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# 7

## Discussion

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According to the findings the highest correlation is between the technology usage and the revenue out of all the correlation coefficients found for the revenue. The coefficient was found to be 0.93. This shows that the usage of advanced technology for infrastructure of a company has a positive effect on the revenue. Therefore it can be concluded that the most important factor in infrastructure management is the use of efficient, effective and appropriate technology to increase the revenue of a software company.

The second best relationship is between the technology transfer and the revenue as the correlation coefficient was 0.91. This shows that technology transfer has a positive affect for the revenue of a company. Therefore it can be concluded that the second most important factor in infrastructure management that effects revenue is technology transfer. The correlation coefficient between resource planning and revenue is also a high value which is 0.90. This shows that its also equally important when maximizing revenue of a company.

The correlation coefficient for technology evaluation and revenue and technology evaluation and revenue gives lower values compared to others showing that their effects are not that strong.

The correlation coefficient between infrastructure expenditure and resource planning shows a high value which is 0.70. This shows that the expenditure increases with the enhancement of the resource planning.

The correlation coefficient between infrastructure expenditure and technology usage also shows a high value. This concludes that the increase of appropriate technology for infrastructure management increase the expenditure of the company.

# 8

## **Development of a Infrastructure Management Strategy for Software Development Firms in Sri Lanka**

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### **8.1 Technology Transfer**

### **8.2 Technology Usage**



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### **8.3 Resource Planning**

### **8.4 Utilization of human resources for infrastructure management tasks**

### **8.5 Technology Needs Assessment**

### **8.6 Technology Evaluation**

### **8.7 Technology Change**

### **8.8 Summary**

The McKinsey's 7S model shown below shows the strategy implementation of a company. According to the findings Infrastructure management is vital to a company. Infrastructure management strategy is one of the main strategies, which affect the main objective of a software development company.

