 (28%)
5 – 10	7 (18%)
11 – 20	5 (13%)
> 20	16 (41%)

Only 2 of the 39 respondents indicated that they had enough. Most respondents noted that there are insufficient IT personnel to meet the requirements of their respective agencies. Demands for computerized systems far exceed the number of personnel allocated to each department. This situation, if not resolved, may lead to under-utilization of computer resources available for each organization.

Government departments' resources of IT personnel ranged from as low as only one (1), to as many as almost two hundred (200). At the time of this survey, some agencies such as the Department of Civil Aviation and the National Unity and Community Development Ministry, had no IT trained personnel. The systems in use, were supplied by vendors. Organizations like the Inland Revenue Board (IRB) and the Statistics Department have big IT units with personnel of 187 and 142 respectively. These departments deal with massive data. The number of departments

with IT personnel of more than 20 made up to about **41%** of those sampled.

A total of 29 agencies responded to the question on percentage of IT allocation as compared to the annual organizational budget. IT allocation here is defined as the allocation for maintaining IT unit services not including new purchases of IT equipment.

Table 11 : *I.T. budget allocations by departments*

% of IT Budget to Organizational Budget	No. of Departments
< 5 %	18 (62%)
5 - 10 %	6 (21%)
> 10 %	5 (17%)

As shown in **Table 11, 62%** of the government bodies reported IT allocations of less than 5% of the whole organizational budget. Only **17%** indicated budget of more than 10%. Departments recording highest IT budget were the Police Department and the SMPKE (Information System For Top Executives) of the Prime Minister's Office. In the case of the Police Department, connectivity is established between police stations in major areas all over the country and their headquarters. The SMPKE has connections to all ministries and some major department.

3.6   Survey analysis and conclusion

Part 1 of this survey, describes the status of application systems among government agencies. It shows how systems are operating, how old they are and how they were developed. The extent of data sharing is also

portrayed. This includes the method for data transfers and how often these data exchanges are executed.

Application systems developed by government organizations are mainly designed for their explicit use. Most have multiple applications running, to serve different functional areas. A significant percentage of these systems exercise data sharing with systems, internal or external to their organizations. Observations from the survey lead to the fact that data-exchanges are most rampant among well-established systems which are more than 5 years of age. This is probably due to the fact that these systems have stabilized and are well-tested.

Further studies on the scope for systems integration in the government sector should be triggered from here. Priorities should be given to those well-established systems that do not incur much change in their operations. Other criteria for selecting systems as candidates for SI should be those operating in real-time mode, as they reflect on the dynamic nature of the data that they contain. Another criteria for selection should be those systems which produce daily outputs that are utilized by others.

Part 2 of the survey that measures the extent of SI efforts has been elaborated in papers produced as listed in the bibliography [27], [30], [31]. They analyze reasons for the slow diffusion of SI in the Public Sector and look into factors determining the success of an SI project.

In summary, on the positive effects of SI to the organization, the most popular responses are :

a) Improved work procedure (mean rate - 4.6)

b) Better communication with related organization (mean rate - 4.3)

On the positive effects of SI to the public, the most popular responses are :

    a) Shorter wait-time (mean rate - 4.34)

    b) Improved data accessibility (mean rate - 4.24)

As a conclusion, SI is still a new concept in the public service. Even though the need is evident, little effort is made towards its promotion. A more concerted effort should be made to increase awareness on its benefit. The Malaysian public sector is well equipped with infrastructures in order to embark onto SI. Leadership and commitment remain the critical factors towards the success of SI.

Project Monitoring Systems: A Case Study

4.1 Introduction

This chapter describes an SI application, in the case of the Project Monitoring System in the Malaysian Government.

One of the potential areas for SI, met through the researcher's term in the public sector of Malaysia, is in the subject of project monitoring. Project development is one of the major roles undertaken by the federal government in order to propagate growth to the nation. The tasks of project formulation, their financing, management of project implementations as well as monitoring their progress, encompass several government bodies. Each party has a part in ensuring the success of these projects. In undertaking their parts, each of these bodies hold or process some data pertaining to projects. Throughout the phases in the a project lifecycle, information are passed between agencies involved. These scenario makes SI deemed fit. As the area of interest in this study is SI in the public sector, the case of Project Monitoring becomes the focus of this study.

4.2 Background of the project monitoring system (PMS)

Government departments are entrusted with the tasks of implementing projects such as building infrastructures like roads and bridges, public amenities like schools and hospitals, as well as running research programs in areas such as economy, social and education, and conducting training programs for government officials or the other interest groups. The

successful implementations of these projects are vital as they form the catalysts to further develop the nation.

The processes of planning, implementation and monitoring of development projects in Malaysia are given due attention by the government, to ensure that they are implemented as planned and according to schedule. The roles of government agencies in a project lifecycle are depicted in Figure 4.1.
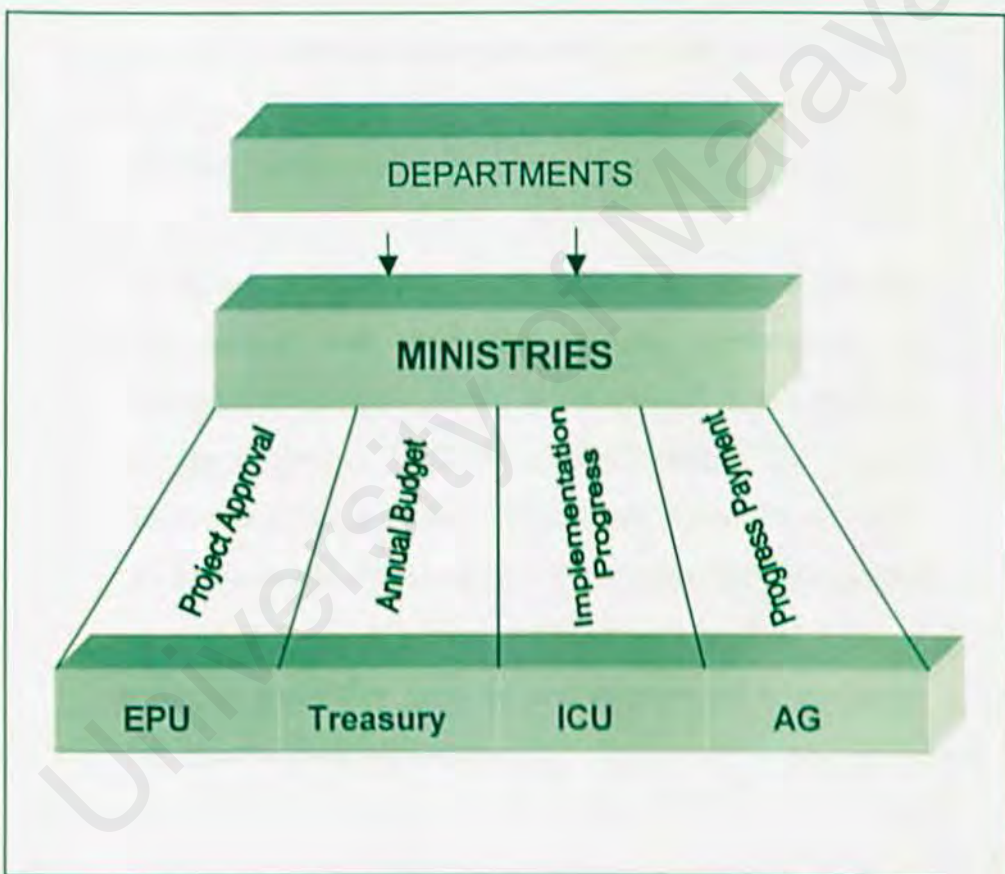

Figure 4.1 : *Organizational roles in project implementations*

In the course of fulfilling these roles, each department had established a system to process data on projects that are relevant to its business area. These systems, manual or computerized, reside within each organizational

premise with some amount of interactions between each other, in the form of documentation or reports sent in periodically.

In 1981, a Cabinet Committee on Development projects issued a directive calling for the integration of these systems. The directive called **Directive No.1** titled **'Steps to Speed Up the Implementation of Development Projects',** stated that :

> *Ministries/Departments with the assistance of the Implementation Coordination Unit (ICU), Prime Minister's Department should develop an information system or use existing systems meant for the same purpose specifically to plan and implement development projects and for making necessary decisions; and*

> *All information systems of the central agencies meant for the control and evaluation of the performance of development projects should be integrated. In this respect, all three systems, SIMKOM of the Treasury, the Project Monitoring System of the ICU and data collection activities of the Economic Planning Unit (EPU) should be integrated so that only one information system will be used. Central agencies and other agencies are encouraged to exchange information with one another.*

In compliance with this directive, government agencies made up of the Economic Planning Unit of the Prime Minister's Department (EPU), the Treasury (TRY), the Implementation Coordination Unit of the Prime Minister's Department (ICU) and the Accountant General's Office (AG) undertook the exercise to integrate their existing systems on development

projects. This project was given the name **SETIA**, an acronym created from each agencies initial.

4.3 The machinery for coordinating development projects

A machinery is set up by the Government to monitor development projects. Figure 4.2 shows the machinery for co-ordination of development projects for the country. The **National Development Council (NDC)** is the highest body that oversees the planning, implementation, coordination and evaluation of development projects. The NDC is set up, with the following objectives:

- To see to the smooth implementation of the National Development Plan and Policies;
- To ensure strategies of implementation meet their objectives; and
- To monitor the effectiveness of government machinery in the implementation of these policies.

This council is chaired by the Prime Minister and comprised of ministers from the relevant ministries.

The **National Development Working Committee (NDWC)**, which is chaired by the Chief Secretary to the Government, is a body of officials from various government agencies involved in development projects. The ICU acts as the secretariat to this committee.
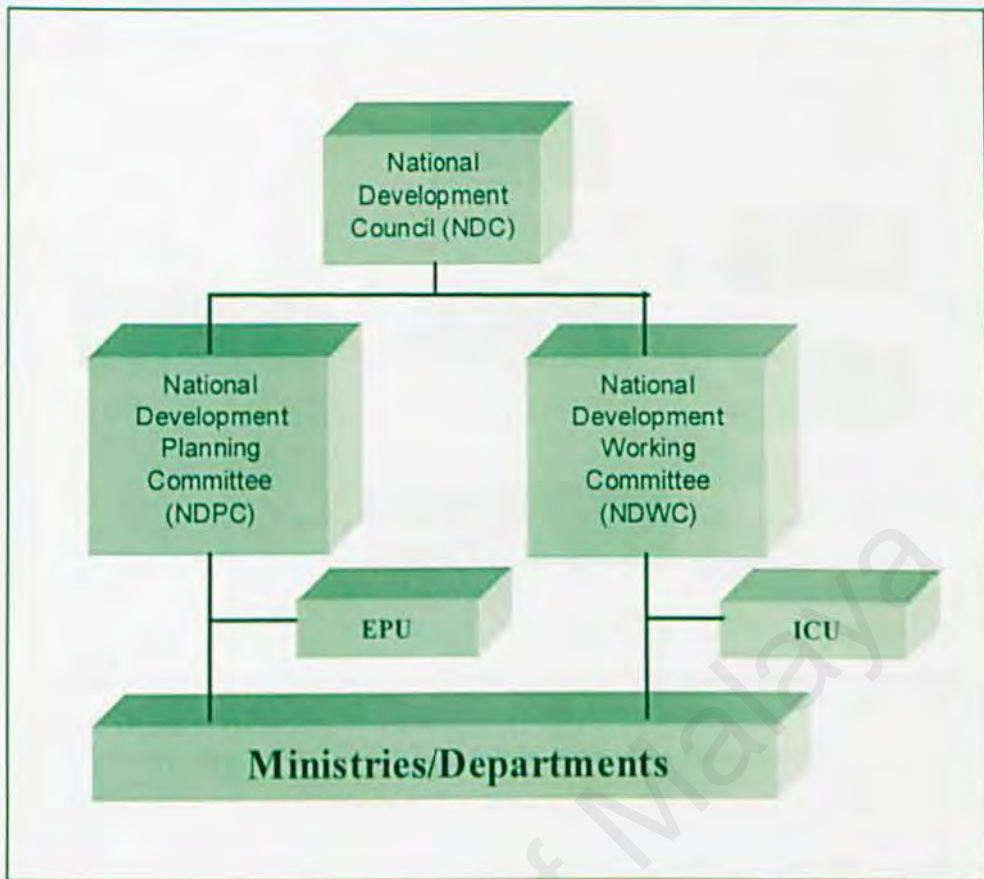
Figure 4.2 : *The government machinery on development projects*