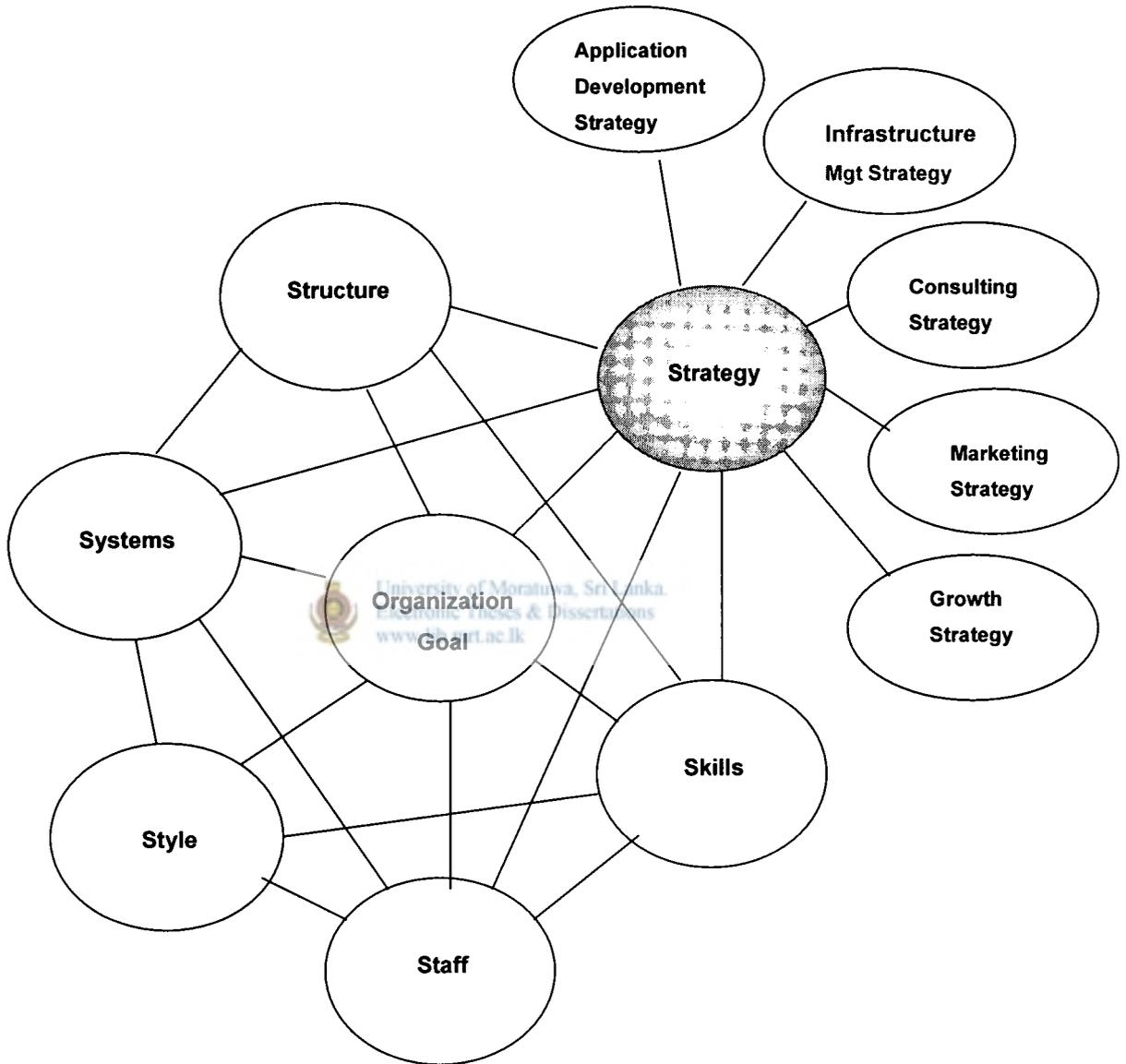


Figure 25: Strategy implementation module

The Infrastructure Management Strategy described below shows how the six infrastructure management components should be optimized to maximize the revenue of the company. The strategy implementation is discussed in detail.

## **8.1 Technology Transfer**

### **8.1.1 Standards**

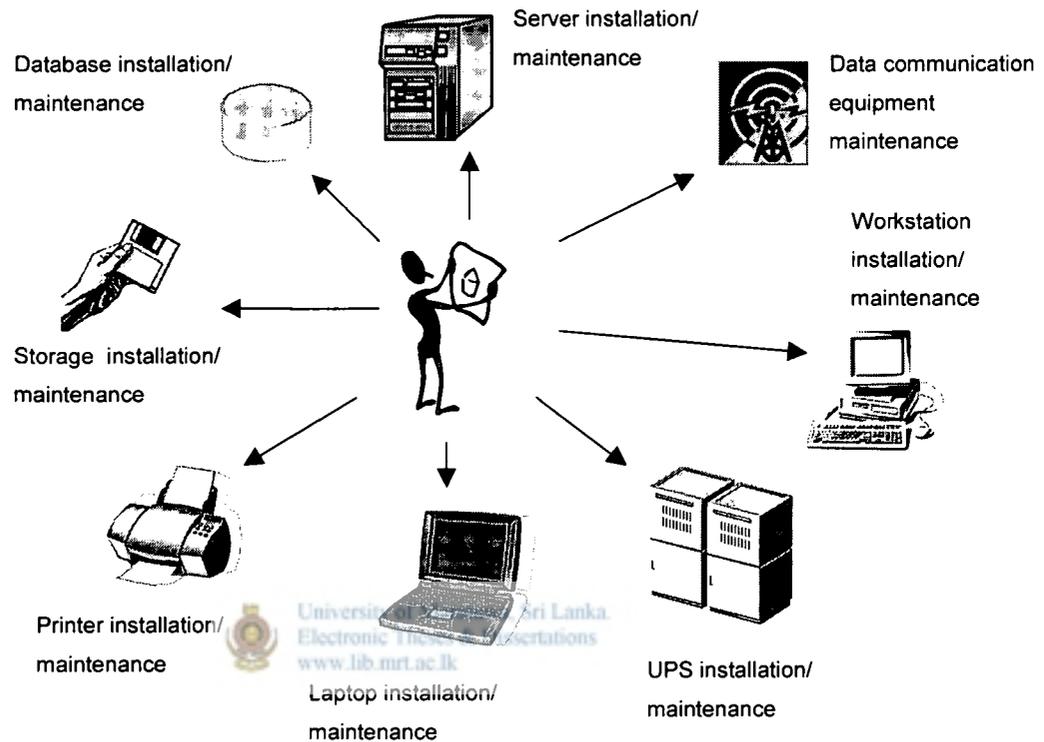
Technology standards is a significant part of infrastructure management. They consolidate existing technology into a firm basis for introducing newer technology, increase professional discipline, protect the business, and improve the quality of the products. Timing is absolutely critical for standards. If standards are proposed too early they can become too restrictive. A standard is defined by a set of specifications. These specifications obviously can not include unforeseen technical advances. If such future technical advances prove beneficial but are out of the scope of the specifications, then the standard is too restrictive. A consequence is that the standard won't be followed but ignored instead. If a standard is proposed too late, then it can actually be counter-productive. In order for applications to be compliant with a standard proposed late, significant re-engineering may be necessary. Rather than moving forward, it becomes necessary to take a step backwards.