4.4   The process of project planning and implementation

In Malaysia, the process for project planning and implementation is segregated into periods of 5 years. These periods are called the **5-year Malaysian Plans**. For each 5-year plan period, development plans are formulated to urge the country forward towards further development. Projects are subsequently conceived by every government agency in conformance with such plans. Figure 4.3 displays phases in a project life-cycle.
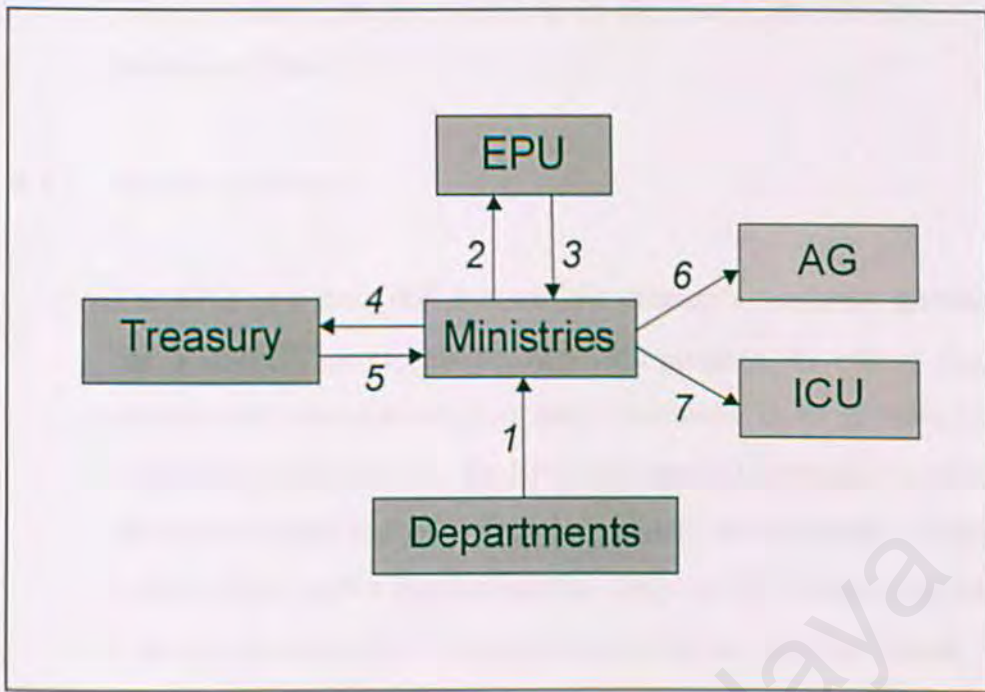
Figure 4.3 : *Project Implementation Process*

4.4.1 Project conception

Each project is initiated by the relevant government agency. For example, a school is planned by the Ministry of Education, a road by the Ministry of Public Works and a hospital by the Ministry of Health. Every period of five (5) years, a list of projects are drawn up by each government department, that are under their jurisdiction. The lists of projects, are then vetted so that they are in conformance with policies drawn out by the ministries, before being forwarded to the EPU for approval.

This exercise of project conception is done before the start of every 5-year plan period. A review on the list of projects or any additional projects that are deemed necessary, is done on the third

year of a plan. This is referred to as the **Mid-Term Review** of a Malaysian Plan.

4.4.2 Project approval

The EPU, as a body that oversees the country's economic growth, has a duty to assess all development projects, to ensure they comply with the national plan and contributes to its growth. On evaluation of the projects, the EPU will issue its approval based on the project scope and cost. Each project will be allocated a 5-year budget ceiling for its implementation. Only on EPU's approval, can a project proceed with its implementation during the Plan Period.

4.4.3 Annual budget

Every year, any projects that are approved for the Plan Period, apply for budget to finance their implementation works. Applications for the annual budget are processed by the Treasury. Approval for the annual fund has to be obtained, before it can go ahead with any development work.

This process of applying for budget, is done before the start of every financial year. The Treasury ensures that funds are given only to projects that have been approved by the EPU.

4.4.4 Monitoring

During project implementation stages, the progress of every project is reported to the ICU, as the secretariat to NDWC. Reports on project progress are submitted at least once, quarterly. The ICU uses information from the reports to monitor the development of

each project. The monitoring process is to ensure projects that are faced with problems, are identified and given due attention by the authorities as soon as possible.

4.4.5 Project payment

As the projects progress, payments are issued to the implementation agents. Payments are made through vouchers issued by the respective government agencies for work done. The Accountant General's Office, then, issues payments on these vouchers.

Throughout the life-span of a project, the implementing agency has to deal with different authorities in the government service. From its initial conception to its completion, data on each project is generated. These data are kept by each participating agencies. The smooth flow of information between these agencies are necessary to ensure each project's successful completion.

4.5 The history of project monitoring system in Malaysia

The emphasis on having a proper system of planning, implementing and monitoring of these projects started since 1957. This is evident with the evolution of the 5-year Development Plan Periods. Projects are planned for implementation for each Plan Period. The end of a Plan Period serves as a check-point for projects, implemented by all government bodies.
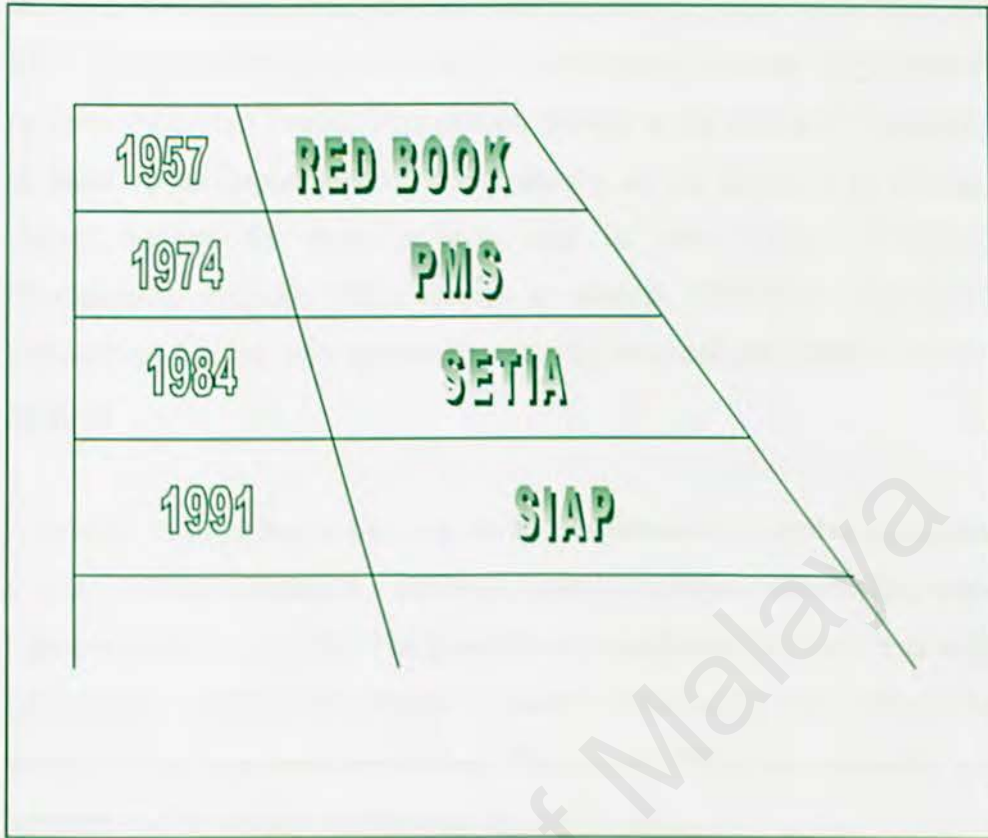
Figure 4.4 : *The evolution of project monitoring systems*

Figure 4.4 illustrates the evolution of project monitoring system in Malaysia. Earlier efforts to monitor development projects was based on the operations room concept, similar to those used in military operations. Operation rooms were established at various levels to keep accurate and up-to-date data on projects through the use of the RED BOOK. The Red Book System provides a mean to keep current information on project progress. It is through this system that relevant authorities get their information, in order to make any decision or to facilitate problem solving, during project implementation stages.

In 1974, with the advent of technology, the government had taken steps to computerize the system for monitoring. The system was then named the

Project Monitoring System (PMS). This system was solely developed by the ICU, which acts as the secretariat to the NDWC. In the meantime, the EPU had developed a procedure for processing the list of proposed projects for a Plan Period. This process results in the listing of 'approved projects' to be implemented. The Treasury, as the authority to allocate annual budgets for these projects, had its own system to handle development projects. This system is named SIMKOM. The AG's Department had its own system for issuing progress payments for these projects.

A project, in its lifecycle had data on its development, recorded into these systems, till its completion. Different aspects of project information were kept on different systems. The government recognized the problems with having data residing on separate systems. Information was difficult to access. Some data were inconsistent. Too much effort was needed to get accurate and up-to-date information on any project.

In its effort to increase efficiencies in handling development projects, a directive was issued by the NDC, to integrate the information systems of these Central Agencies. This led to the creation of SETIA, an integrated project monitoring system, whose name was derived from the acronym 'Sistem EPU, Treasury, ICU and AG'.

An extension to the SETIA system was later developed to monitor projects down to its component levels. This system was named SIAP. This system enables ICU to further break down a project entity, as recognized by the EPU, into sub-projects. This breakdown facilitates meaningful monitoring at the physical level. For example, EPU would identify a project as 'Membina Sekolah-sekolah Rendah Negeri Johor' and allocates it with a lump-sum 5-year allocation, but ICU needed to monitor progress of each

single school during its development stages. In this system, each activity of a sub-project is identified and its physical progress monitored.

4.6   Reasons for change

The evolution of the systems for monitoring development projects in Malaysia was triggered by a few factors. Some of these factors are:

a. Agencies involved in implementing development projects had to report to different authorities on different aspects of a project. The tasks of reporting became a burden to the officers-in-charge at the agencies' and ministries' levels. The EPU needs to be kept updated on a project progress during mid-term reviews and at the end of a Plan Period. The ICU has to be informed of its implementation progress at least once every quarter while at the same time project status needs to be reported to the Treasury in order to apply for the next annual budget.

b. Since data was collected by separate Central Agencies, its consistency was sometimes questionable. Project expense, reported, may not reflect the same progress at the physical level. Project status may be recorded differently by different agencies, perhaps due to the time of reporting. This led to conflicting data that is not very useful for decision making.

c. The timeliness in getting accurate, up-to-date data on projects was a problem, as information on different aspects of a project were kept separately, by different authorities. Information on project expenses was available with the AG, while information on the physical progress was with the ICU.

d. As data on projects were required and kept by separate agencies, duplication of data persists. This led to the wastage of government resources, be it hardware resources or human resources for its maintenance etc.

e. The problems on data management were not properly addressed. The levels of interest of each party involved are different. Much focus were given to the need for information by the top level management. Insufficient considerations were given to ease the tasks of data capture. Tools were not designed to simplify reporting from the ground level. The systems were not useful for project managers who manages the daily development of projects.

4.7   The current system

In addressing the problems faced by having multiple systems for handling data on development projects, a system was developed at ICU. This system provides a database on projects. It acts as an information center for development projects. Data on project scope, cost, financial status, physical progress as well as problems faced during implementation are kept. Data are fed into this system by the participating agencies either through online file transfers, tapes or through hardcopy documents received. Updates are done mainly through batch processes. Online updates are only done by officers of the ICU through information received in documented forms. Agencies report progress by sending updated records in batches through file transfers. The EPU and Treasury do not have online update functions even though they are the authorities in project cost and annual project allocation, respectively. The AG's Department sends magnetic tapes on project expenditures, monthly.

Reports are generated as and when requested. The EPU and Treasury do not generate reports on project status, at their ends. Outputs from the system are generated from the ICU.

4.8 Benefits of a centralized monitoring system

Having a centralized system such as SETIA has its advantages.

a. It provides a single point for reporting matters pertaining development projects. Agencies do not have to report to different Central Agencies on the same subject, thus reducing their workload.

b. A single system means a single source of information. Any information needed on any projects may be obtained from a single source, without having to search several databases. This way, Central Agencies do not produce conflicting reports on projects.

c. With information on financial allocation and expenditures captured by the system, any financial shortfall within an agency can easily be detected. This information is useful for the authority to ensure proper management of projects, and to identify any setbacks faced by the projects.

d. Data on the physical progress of each individual project can be made easily accessible to the authorities to facilitate rapid action and future planning.

e. The system also provides for a platform to report problems faced during project implementation. The NDWC will advise and make recommendations on how to overcome the problems. Any problem

reported can be quickly overcome if it is detected early, thus reducing risks of project failures.

4.9   Issues in the current monitoring system

During the study, some pertinent issues were highlighted, that hampers the concept of integration. In the context of project monitoring, it is observed that technology does not constitute a major issue. The aspects of work organization and the business process appears to be putting a hindrance to its successful implementation. The current system does not seem to make efforts on integrating information sources, easier. The followings are some of the issues identified :

A. Need for better coordination between participating central agencies

Having an integrated system such as SETIA, needs the participation as well as commitment from involved parties. The roles of each agency involved in the formulation, planning, approval, implementation and administration of projects, in relation with the system have to be clearly defined and agreed upon. Procedures should be laid out and observed. The needs and constraints of each party must be carefully considered and solutions that are agreeable to all parties must be met. In this aspect, the lack of involvement from the Treasury in keeping information in the system, up-to-date, is an example.

Figure 4.5 explains the hierarchy of control on development projects. Annual budget is allocated for every *sub-heads* under a *vote-head*. Agencies are subsequently required to subdivide the allocation according to each project, as identified by the EPU. The breakdown has to be updated into the system. Such data are not fed back into the

system through the Treasury. Instead, it has to be sought by officials at the ICU from the respective agencies. Even input on annual allocations are fed into the system by ICU officials through information extracted from printed copies of the annual budget books produced by the Treasury. An extract of this document is shown in **Appendix C**. This issue demonstrates a breakdown in the mechanism for data update from Treasury.

The AG's Office controls the flow of funds to parties undertaking government projects. Government departments issue payments through vouchers handed out for jobs done. Vouchers issued to implementing agents, for purposes of payment from the AG's department sometimes do not quote the Project ID. This issue poses a problem of tying up information on progress payment to projects.

The examples stated above, illustrate the breakdown in several mechanisms for keeping data on the system up-to-date and consistent with the real project status on the ground.
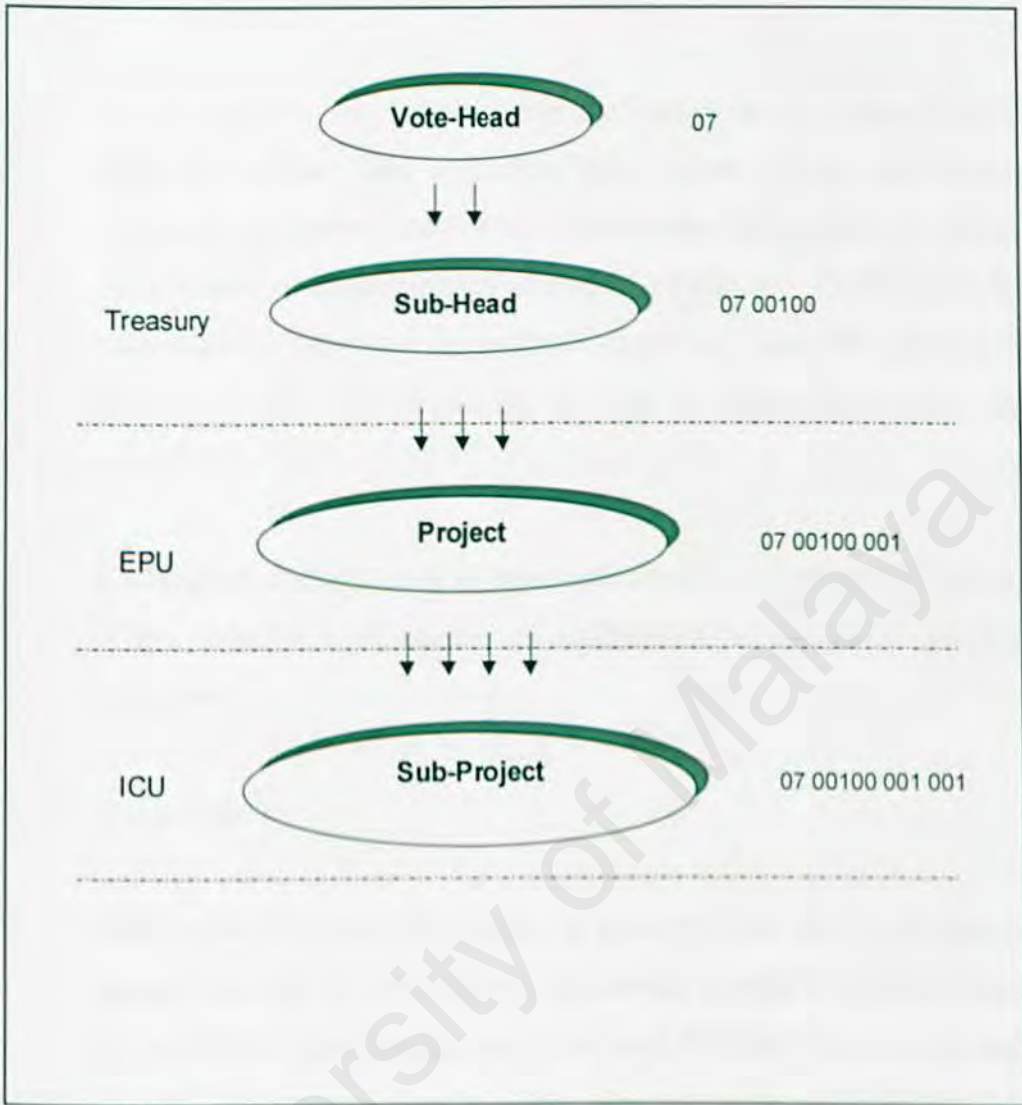
Figure 4.5 : *Hierarchy of control on development projects*

B. System and data ownership issue

In the case of the SETIA system, participating agencies do not feel they are part of an integrated system. This is shown through their lack of commitment towards information kept in the system. Each party are only concerned of data within their business domains. They do not

show concern about data which are beyond their levels of control, even though they have consequential relations.

As an example, the Treasury controls budget at the subhead level. When a *subhead* gets a funding of a certain figure, the agency concerned is required to report the breakdown of allocations to projects under the subhead. Sometimes when this is done, the breakdown of the sum does not tally with the subhead allocation. Thus, incompleteness of data occurs. This results in the lack of useful information for monitoring.

Keeping data consistent is an important aspect of an integrated system. When inconsistencies happen, the usefulness of an integrated system is degraded.

C. Data-capture

Data is not fed into the system at source. Data for the system is updated in batches. The present monitoring system is a report-based system. Rather than having input generated from the respective agents, as and when transaction is done, they are sent periodically upon requests. This results in the lack of timely data, which are useful for decision making.

Providing a proper tool for data entry into the system is vital. Such tools need to be incorporated into the system without burdening users of the system with additional tasks.

D. *Changes in project identification*

The lack of commitment from involved parties is also evident in the issue of projects with identification numbers. During the design stage of the SETIA system, it was agreed that projects be assigned identification numbers that conform to the number generated through the government financial system. The Identification Number structure is shown in Figure 4.5. The design for Project Identification Number is in line with the level of control by the respective central agencies. But, through the years, the Treasury sometimes change the identification number of a *subhead*, through the insertion of a new item in their list. Such action results in the complication of maintaining a unique identification of a project throughout its lifecycle. It sometimes causes expenses being charged under a different project due to the lack of a coordinated move among agencies concerned.

Standards and procedures that comply to rules of parties involved in an integrated environment are important. Conformance to standards is important in keeping an integrated system consistent.

E. *Levels of information requirement*

Keeping data in the system that only caters for the requirement of the central agencies, sometimes cause meaningful information to be lost. These information are only beneficial in generating a macro-level report. During times, when intervention are necessary, detail information on projects are required. Such information are usually kept by the project managers on the ground. Integrating the micro-level information to the system can prove to be useful. The linkage of detail data with and data from a higher view provides a better picture on a project. It helps give a consistent view of a project. A wider

perspective of a project can be made available whenever necessary without having to seek for information from many sources.

Input for an integrated system should be captured as they are generated. Data that get captured at a lower level should be kept in that form and only get summarized when needed. Tools for data-capture should be designed such that they remain useful to the users.

4.10   Discussions and recommendations

An integrated system should form a repository of data on a common subject. Irrespective of where data are generated, they all have to come into the *system* through business functions that are related. Data ownership should remain, with levels of authorities clearly spelled out between business functions. Data security is an issue that has to be tackled, as the lack of it may cause non-usefulness of the system. Capturing data at source helps in getting timely data and prevents discrepancies of data which is usually the result of the difference in the time of data input.

The tool for project monitoring proposed in this project is designed to address some of the issues stated before in Section 4.9, specifically issues (A), (B), (C) and (E).

Coordination and commitment of agencies involved may be further improved by providing a tool that provides a window to the *system* at their ends. By having such facilities, the users should feel they are part of the system, rather than just a supplier of data.

Through having such a facility, the control of information under each business domain can be easily managed. The Treasury, for example, can

easily check how the allocated sum under a sub-head is being sub-allocated.

The issue of timeliness of data may be overcome if agencies are provided with a tools that are used in their daily works. When data are captured at source no added tasks of reporting are required.

Integrating data from various levels of control, provides flexibility in the way we utilize information. A top level view is only good at giving a macro picture of subjects. When a micro level analysis is required, more detail information is needed. In the context of project monitoring, for purposes of intervention by higher authorities, detail information on project activities are most useful.

Looking into the issues discussed above, the researcher proceeds to illustrate a possible solution to address some of the pertaining problems in the present monitoring system.

The next chapter describes the model solution.

A Model Data-Capture Tool
On Project Monitoring

5.1   Introduction

Based on the case study discussed in Chapter 4, project monitoring brings
forth the characteristics of a candidate for SI. It has the criteria suitable for
an integrated system. As the process of project implementation revolves
around several parties within the government sector, an integrated
approach to this subject should be further examined and applied. All
business functions of the relevant bodies that concern development
projects should be looked upon as parts of a bigger system for project
implementation, of the government.

This chapter describes how the concept of SI may be applied in the area of
project implementation and monitoring in the government. It proposes an
approach for SI on matters pertaining development projects, which is an
important agenda for the country. It justifies why SI should be established
and discusses some issues pertaining to it. Inherently, it describes the tool,
the researcher deems appropriate to be used in the integrated project
monitoring environment.

5.2   Background of the model system

The process of implementing development projects involves several
government departments, as described in Chapter 4. These departments are
implicated at different phases of a project life-cycle. Government agencies
that act as implementing agents for development projects are concerned

with every aspect of project management such as preparing project plan and implementation schedule, managing resources as well as monitoring work progress. Payment vouchers are issued as works progress. Every project activity is closely monitored to ensure that it is implemented according to schedule.

As development works progress, the relevant central agencies monitor or intervene whenever necessary. The EPU, does project review every third year of a Plan Period. This exercise is termed The Mid-term Review of a Malaysian Plan. The Treasury, checks on project status annually, during budget examination sessions with the implementing agencies. This is done before allocating new budget to finance further works on projects. While the ICU monitors project progress every quarterly or whenever problems arise. Information are needed at these levels to support decision-making and to enable interventions by agencies concerned. In the mean while, new data are captured at different phases of a project life-span, such as additional allocations, transfer of funds, progress payments etc.

As discussed in earlier chapter, well-established systems that execute data-sharing often, deserve to be candidates for SI. The dynamic nature of data they contain, make an integrated concept more beneficial to parties involved. In this case, data on projects that are progressively recorded according to work progress on the ground, are useful for purposes of monitoring and intervention.

The prototype system is developed to address some of the problems that prevail in the current system. It focuses on providing a tool to capture data right from the stage of project planning to recording project progress. The tool is designed to capture data at source, that is, where works on projects are closely monitored on the ground. The area of focus for the developed model is shown in Figure 5.1.

The model illustrates 2 levels of integration. It incorporates the concept of data integration as well as software integration. *Data integration* takes into account every department's needs. It covers multi-level authorities on data while allowing the flexibility of access to details at each level. Details on project components are linked to the parent project. This feature is not available with the current system where database on projects are kept separately from their project components or sub-projects. *Software integration* is illustrated through the use of images and linkages to established software tools such as MS-Project to enhance the system capability, thus making it useful to users.
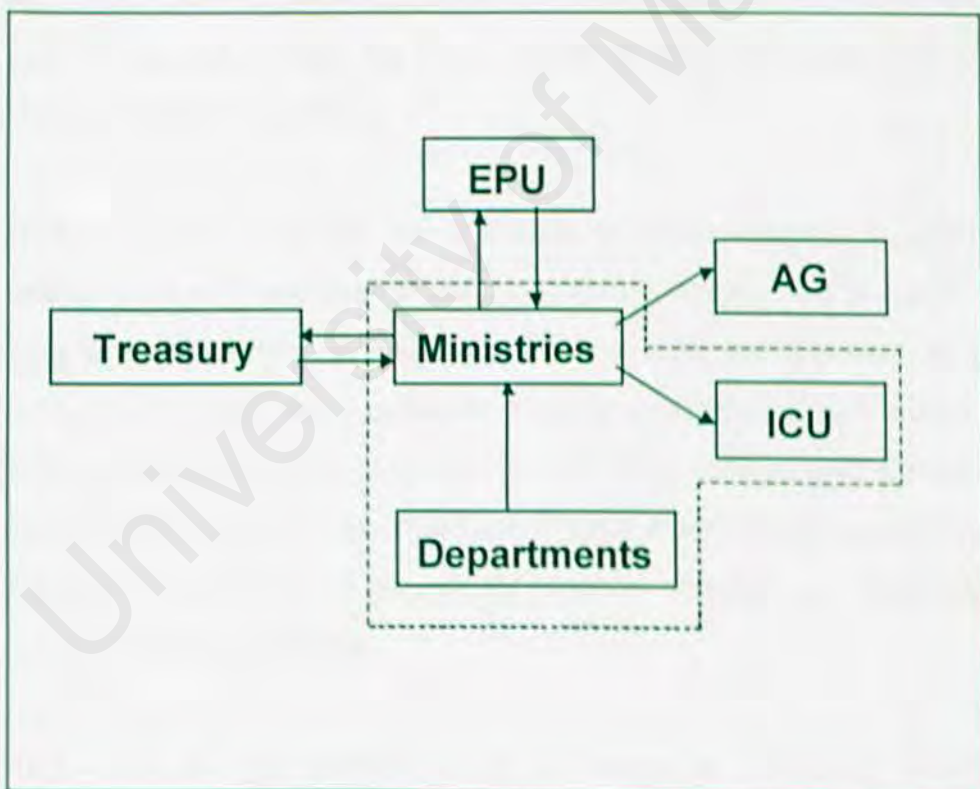
Figure 5.1 : *Focus area of the prototype*

5.3   System brief

The model is a prototype system for capturing data as projects progress. It serves as a tool for project managers to record project development managers while allowing them to have access to other information such as the financial status of each project. At the same time, the data collected using this tool can be made accessible to relevant central agencies as a mean of reporting project progress. This concept enables data collection at source. When implemented in a networked environment, integration is achieved through data-sharing with other relevant agencies. In an integrated environment, each agency that deals with projects such as the EPU, Treasury, ICU, the AG's office and the respective ministry, may have access to the same piece of information without it having to be replicated. Data on projects, generated by other agencies, may at the same time be updated through the same concept at their respective sites and made available to the others.