Standards are an important part in technology transfer in a company. The quality of the management process is enhanced by the transfer of standards at the early stage of a company. In order to make the infrastructure management processes efficient standards have to be maintained. Standards that needs to be transferred are listed in appendix I.

### **8.1.2 Guidelines and Documentations**

Guidelines plays a major role in infrastructure management since a large no of tasks has to be carried out by the infrastructure personnel daily in software companies. These tasks are complicated and a simple mistake can lead to a big loss for the company as all the development staff depend on the infrastructure. Its important to have 100% uptime of the infrastructure and excellent performance to accelerate the

development process. To increase the accuracy and the efficiency of the processes guidelines are needed. These guidelines which used for infrastructure implementation and maintenance have to be transferred at the initial stages of the company or developed in-house. Guidelines that needs to be transferred are listed in appendix I. The use of guidelines are shown in the diagram below.



**Figure 26:** Usage of guidelines

### 8.1.3 Research and Selection

At the start up of the company the development tools have to be obtained to start operations. For this the most appropriate software tools that need to meet the company objectives have to be transferred. In addition the most appropriate and cost effective software for LAN/WAN maintenance as well as database administration has to be transferred. When obtaining the software their manuals and the knowledge to use them has to be transferred. This can be done through training programs, workshops etc. Also control/monitoring software for infrastructure control has to be transferred.

## **8.2 Technology Usage**

### **8.2.1 Identification**

To enhance the technology usage it is important to identify the infrastructure requirements for software development projects, the most cost effective computers to be included in the purchase plan, the needed third party Software for development and prepare the licensing plan, the software with the appropriate functionality for development, the needed appropriate equipment for data recovery and the needed appropriate and cost effective equipment/software for data security.

### **8.2.2 Selection**

Discussions has to be held with the project managers one month before the project starts to find out the requirements. The nature of software developed, the software tools that needs to be used, the project life cycle, the no of team members has to be found in order to prepare the infrastructure on time. It can be found from the software vendors what the configurations needed to use the software selected. Depending on these facts and the appropriate configuration for workstations, which are used for software development and other purposes and when they are needed can be decided. In addition the needed software and when they should be purchased can be decided. The decisions on purchasing the right equipment at the right time is vital to accerlerate the software development as well as produce quality bug free software which increase sales.

### **8.2.3 Server Consolidation**

The expansion of the projects and their needs has to be closely monitored and the required servers and back up equipment and storage equipment has to be obtained in a cost effective way. Since there is wide range of servers in today's market to serve various needs it is important to select the most appropriate and the cost effective ones. In a situation where software projects are increasing and database environments are adding rapidly more centralized servers can be added to reduce the long term cost. IF

the company expansion rate is low and the growth of the databases are low, middle level servers can be used. Only the most critical databases and files should be backed up using back up equipment. In large companies where a large no of different databases has to be maintained storage area networks can be used. SAN technology inserts a network or fabric or switching device between servers and storage that enables any server or application to access any storage connected to it. The fabric can then be configured to allow various servers to access various storage.

When selecting servers their efficiency in the long run should be assessed carefully. The life time, upgradability, performance and cost has to be analyzed. Upgradable Servers with a life time over 3 years should be purchased. Before purchasing the characteristics of all servers found in the market they should be compared and the most cost effective, reliable ones should be purchased. It is always advisable to buy the latest models as the server technology is changing rapidly making them obsolete every year. The most cost effective and appropriate equipment for data recovery should be purchased depending on the requirements. In deciding this the capacity to back up, how frequent the back up needs to be takes to what level the reliability should be has to be taken into consideration.