Data on project activities are collected at source through a project-management software used to aid the project managers in the course of their work. The information are then linked to other data available on the main project. Using the client/server concept, the linking of information at various levels (i.e. project, sub-project, activities) enables data generated by different sources to be connected. Project managers are spared from having to re-enter data on projects for purposes of reporting to the central agencies and the ministries.

This model also incorporates the use of images as a mean for viewing physical progress of projects, as works progress. This way, officers at the central level may have a real up-to-date view of projects for visual evaluation. Graphic representation of data is also included to enhance data

display. Graphs are generated from data directly accessed from the database.

Features of the tool are designed to serve several purposes :
- it is integrated into the main system for project monitoring,
- it enables real-time update into the system,
- it serves both the needs of users at the ground level as well as the monitoring bodies, and
- it allows top-down and bottom-up view of project information.

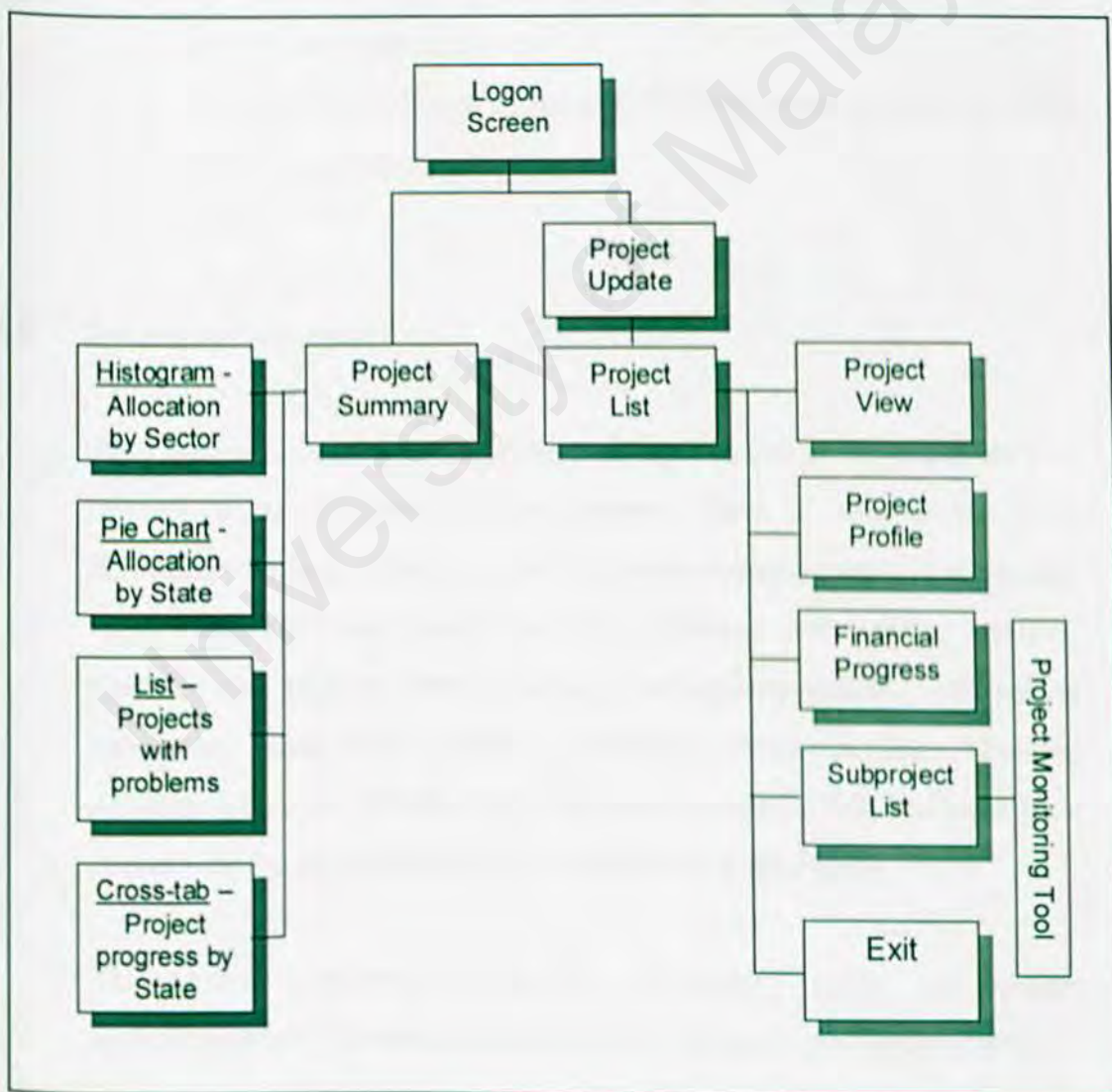An overview of the prototype is depicted in Figure 5.2.

Figure 5.2 : *Process flow of monitoring tool*

5.4   System objectives

This prototype is developed to meet several objectives :

a) To simulate a data-capture system as a mean of gathering data at source;

b) To incorporate the *same look & feel* with current office tools with a *point & click* feature.

c) Integration of graphical features to give overall views on projects

d) Integration of imaging system as a form of reporting project progress

e) To enable multiple-level monitoring in a single system (ie project/subproject/activity)

f) To allow flexibility in monitoring different types of projects (with differing activities)

5.5   System environment

This system is developed using the desk-top version of Powerbuilder 5.0, running under Windows-NT environment. Data is held in the SQL Anywhere database. The choice of the database management system may vary. Data may also reside on other database management systems (DBMS) that support Open Database Connectivity (ODBC). Whenever appropriate, data may reside on different platforms, thus allowing autonomous control of data. SQL Anywhere is used in this case because it comes with the Powerbuilder version available at the faculty.

The system developed is capable of running under the internet environment with the use of the appropriate dynamic link library (DLL).

5.6 Target users

Currently, data-input for the project monitoring system (PMS) is mainly done at the ministry level. The officers in charge of development are assigned the task of reporting project progress to the relevant central agencies. Updated records are sent in batches to ICU through online file transfers or copied through diskettes. These files are used to update project records residing in the main project database at ICU.

However it is proposed, with the use of this tool, data capture should be done at source, that is, at the project manager's level where all activities of projects or subprojects are managed. Through this method, information will be updated directly from the ground instead of going through another agent. The approach should improve the timeliness of data as well as improve data accuracy.

5.7 System rationale

5.7.1 Enables data collection at source

One of the shortcomings of the existing system for monitoring, that is in use, is the way data are input into the system. (See illustration in Figure 5.1). Reports on the progress of each project on the ground are sent by the implementing agency or contractors to the respective client agency through various means such as meetings, hard-copy reports, site-visits etc. These data are then transcribed onto different formats as required by the central agencies.

At a lower level, data on project activities are entered into a PC-based system in the form of activity schedule. Each activity has its

scheduled start and end date. As activity starts the actual start date is captured. A copy of the data is then sent to the ministry either through diskettes or using electronic file-transfer.

A more summarized report on project status, is at the same time prepared in the form of a hard-copy report. The format of the report which is named Form S3, is designed to meet the requirements of the ICU. This report is sent to the ministry for compilation. An officer at the ministry shall then enter the data into the system provided. This data is then sent through file-transfer to ICU through the network SETIA-Net. This data will eventually be used to update information on the project data-base held centrally at the ICU.

With the proposed system, data are entered at source. It is incorporated as part of a project management task. The overall project status shall be updated by the project coordinator. In a networked environment, this data may be shared or a copy of which shall be made available to the agencies concerned. This approach of data-entry which is done at source saves the project manager from another job of data-entry for purpose of reporting. The speed at which data may be made available to the agencies concerned will be very much improved. The question of timeliness of data can be addressed through prompt data-entry, that is, as and when work is done on the ground.

The issue of data-duplication can be significantly reduced. Central agencies interested to know project progress may have direct access to more up-to-date information. This will also reduce data inconsistencies among agencies that would normally have separate sets of project status reports.

5.7.2   Allow flexibility of data kept at ground level

Most of the data kept on projects, currently, are based on the requirement of central agencies. The systems in use are based on fixed format, text based data which allows for standard pre-determined activities. The current system also allows limited data on project schedule. This limits the usefulness of data to the people on-the-ground. They need to keep data to fulfill their varying requirements at a more detail level. To conform to the central agencies' requirement, data need to be transcribed into suitable formats for central agencies' consumption.

The proposed system allows flexibility in the details of data kept. This is done by providing a linkage between the project data, as defined by the central bodies, and project components that are broken down according to the project manager's needs. This is achieved through the use of a project management tool at ground level that is integrated into the main system. Data that are useful to the people managing the projects, are kept in a systematic manner. By enabling this linkage, useful information is not lost and the requirement of central agencies may still be fulfilled.

5.7.3   Single-entry concept

Specific data should be entered into the system from a single source. The job of updating project status should not need to be repeated. The tasks of reporting project progress to various authorities in different formats, only increase the burden of project managers and coordinating officers at the ministries. Every data-item fed into the system should only be updated by the authorized

personnel where data are generated and not re-entered elsewhere. Others should only be allowed to have access to the piece of information through read-only mode.

In the present system, basic data-items like project location, project cost, annual allocation repeatedly appear on various forms. With every party having access to the same data source, such information should not need to be repeatedly reported. This way, no inconsistency of data may occur. Duplicated efforts should be avoided.

5.7.4 Enable multi-level monitoring

Projects being implemented by government agencies are monitored at the ministries as well as the central agencies. The types of data required, varies. The levels of control imposed by the respective agencies also differs. For example, the Treasury is only concerned with controlling data at subhead level. (Please refer Figure 4.5 in Chapter 4). Each subhead may comprise of several projects as listed by the EPU or ICU. Meanwhile, ICU may be interested at looking into project progress at sub-project level, such as the building of a particular ward of a hospital project.

Integrating the systems dealing with development projects, may seem to be a meritorious aim, but, getting a consensus on the level of monitoring by central agencies seems remote. Efforts to arrive to a certain level of standards in monitoring have not been successful. This has caused a considerable amount of burden to the implementing agencies in the course of reporting project progress and to synchronize data according the central agencies' needs.

Data-control, should be done through the computerized system. Levels of project details can be achieved through a data-base that is designed to accommodate these details. Various forms of data may be inter-linked with each other in an integrated system. By allowing data to be input as they are generated, linking data at various levels, should not be a problem. For example, when the Treasury enters data on transfer of funds between subheads, tallying payments made by the agencies with the allocated amount for the project may systematically take place.

5.7.5 *Non-duplicating data*

One of the objectives of having an integrated system is to avoid duplicating data at several locations. Despite efforts to integrate the current systems on development projects, agencies are still keeping separate sets of data at their respective locations, whether in a database, flat-files, or hardcopy documents. This increases the risk of non-consistent data between the agencies when reporting to the *National Development Working Committee (NDWC)*. Besides, duplicated data consumes redundant resources, manpower or hardware.

The proposed system, though not illustrated in full, supports the concept of integrated data environment. Whether data are located in a central database or several distributed databases, need a further elaboration. The decision would be based on how dynamic are the data, data sensitivity, rate of access etc., which is outside the scope of study. However, data should be stored once and updated by the authorized party, at source. They shall then be made accessible to the parties concerned, in order to support other functional areas. For example, the breakdown of the annual allocation by sub-heads,

according to projects, should be entered directly by the implementing agencies as authorized. Subsequently, the central agencies interested may have access to this piece of information in to support decisions. In the current system, this information is sent to the ICU, to be updated into the central database.

5.7.6 *Common interface (if implemented under internet/intranet)*

Using a desktop computer in their daily chores is common today, in the Malaysian public service. At the same time, having internet access is not uncommon. The point-and-click tool in today's information era, has become a common phenomenon. The developed model, does away with the hierarchical, menu-driven method to have access to information. It uses the point-and-click technique common to the state-of the-art. This enables the operator to familiarize with the system faster. As explained earlier, by implementing the prototype on an intranet platform, this system provides a convenient tool for users through the use of a common-platform with the other commonly used softwares.

5.7.7 *Works on multiple platform*

The prototype developed to illustrate the proposed module for monitoring development projects, works in a client-server environment. It is developed using Powerbuilder 5.0 desk-top version. Adapting the developed module onto a different platform such as a Windows 95 PC or a UNIX environment is possible even though it is developed under WINDOWS-NT. It is also capable of interfacing with several databases at the same time, as long as it supports ODBC. Today, with the new version of Powerbuilder tool it is also possible to run the application under an internet

environment, with the use of a suitable dynamic link library (DLL). This will, thus enable agencies with different machine types to use their existing machine to interact with the system, rather than having to change everything altogether in order to be part of the integrated system.

5.7.8 Ability to access multiple databases

The software used for this prototype allows access to different databases, concurrently. Data may be kept at the respective agencies for security reasons. Authorized access to data is enabled across data sources by providing linkages between databases. Data locations are transparent to users. The same piece of data need not be replicated between agencies, in an integrated solution.

5.8 System features

The prototype system functionality spans over agencies' need to keep progress records, in the course of project's development. It also takes into account the task of reporting to higher authorities. These features include the capability of listing project information according to project entities as defined by the EPU, holds data on project funding and annual allocations from the Treasury as well as project breakdowns as needed by the ICU. To serve project managers on the ground it provides link to a project management tool. For the purpose of this prototype, MS-Project is used to enable them to monitor project activities according to their schedule. This tool also enables managers to manage resources as well as keep tab on progress of project activities using tools such as Gantt charts.

Sample screens from the prototype are illustrated in **Appendix G**. The screens are designed to illustrate the features of the tool that provide windows to different aspects of a project. Illustrations are given on text-based information, as well as in other forms such as graphic displays and images. Graphic displays gives an overall picture on projects, while project image is used to complement information on project status.

5.9   Usability test

A test is conducted among personnel involved in project monitoring or was once involved. It is intended at obtaining a measure on the usability of the tool in meeting its intended objectives. The test is also used to gauge opinions on the relevance of the tool in relation with the issues of integration in project monitoring.

5.9.1 Aspects of assessment

The suitability of the tool in the context of the case study, is assessed based on three aspects, using a questionnaire that is completed by the testers.

The first part assesses features incorporated into the prototype with regards to its function as a tool for project monitoring.

Secondly, responses are sought on the testers' opinion of the critical success factors for SI. Through this, the researcher tries to gauge the importance of proper tools to serve users in an integrated environment. The measure is used to support the hypothesis that the presence of an appropriate tool for the user has a high impact on the effectiveness of an integrated system.

In the third part, the testers are asked to rate the relevance of the tool in meeting the objectives of SI.

5.9.2 Method of test

Ten personnel who have been involved in project implementation or monitoring were asked to evaluate the system.

First they were briefed on the background of the study, the concept behind the prototype, the system environment of the model and the scenario of the actual system environment if implemented in full scale. They were later given a demonstration of the model system. Verbal feed-backs on how the system may be improved were received during the demonstration. After the demonstration the users were required to fill in the evaluation forms as shown in Appendix I.

5.9.3 Background of testers

All of the respondents who tested and responded to the questionnaire given, have experience, one way or the other in the area of project monitoring in the public sector. Some have experience at the implementing agencies' organization, some at the central level and some with the application support team.

Even with the existing system available for monitoring, **50%** of them have other systems for keeping data on projects, manually or in computerized form. This amounts to duplicated efforts in maintaining separate systems.

All respondents have access to computers in their daily works and use the internet. This indicates the wide use of internet in government office today. The use of internet covers the area of research, information publishing (mostly internal), electronic mailing and inter-organizational communication in general, as indicated by **70%** of the responses,

5.10   Usability test results

The following are the responses on the tests.

5.10.1 Ratings on the tool functionality

The features of the tool developed are assessed on the scale of 1 – 5. Each feature is evaluated in terms of its usability as a tool for project monitoring. Depicted below are statistics of the evaluations obtained from the testers.
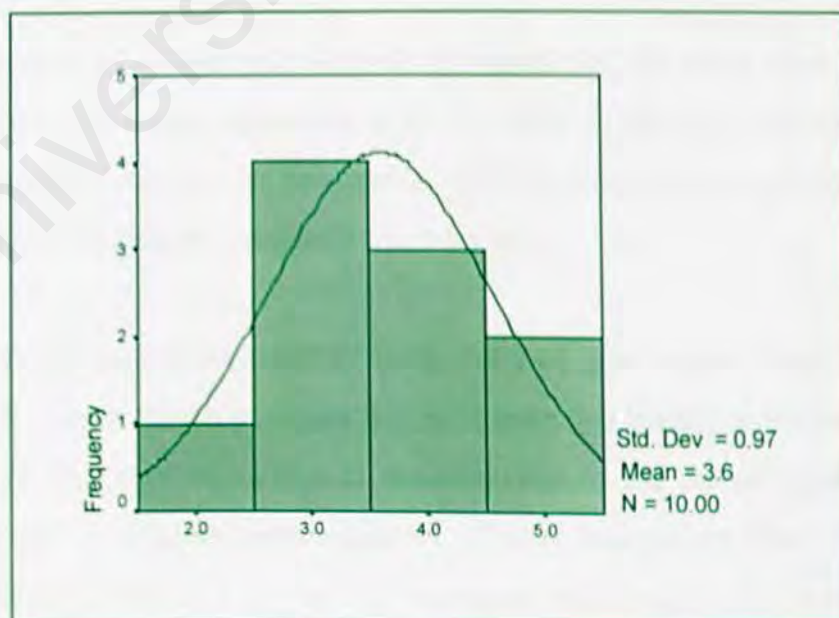
Figure 5.3 :   *Measure of usability of imaging feature*

Five out of 10 i.e. 50% of respondents rate the imaging feature as above average, in terms of its usability. The majority (80%) give it a rating of between 3 to 5 on the scale of 1 to 5. The mean score on this feature is 3.6, as shown in Figure 5.3.
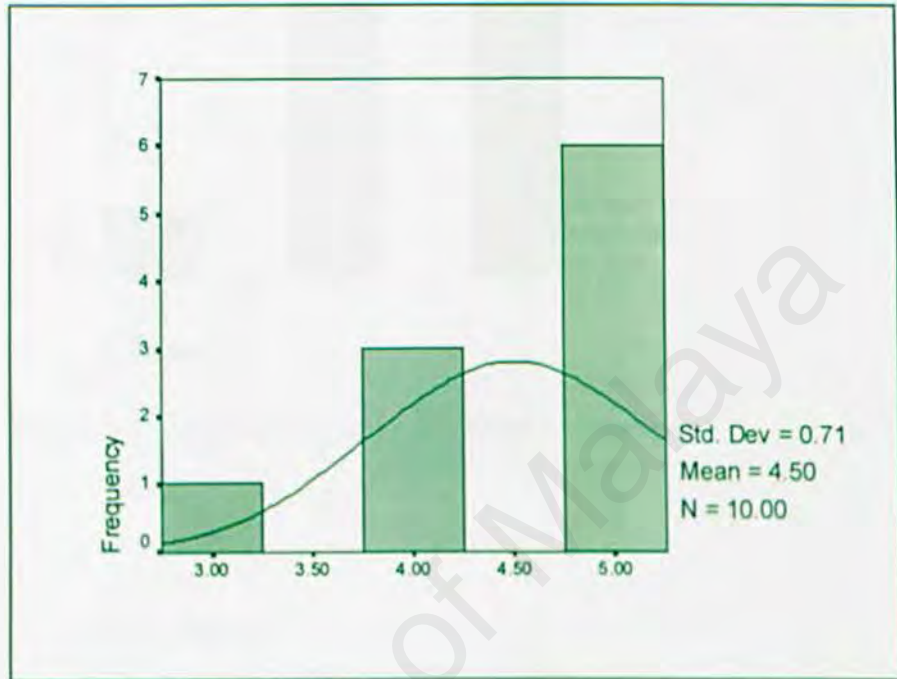

Figure 5.4 : *Measure on ease of use of tool*

In terms of ease-of-use, as given in Figure 5.4, the mean score is 4.5, out of a maximum score of 5. This reflects the point and click feature of this tool as favourable. 60 % of respondents gave this feature the highest score of 5 i.e. 'very high'.

Navigation between widows using the tool, gets a mean score of **4.3**. This is shown in Figure 5.5. 90% rates this feature as between high and very high. This is probably due to the use of control button to swap between windows. Control buttons are used to a different view of a project. For example, with a click of a button the user has the choice of looking at the financial aspect or the physical aspect of the project.
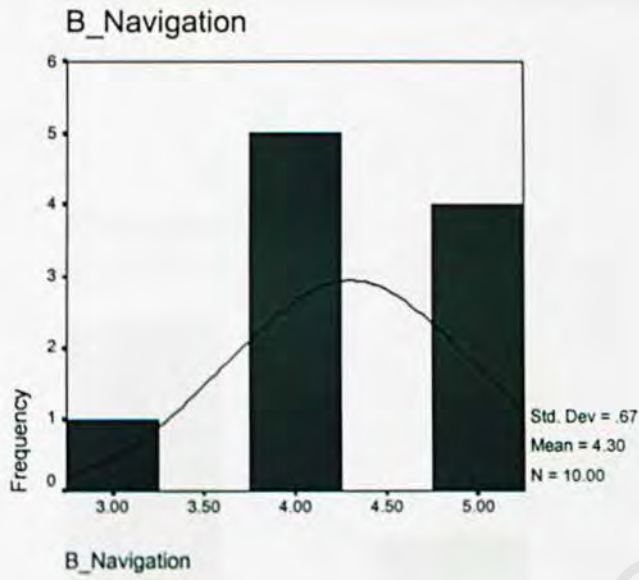
B_Navigation

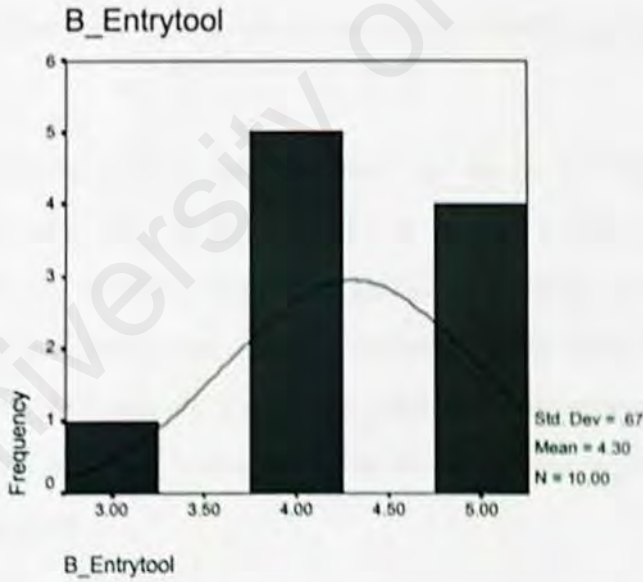Figure 5.5 : *Measure on ease in system navigation*

B_Entrytool

Figure 5.6 : *Measure on suitability of model as a single-point-entry tool*

The tool suitability as a single-point data entry tool gets a mean score of 4.3, as shown in Figure 5.6. 90% is in favour of this

feature as it is useful to be used at the desk-officers level. At the same time, it can be used to pass over information to monitoring authorities.
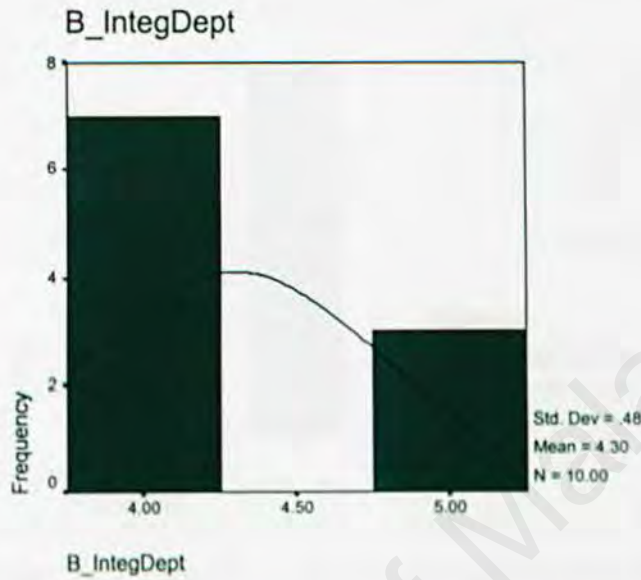

Figure 5.7 : *Measure on suitability of model in integrating*
              departmental needs

All respondents rate the tool, in terms of integrating central agencies need, as between 4 and 5. This is shown in Figure 5.7. Having windows from agencies' point of view, such as provided in the tool, may ease communication between them. In an integrated data environment, a common pool of information may be accessed from different locations. Data inconsistency will not be an issue anymore.