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#### **8.2.4 Monitoring and Tuning**

In order to ensure the efficiency and effectiveness of the LAN/WAN and the data communication equipments such as switches, modems, routers etc. their performance should be monitored daily so that action can be taken immediately to rectify if there performance drops at any instance. Traffic monitoring and network performance monitoring software can be used for this purpose. Performance tuning in servers, databases and the network is necessary for effective data communication. These should be done by highly skilled network and database administrators based on the organization standards, guidelines and policies. Maintenance activities of servers, workstations databases and LAN also should be carried out according to a standard, guideline and a policy.

### **8.2.5 Budgeting.**

The infrastructure budget should include the rough cost of each item and the time it needs. In order to create the detailed infrastructure budget it is necessary to forecast the requirements of the software project teams. This can be done by monitoring the growth of the development and the change of the environments. The project requirements and the annual development plan of the company has to be assessed and also to decide the amount to be spent yearly on infrastructure the cash flow and net profit of the company should be identified.

### **8.2.6 Security Implementation**

#### **Server and Clients Protection and Configuration Level**

All clients connected to the network shall have an updated basic virus protection. The virus protection software shall be designed for its purposes, e.g. a mail server needs a special version of virus protection SW.

Updated virus protection means

- Automatic updates of virus definition files
- Automatic updates of virus scanning software
- Managed by the Symantec System Center

#### **Web Server**

All clients with installed Web Servers shall be updated with the latest security patches. Security patches are provided by the Systems Administration department.

#### **Advanced OS Patch Level**

Vulnerable clients and servers can be protected by having applied the latest security patches released from the supplier. Supplier updates shall be continuously checked and all connected servers or clients shall be manually or automatic updated.

- The latest patches released for OS
- The latest patches released for web application and web based software.

### **Firewall Protection**

In some cases when a virus protection is not good enough, clients/servers can be protected by putting them behind a firewall. The firewall's mission is to filter the IP traffic and prevent unauthorized access. Firewall can be one of the following cases.

- A firewall service delivered by your Internet Service Provider.
- A hardware based firewall like a router or equal equipment.
- A Software based personal firewall installed and activated on each

client

### **PAN Network**

PAN – Personal Area Network is the personal network for to connect PDA's, Cellular phones and other toys to a personal client or to a LAN. Since PDA's and Cellular phones can connect both to Internet and to clients, they are a potential risk to be infiltrated by viruses which then can be spread to clients and further in a network.

At the moment these types of connections represent a very low risk of getting infected by viruses and since clients are protected against viruses, no further action needs to be taken.

### **Site WAN Connections**

Global Networks consists of many different WAN connections. A WAN connection is defined as a connection out of control for a site e.g. leased line or F/R.

WAN connections to a public network (like Internet) shall be protected by a firewall (FW). The FW shall be able to filter and log all traffic and be managed centrally.

### **Public Internet and Extranet**

Public Internet and Extranet zones are networks where controlled access are allowed from Internet. Connected servers and clients get more exposed for virus or unauthorized access or infiltration from Internet and therefore it requires an increased protection.

All servers and clients connected to Public/extranet shall have

- Basic virus protection
- Advanced OS patch level

### **Remote Access Connections**

Remote access means any type of access from outside of a organizations network to another network (outside our shell defense). A remote access is typical a dial up connection, (ISDN or any type of modem connection) or a VPN client access from anywhere on the Internet.

All clients used to get remote access to IFS network shall have

- Basic virus protection.

### **Direct Internet Connections**

Direct Internet connection is an unprotected connection and the organization should not allow any client to directly connect to Internet without a proper protection. All clients that are used to connect directly to the internet (not via Network) should be protected by

- Basic virus protection
- Firewall protection

### 8.3 Resource Planning

#### 8.3.1 Purchase Plan

The purchase plans should be prepared after budget and after detailed studies of the infrastructure in the whole organization. The needs for each project as well the organization as whole has to be identified first. The purchase plan should contain the order date, delivery date, cost and payment dates. When creating the purchase plan it should be prepared in such a way that there is no loss to the company. The cash flow should be taken into consideration when preparing the plan. In addition the availability of goods, their implementation time, delivery time should be considered so that they arrive without affecting the development process.

#### 8.3.2 Procurement of PCs, Laptops and Desktops

When purchasing desktop/laptop PC's the goal is to buy equipment that has a lifetime of

Desktop PC's 3 - 5 years

Laptop PC's > 3 years



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It is impossible to state strict rules that always must be adhered to so the general guideline is "A great deal of common sense combined with a high level of cost effectiveness".