Integrating tools like the Project-Management software, is very much favoured, by 80% of respondents. Their responses are depicted in Figure 5.8. This feature gives room for more data to be kept on project activities, while keeping its link to the main project. Project managers may find this feature useful as it helps them in

their daily tasks. At the same time, information can be made available to higher authorities through the same platform.
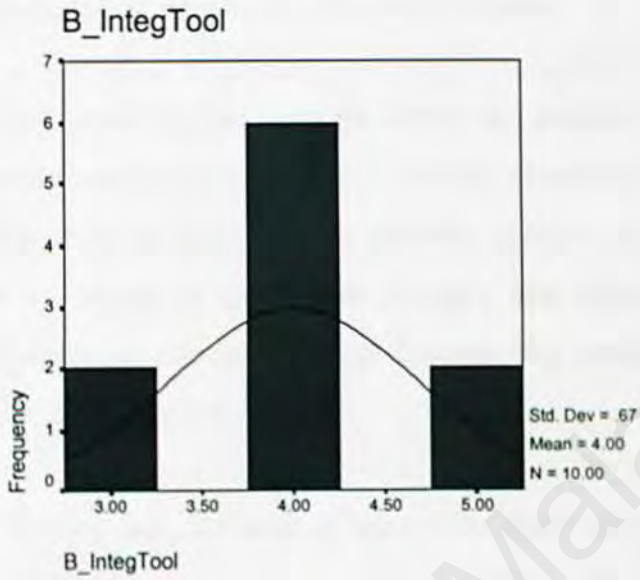
B_IntegTool

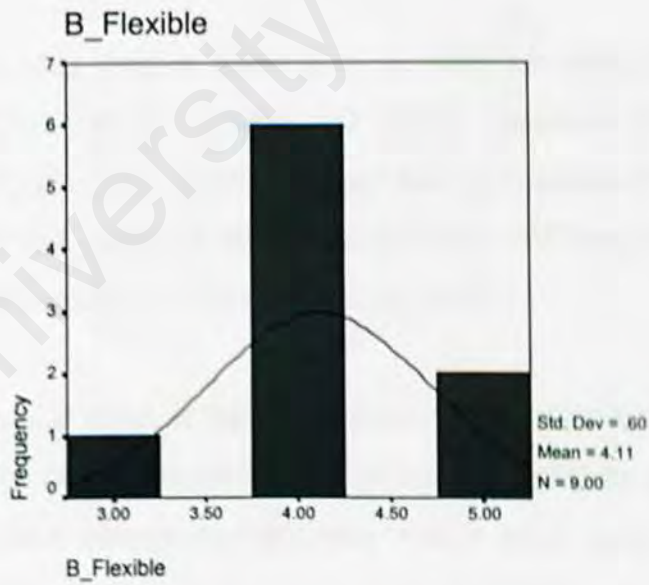Figure 5.8 : *Measure on the use of tool integration in model*

B_Flexible

Figure 5.9 : *Measure on flexibility feature of model*

The flexibility provided in such a set-up, as demonstrated in the tool gets a mean of 4.11, as given in Figure 5.9. 90% rates it as high or more. It gives the user of the system, a mean of keeping detail information according to their needs rather than conforming to formats required by the monitoring bodies.

Based on the *highest mean* (ie **4.50** in the scale of 1 to 5) and the *highest cumulative score* (45), the ease-of-use of the tool, gets the mark from the tests. This is probably due to the point-and-click feature which is more user friendly and common in today's softwares. It also incorporates features like images and graphics rather than pure text.

Following that, the *ease of navigation from screen to screen*, its suitability as a *single-entry tool* for reporting project progress, and its functionality in meeting central agencies' need in an integrated environment get means of **4.30**.

Ranking third in terms of mean score i.e. **4.11,** is the flexibility allowed in the system that allows variations of data kept on projects. That means users are free to maintain details on data as deemed useful to them instead of just fulfilling central agencies' needs in the form of summarized data.

Ranked fourth is the integration of other office tools in the system such as demonstrated in the linkage built with the more specialized project management software, with a mean score of **4.00**. Other office tools such as e-mail and word-processing tools may be similarly incorporated.

The incorporation of project image and the ability to obtain graphic display on data, scored a mean of **3.60**. Project images is included

to give a better picture of the project status on the ground. While graphic presentation of data is deemed useful to give an overall analysis. These features are only briefly demonstrated in the prototype, thus likely, the reason for the least mean score.

5.10.2 *Critical success factors for an integrated project monitoring system*

As part of the test, the questionnaire includes a section to gather opinion from the people on the critical success factors for an integrated project monitoring system in government. A scale of 1 to 5 is given to indicate the degree of importance of each factor. The results are as shown below.
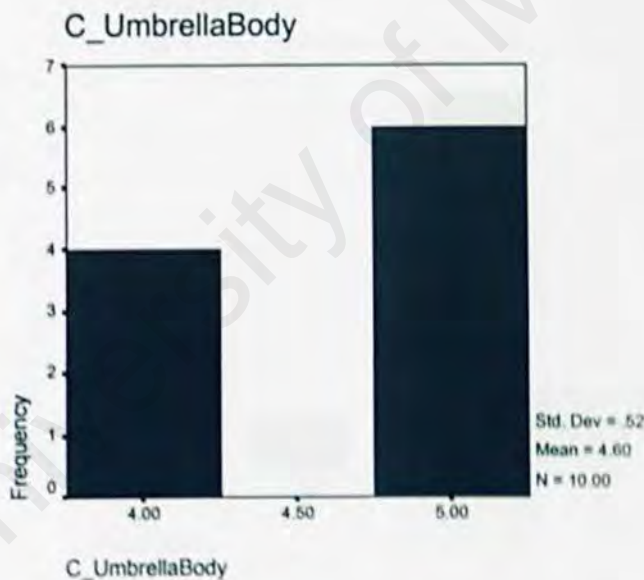
C_UmbrellaBody

Std. Dev = .52
Mean = 4.60
N = 10.00

C_UmbrellaBody

Figure 5.10 : *Measure on the importance of an umbrella body*
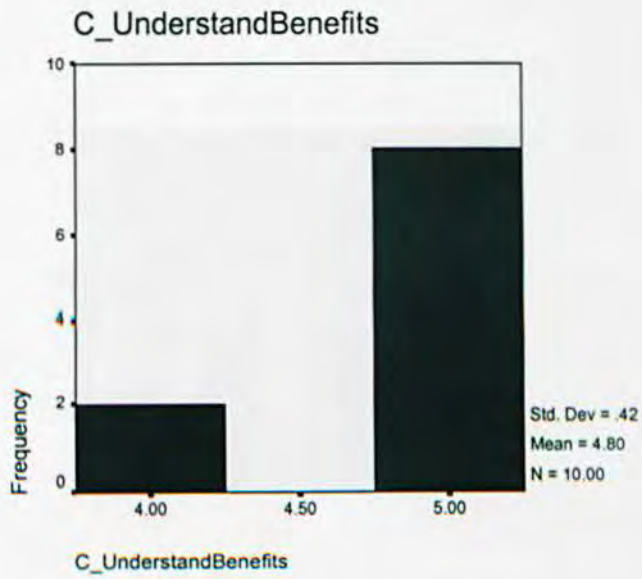
C_UnderstandBenefits

Figure 5.11 : *Measure on the importance of users to understand integration benefits*
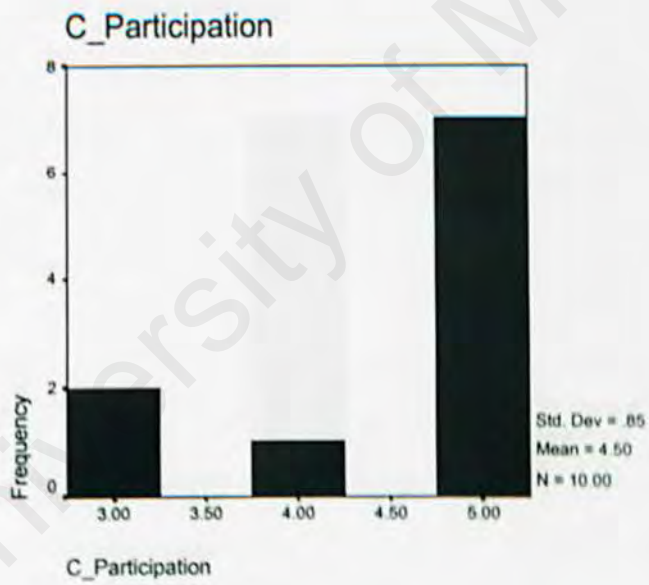
C_Participation

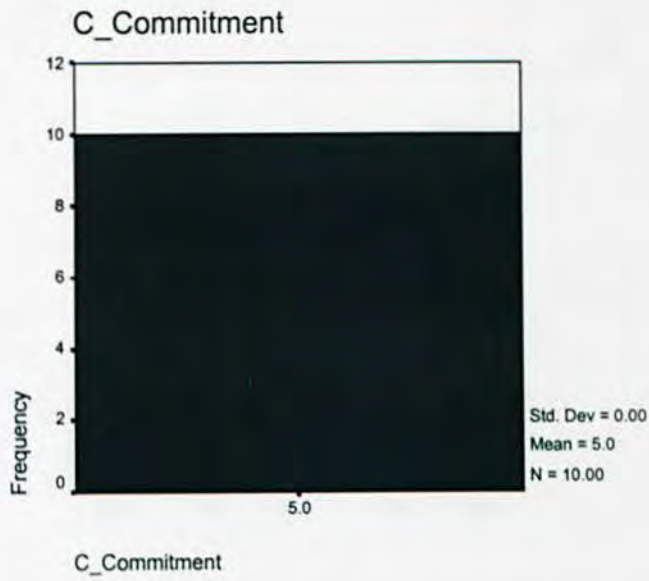Figure 5.12 : *Measure on the importance of participation in integration project*

C_Commitment

Std. Dev = 0.00
Mean = 5.0
N = 10.00

C_Commitment

Figure 5.13 : *Measure on the importance of commitments*

C_NetworkInfra

Std. Dev = .67
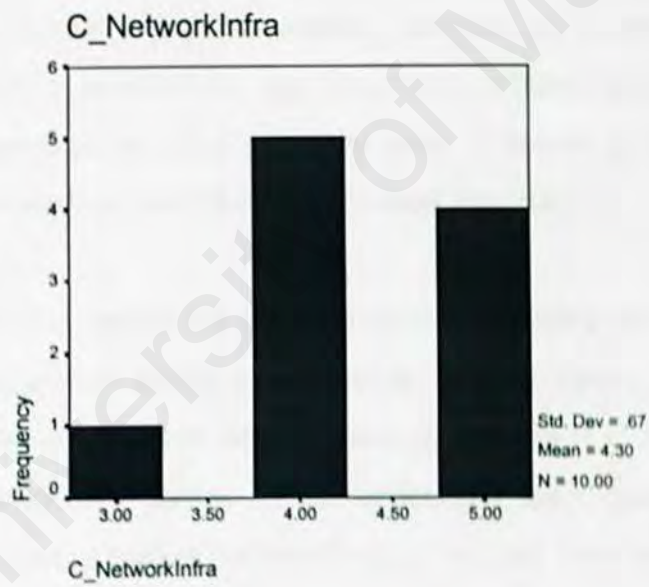Mean = 4.30
N = 10.00

C_NetworkInfra

Figure 5.14 : *Measure on the importance of an effective network infrastructure*
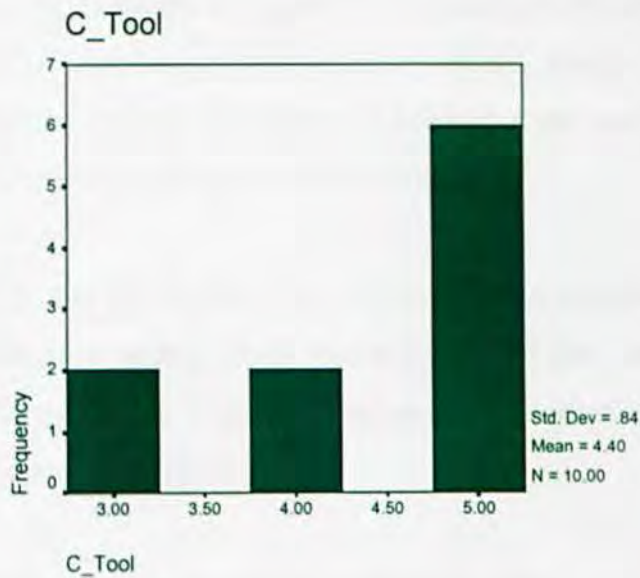
Figure 5.15 : *Measure of the importance of an appropriate tool*

As revealed from the finding, the issue of *commitment* from all parties involved in any integration efforts, were unanimously agreed as the most important issue, as shown in Figure 5.13. All respondents rated this issue as most important.

Second, comes the question of *understanding the benefits* of the integration efforts to all parties. This is shown in Figure 5.11. Nobody wants to have systems integration if it only benefits the others. All parties should understand their contribution to the project as well as the benefits they can gain from them.

Thirdly ranked in terms of mean score, is the setting up of an *umbrella body* to oversee the integration project, as shown in Figure 5.10. It is important that a higher authority body be set up to set terms, coordinate and steer the project concept. One cannot expect a department to change the way they operate, in order to have an integrated system.

Fourth, as shown in Figure 5.12, is the issue of participation by all parties involved, throughout the system design stages and the implementation. This factor is deemed important so as to ensure requirements of all shall be fulfilled.

Fifth and Sixth, only come the need for a *suitable tool for data-capture* at source (refer Figure 5.15), and the issue of having an effective *networking infrastructure* to help enhance the integration efforts (refer Figure 5.14).

5.10.3 Indicators to a successful integrated system

To supports the arguments on the rationale of the model, the questionnaire includes several indicators to be rated by the testers on their relevance, to the issues of systems integration it was addressing. Testers are required, using the scale of 1 to 5, to rank the relevance of each indicators. The followings are the results of the findings.

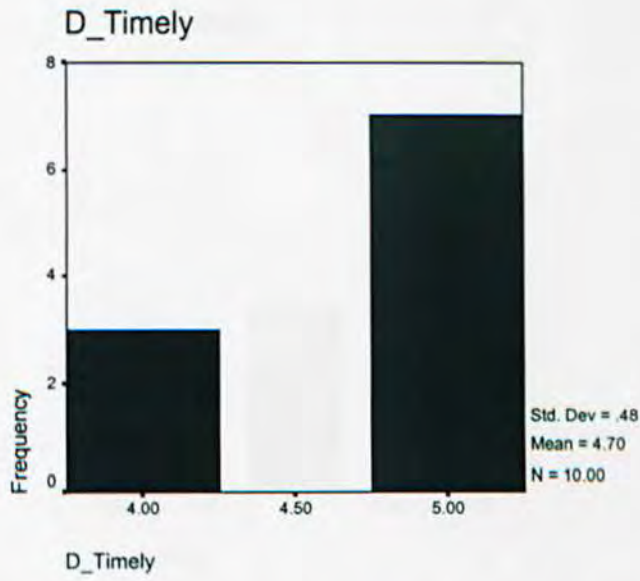D_Timely

Std. Dev = .48
Mean = 4.70
N = 10.00

Figure 5.16 : *Measure on the tool contribution towards timeliness of data*

D_Accuracy
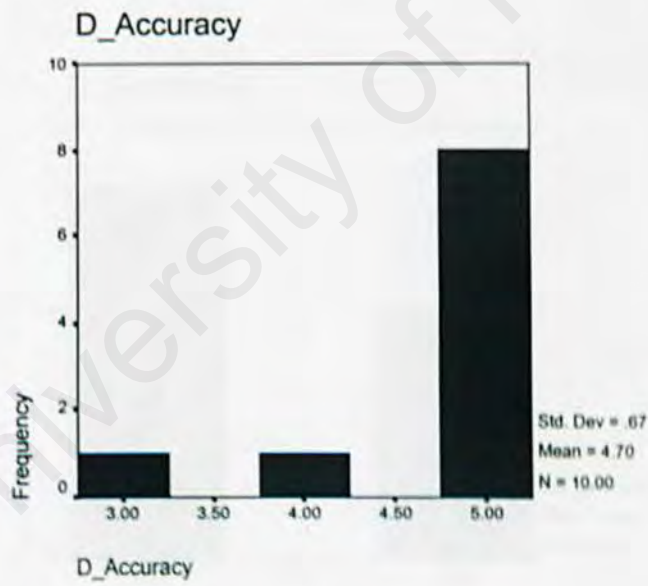
Std. Dev = .67
Mean = 4.70
N = 10.00

Figure 5.17 : *Measure on the tool contribution towards data accuracy*
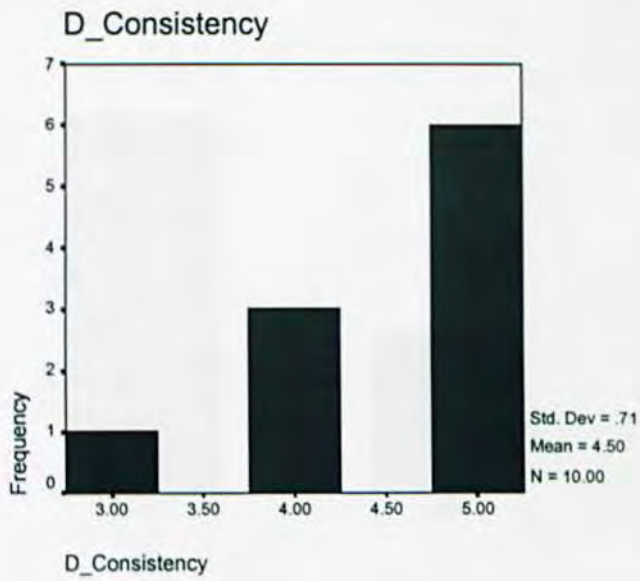
D_Consistency

Figure 5.18 : *Measure on the tool contribution towards data consistency*
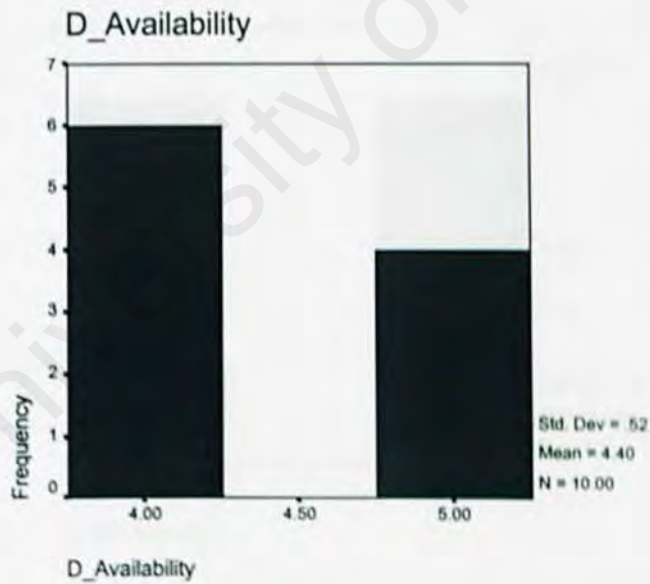
D_Availability

Figure 5.19 : *Measure on the tool contribution towards data availability*

D_MultiReport

Std. Dev = .48
Mean = 4.30
N = 10.00

D_MultiReport
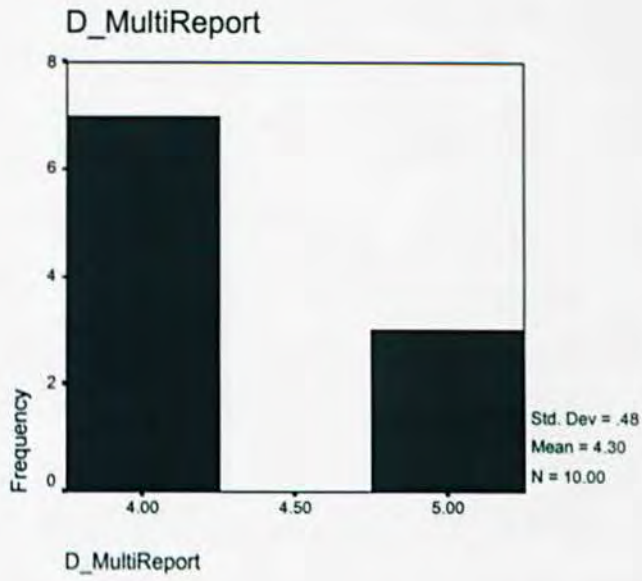
Figure 5.20 :   *Measure on the tool contribution towards avoiding multiple reporting*

D_Manpower

Std. Dev = .53
Mean = 4.50
N = 10.00
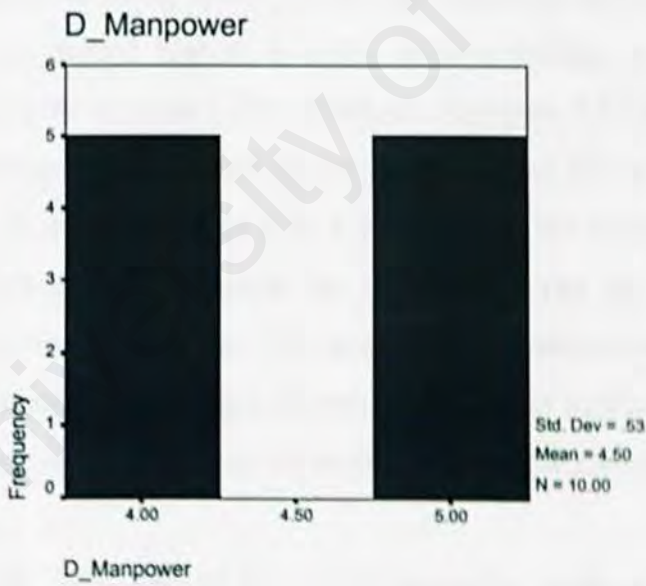
D_Manpower

Figure 5.21 :   *Measure on the tool contribution towards manpower utilization*
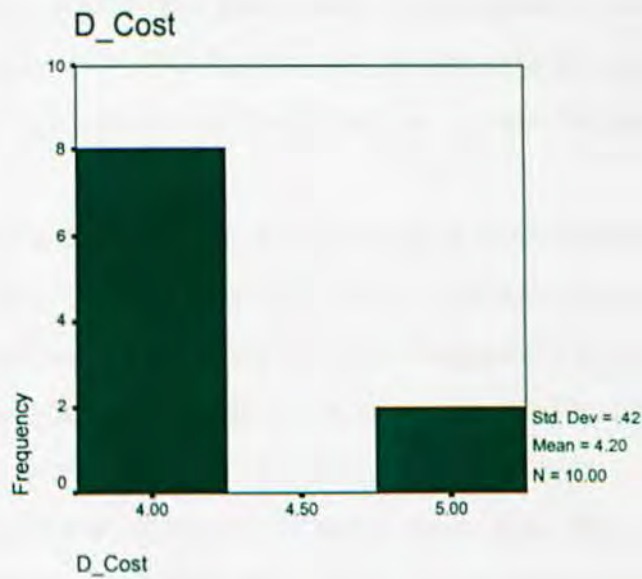
D_Cost

Std. Dev = .42
Mean = 4.20
N = 10.00

Figure 5.22 : *Measure on the tool contribution towards cost saving*

Based on mean score of **4.70**, the *timeliness* and *accuracy of data* were ranked highest in terms of determining the success of an integration project. This is shown in Figure 5.16 and Figure 5.17. All testers has ranked the timeliness of data on the rank of either 4 or 5, on the scale of 1 to 5 according to the degree of relevance. Such finding indicates the benefit that can be gained through systems integration. The accuracy of information through such system shall definitely be enhanced, as it is captured at source and consistent throughout the establishments, for a given time.

Both indicators of *data consistency* and *reduced manpower* for maintaining separate systems, received a mean score of **4.50**. This is shown in Figure 5.18 and Figure 5.21 respectively. Data consistency will be achieved when updated data is made available to participating agencies. So, in this concept of systems integration, where data is updated once and then shared, all parties will have consistent information to base their decisions on.

Data availability, comes next with a score of **4.40**, as shown in Figure 5.19. This fact prevails, as when systems are integrated, up-to-date data are sustained, once they are entered into the system.

The reduction in the task of having to report many times on project status, is another outcome, in an integrated system. Here, this fact has been rated **4.40**, as shown in Figure 5.20, by the personnel who participated in the test. The requirement of *multiple reporting* on projects arise when overseeing agencies request for information which are not made available to them. This, thus, puts a burden on implementing agencies to fulfil. So, by making data available over an integrated system, these agencies may be allowed access to information directly.

Last, but not the least in terms of the consequence of a successfully integrated system will be *cost saving*. Traditionally, each establishment will have to bare the cost of maintaining a computer system which requires manpower, sufficient hardware to support organizational requirements, suitable software to support applications and of course the basic infrastructure to maintain the system. When data need not be duplicated, application systems need not be rebuilt and processing power is shared. The public service may be able to reduce the cost of manpower to maintain separate systems, the cost of disk space needed for duplicated data and the cost of having excessive processing power by the individual organizations. This indicator is rated at **4.20**, as shown in Figure 5.22.

From the above findings, all indicators listed, scored means above 4.00, on the scale of 1 to 5, according to the degree of relevance to

the issues of systems integration. These indicators support the appropriateness of the model in the context of the case study.

<div align="center">

Chapter 6

Conclusion

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6.1 Systems integration in the Malaysian public sector

Systems integration in the public sector context of Malaysia enjoys the support of the Government. Policies on the utilization of IT provides for the basis of its growth within the government sector. The introduction of the Electronic Government substantiate the need for integration in information systems existing among government departments. Awareness on the benefits of systems integration should be an agenda to be reckoned with, and moving towards this concept should be the goal of the Public Service, in order to meet up to the demands of today's challenging world.

6.2 Systems integration considerations

With the advent in information technology today, the move towards SI is no more a technology issue. Network technology, open system standards, communication protocols, bridges, interface tools, client-server technology and the Internet, all provide a platform towards integration. SI, now should be looked at from the business and organizational angles. In working towards SI adoption in the public sector, criteria should be set in choosing suitable candidates for integration.

6.2.1 Commonality of data

Data on a common subject should be organized in an integrated environment. Rather than having several agencies in the public sector collecting the same data, multiple times, an understanding

on which point data should be captured, may save duplicating efforts both from the services and the public at large. As an example, a citizen's address need not be captured many times by the Inland Revenue Department or the Vehicle Licensing Department as this information is already available with the National Registration Department.

6.2.2 Data-sharing requirements

Data exchanges on related subjects is common among government bodies as discovered through the survey (Chapter 3). Complementing pieces of information adds value to data. Where data-sharing is beneficial, avenues should be sought to integrate systems. Such moves enrich information sources as well as streamline needed resources amongst government departments.

6.2.3 Resource savings

When data is replicated between agencies, the use of resources such as hardware and the supporting softwares are duplicated too. The number of employees required is also multiplied. In areas where data may be shared, the cost saving through shared resources should be a matter to consider.

6.2.4 Quick retrieval

When data is available within an integrated environment, information retrieval will be less of a hassle. Gathering information from diversified resources can be exasperating. The time needed to run around several authorities to gather data may deem the information outdated. In many cases data consistency becomes an issue when data are collected from different sources at different times.

6.2.5 *Single point data capture*

Data should only be captured once. The same piece of data may be accessible without it having to be re-entered elsewhere in the public sector.

6.2.6 *Security issue*

Only where data security becomes an issue should integration efforts be reconsidered. Although levels of security may be applied, where security is possibly jeopardized, the need for SI has to be reevaluated.

6.2.7 *Personal privacy*

Personal privacy issue has got the attention of many countries. Careful considerations should be given during the design of an integrated system, so as not to compromise on this issue.

6.3   Lessons acquired

Through this study, an exposure to the state-of-the art in IT in general, and SI particularly in Malaysia, are acquired. This include current network infrastructures, hardware platforms, various operating systems, application tools, object-oriented technologies, databases, internet tools, client-server concepts and many others. Learning from experiences of others through literature reviews, let us reflect on how best to exploit technologies to fulfil our needs, within our environment. On this account, the researcher felt it necessary to translate theory into practice. Using available technology, work is done to deploy current tools into a case where systems integration seems appropriate. Several platforms were considered. After

evaluating several infrastructure, a model is developed, that is able to run under a client-server environment as well as under an intranet environment (i.e. functioning using Internet technology).

6.4   Contribution of this research

The survey gives a picture on the need for systems integration within the public sector. The amount of data exchanged and the frequency they are done indicate the necessity for SI.

The extent of SI adoption amongst government agencies is also reflected. Although SI is a goal for information systems management in Malaysia, it is hardly looked at beyond the boundary of the organization.

Discussions on the case study depicts a picture on some of the practical issues that should be addressed in adopting towards SI. The proposed solution covers the four aspects of SI that was discussed in Chapter 2.

The prototype developed, can be a tool to demonstrate how SI concepts can be applied in the case of Project Monitoring. Convincing the users through the use of this prototype, may lead to a better understanding of how SI can be effectively exploited and what benefits may be acquired from this concept.

6.5   Further researches

Based on the study, a lot can be done towards research in this subject. Some of these works should be followed up as indicated below.

6.5.1 On the subject of SI in project monitoring, further research should be done on the process of project approval by the EPU, management of annual budget by the Treasury and the integration of the payment system of the AG. These should provide for a total integration in the area of project monitoring in the public sector of Malaysia.

6.5.2 Further research should also go into the database design for this integrated environment. The application of an object-oriented approach on this subject should be encouraged.

6.5.3 Issues on data security and levels of control may also be a subject of study in the integrated system proposed for project monitoring.

6.5.4 In general it is felt that a study may be taken up to look into government meta-data. This study serves as a prerequisite in making systems integration a goal for the public service.

Thank You

Bibliography

1. David Osborne, Ted Gaebler (1992), Reinventing Government (pg 34-42), Addison & Wesley.

2. James Y. Bryce, Systems Integration
   - http://www.bryce.com/sysinteg.htm (Acc. 24.4.98)

3. D. Richard Kuhn , On the Effective Use of Software Standards in Systems Integration. National Computer Systems Laboratory, National Institute of Standards and Technology, Gaithersburg.

4. C. V. Ramamoorthy, C. Chandra, H. G. Kim, Y. C. Shim, V. Vij "Systems Integration : Problems and Approaches" Computer Science Division, University of California, Berkeley.

5. MAMPU (1997), Electronic Government Information Technology (EGIT) Policy And Standards.

6. ICU, Prime Minister's Dept., SETIA Documentations 1984 - 1996

7. Tamar Zemel, Wilhelm Rossak : "Mega-systems : The issue of Advanced Systems Development", Inst. For Integrated Systems Research, Dept of Computer and Information Science, New Jersey Institute of Technology, Newark.

8. Kenneth C. Hoffman (1992), Management of Enterprise-Wide Systems Integration Programs, The Mitre Corporation - IEEE 0-8186-2697-6/92

9. Peter G. W. Keen (1995), Every Manager's Guide to IT - Harvard Business School Press

10. Erik G. Nilsson, Else K. Nordhagen, Gro Oftedal (1990), Aspects of Systems Integration -TH0309-5/90/0000/0434 1990 IEEE

11. Price Waterhouse, I.T. Budget Survey of the UK
    - http://www.pw.com/uk/243e.htm (Acc. 15/8/97)

12. The International Council for Information Technology in Government Administration (ICA) : A Glimpse at the Government of the Year 2010 by 25 Countries
    - http://www.ogit.gov.au/ica/icaartic.html – (Accessed 13/8/97)

13. The Chancellor of the Duchy of Lancaster and Cabinet Minister for Public Service (1997), Government Direct : A Prospectus for the Electronic Delivery of Government Service.

14. Government Use of The Internet
    - http://www............ (last acc. Oct 1997)
    - [actual document location misplaced]

15. Paul A. Strassman (1997), Governance: The New IS Agenda
    - http://www.computerworld.com/search/AT-html9502/950201SL9502lead.asc.html

16. D. Zantinge, P. Adriaans (1996), Managing Client/Server; Addison-Wesley (pg. 52-67)

17. Pervan and Klasss (1992), The Use And Misuse of Statistical Methods In IS Research, from Information Systems Research Issues, Methods and Practical Guidelines, Blackwell Scientific Publications.

18. Lang Chow (1996), Database Publishing on The Web & Intranets; Coriolis Group Books (pg.27-57)

19. Dr. Prakash Ambegaankar (1997), Intranet Resource Kit; McGraw Hill (pg. 230-279)

20. Ian Graham (1996), Object-Oriented Method, Addison-Wesley (pg. 1-53)

21. Bill Gates (1997), Government Technology for the 21st Century

22. James Martin (1989), Information Engineering (pg 1-27), ISBN 0-13-464462-X; Prentice Hall

23. Bertrand Meyer, Object Oriented Software Construction; Prentice Hall

24. Hsi-Peng Lu, Do-Chin Yeh (1998), Enterprises Perceptions on Business Process Re-engineering: A Path Analytic Model, Int. Journal of Management Science Vol.26.

25. Henry C. Lucas(1990), Managing Information Services

26. Ralph M. Stair(1992), Principles of Information Systems – A Managerial Approach

27. Zaitun A. B., Noriati B., Mashkuri Y. and A. T. Wood-Harper (1998), Bridging the Islands of Information Systems: The Task Ahead, IRMA '98, 17-20 May 98, Boston, USA.

28. Zaitun A. B., Mashkuri Y. and A. T. Wood-Harper (1998), The Diffusion Of Systems Integration In A Developing Country: A Study In Malaysia, IRMA '98, 17-20 May 98, Boston, USA.

29. Noriati B., Zaitun A.B. and Mashkuri Y (1998), Doing Government Business in theInternet Age: Monitoring Development Projects, in Effective Utilization and Management of Emerging Information Technologies, Edited by Mehdi Khosrowpour, Idea Group Publishing, ISBN 1-878289-50-0, 17-20 May 98, Boston, USA, pp. 817-819

30. Zaitun A. B., Noriati B., Mashkuri Y. and A. T. Wood-Harper (1998), Reasons for the Slow Diffusion of Systems Integration in the Public Sector, ICMU '98, 28-30 September 98, Uniten, Malaysia.

31. Zaitun A.B., Noriati B. and Mashkuri Y. (1998), The Diffusion of Systems Integration in a Developing Country: Triggers, Obstacles and Success Factors, CESII'98, 21-23 September 98, Miami, Florida USA.

32. Commonwealth of Australia (1995), Guidelines for Managing Electronic Documents in Australian Government Agencies - Essential Groundwork : Review of current practices.
    - http://www.peg.apc.org/~tomw/edgessen.html. (Acc. 12/18/96)

33. Richard Barnwell (1995), The essential Distributed Objects Survival Guide
    - http://www.omg.org/dh/dom.htm (Acc. 1/8/97)

34. Jeffrey Burrows (1997), Community Information Networking - An overview
    - http://ourworld.compuserve.com/homepages/jcy/cominfo.htm.

35. Office of the Vice President of USA, Re-engineering Through IT (Pt 1)
    - http://docs.whitehouse.gov/white-house-p...ering (Acc. 14/1/97)

36. Adrian Blakey, Using Object Databases on the Internet
    - http://www.objfocus.com/odb.htm (Acc. 21/1/97)

37. Arnold Kling (1996), Intranet Recommendations.
    - http://www.homefair.com/late96/intranet/intranet.html/ (Acc. 30/1/97)

38. Connectivity PLUS, Intranet Design & Implementation Services.
    - http://www.cplus.net/intranet-2.html (Acc. 30/1/97)

39. David Strom (1996), Art, Geeks and Power Ploys: How to build up your Intranet
    - http;//www.strom.com/pubwork/forbes8816.html (Acc. 30/1/97)

40. The Intranet- A Corporate Revolution
   - http://www.intranet.co.uk/papers/intranet/intranet.html.(Acc. 30/1/97)

41. Steven L. Tellen (1996), Intranet Organization: Strategies for Managing
   Change ; The Intranet Journal

42. State of Florida Information Resource Commission (1996) - Florida's State
   Strategic Plan for Information Resources Management:1996/1997-1999/2000

43. Minnessota State (1995), Statewide Information Resource Management
   Policies
   - http://www.state.mn.us/ebranch/admin/ipo/hb/document/rm15pol.html.

44. NORDINFO, Description of the Nordic Metadata project: Cataloguing,
   Indexing and Retrieval of Digital Documents.
   - http://linnea.helsinki.fi/meta/projplan.html. (Acc. 1/8/97)

45. Wisconsin State (1997), Metadata Tools
   - http://badger.state.wi.us/agencies/wlib/scol/metatod/mtools.html.
   (Acc. 12/97)

46. Steven L. Tellen (1996), Intranet Methodology: Concepts & Rationale

47. Steven L. Tellen (1996), Intranet and Adaptive Innovation : The move from
   control to coordination in today's organizations

48. Michael D. Myers (1997), Qualitative Research in Information Systems
   - http://comu2.auckland.ac.nz/~isworld/quality.html.

49. IMSC-TG Report (1997), Architecture for Access To Government
   Information
   - http://www.adfa.oz.au/DOD/IMSC/imsctg/imsctg1b.html

50. Ian Campbell, The Intranet: Slashing the Cost of Business
   - http://home.netscape.com/comprod/announce/idc/summary.html. (Acc.
   25/6/97)

51. Marc Andreessen, The Networked Enterprise
   http://home.netscape.com/comprod/at_work/white_paper/vision/intro.html
   (Acc. 8/7/97)

52. MCB University Press, Research Methodology
   - http://www.imc.org.uk/services/courseware/bmgt&session/bm1.html
   (Acc.29/4/97)

53. Hummingbird Communications(1996), The Intranet: Implementation of Internet & Web Technologies in Organizational Information Systems.
    - http://www.hummingbird.com/whites/intranet.html. (Acc. 4/10/97)

54. MENTOR, The Role of IT in Business Process Reengineering
    - http://www.mentorgrp.com/pubs/mrrison.htm. (Acc.6/6/97)

55. Yogesh Malhotra (1997), National Information Infrastructure:
    - http://www.brint.com/papers/nii/issues.htm.

56. Paul Rogers (1996), Publishing with World-Wide Web Technology: Methodologies for the Internet and Intranets
    - http://www.imagic.com.au/~magi/intra.html.

57. Unwin Technology (1995), Intranet Methodology
    - http://www.unwin.co.uk/intranet.html

58. INET'96, Intranets: Internet Technologies Deployed Behind the Firewall for Corporate Productivity
    - http://www.process,com/intranet/wpz.htp

59. Zueros: The Network Security Crisis - A White Paper
    - File:///c\/TEMP/WHTPAP~1.HTM (Acc. 2/6/97).

60. Natalie Zee, New Technologies in the Work Place :Approaching the Virtual Office
    - http://bliss.berkeley.edu/impact/students/nataliez/nataliez-final.html (Acc 10/11/97)

61. Kalee Sprague, Latin America's Information Revolution: Myth into Reality?
    - http://bliss.berkeley.edu/impact/students/kalee/kalee-asis.html (Acc 10/11/97)

62. Steven Mark (1994), The Information Superhypeway: Corporate America, the US Government and the Mass Media: Selling the Abstraction to the nation.
    - http://bliss.berkeley.edu/impact/students/steven/steven-final.html

63. Eric Brynjolfsson & Shinkyu Yang (1996), Information Technology and Productivity : A Review of the Literature
    - http://ccs.mit.edu/erik/itp/

64. Maurice Frank (1995), Database and the Internet
    - http://www.dbmsmag.com/f19512.html.

65. Varun Grover (1997), A Tutorial On Survey Research: From Constructs to Theory
    - http://theweb.badm.sc.edu/grover/survey/MIS-SUVY.html.

66. MAMPU(1996), Electronic Government

67. USA Government (1995), Reengineering Through Information Technology
    - http://www.npr.gov/library/reports/it.html.

68. G7GOL (1998), Information Sharing and Re-Use for Improved Government Services : Vision, World Trends and Solutions
    - http://www.open.gov.uk/govoline/golintro.html