#### Laptop PC's

The total cost of a laptop PC is considerably higher than the cost of a desktop PC. This is based on the higher investment cost and the considerably higher service cost. In addition to this, the lifetime of a laptop is shorter than for a desktop PC.

Always laptop PC's should be purchased for users who are traveling frequently. This means that he is traveling frequently, not just a few times a year. Example: Once a week or a week per month. The person must have a direct need for a laptop on the travels and have a need to work at irregular hours and has substantial difficulties in getting to the office at these hours. Also the person should work a considerable

amount of extra hours (not just a few hours a week), and should continue to do so, and should have a need to do this from home.

Upgrade of laptops is often initiated due to performance reasons. In many cases a disk cleanup or a reinstallation of the OS can solve the problem and increase performance considerably. Such a procedure shall always be tried before purchase of new equipment. In many cases it's possible to increase performance by configuration the laptop with more RAM memory. When an upgrade of a laptop is required, the need should be reconsidered. Maybe the need for having a laptop has changed. Once given a laptop does not necessarily mean that the need exists forever. The fact that other people have a laptop is not a reason for purchase. An extra screen for a laptop shall never be purchased, except in special cases (e.g. medical reasons). The cost can in most cases not be justified. The decision to purchase a laptop should be based on existing and relevant needs for the individual. Needs that might come up in the future should not be considered. Installing/using a pool of laptops for people with occasional or temporary needs should be considered.

### **Desktops PC's**



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Desktop PC users can be divided into Power users and other users. New PC's are always configured for Power users and former Power users PC's is inherited by other users.

- Always PC's should be purchased for Power users
- Other users inherit old Power users clients.

Power users are experienced users who are more competent in software development.

### **8.3.3 Utilization of Human Resources for Infrastructure Management Tasks**

#### **Desktop Admins**

Desktop Admins are those people that handles all client PCs and all operations involved in these. This includes setting up and configuring the PCs as well as setting up the users account using the PC and joining this PC to the network domain. Also handling of organizational group membership is done by Desktop Admins.

- Create a new user
- Create External Consultants Account
- Reset a password for a user
- Add/remove users to/from an organizational group
- Adding a computer to the domains
- The procedure for moving user/computer accounts between sites if any
- Defined policies and standards for the domains

### **Network Admins**

Network Admins are those people that handles all network services in the network domains.

This includes DNS, WINS and DHCP. The network admin has been given rights to handle the above services as well as the right to logon to domain controllers for diagnostic purposes. Authorization of DHCP servers should be delegated to network admins.

### **Tasks Carried Out**

- Check replication in domains
- Installation/configuration of DNS service
- Installation/configuration of DHCP service

### **8.3.4 Efficient Inventory Management**

A buffer of computers, hard disks, memory, server hard disks, power cables, network cables should be maintained to install in a emergency. The buffer size should be decided by observing the rate of damages that occur for each of the above mentioned accessories. Buffers of certain items may need to be big and another may be small. A rapidly expanding company should have computer buffers as well as additional server accessories as back up. The buffer should be filled when it is emptied more than 50%. All the details such as serial no, purchased date, purchased price, delivered date, ordered date, user, location, fixed asset no of all the equipment should be maintained using a database application.

### **8.3.5 Back Up**

When it comes to software development backing up developed program files and data are important. If the company lose them due to a disaster it would take a long time to develop the programs and bring to the previous stage. Therefore daily back ups of software developed and data in databases should be taken on tapes which are reliable. The backing up mechanism should be made efficient and cost effective through network backing up mechanisms. In addition they should be taken without affecting the daily work. Scheduled jobs can be run in the night to take backups. Software version control mechanisms such as CCC Harvest Server Technology can be used to keep each version of a program in a central server. These kind of servers are ideal for large and medium scale software companies where distributed computing takes place.

### **8.3.6 Competency Development**

Its highly important that the infrastructure management personnel is highly competent in their field since the performance of the whole company depend on the IM tasks. The personnel involved in the systems administration tasks should be given training continuously on new technologies and their implementations in order to enhance the quality of service as well as improve the IM processes and implement new technologies. It s vital to assess the competency of the staff every 6 months so that it can be planned to train them without affecting the infrastructure performance.

### **8.4 Technology Needs Assessment**

The technology needs change in software company rapidly as the IT technologies are changing faster than any other technology in the world. Since IT technologies get obsolete quite soon the companies should change with the technology trend to compete the technology leaders. Therefore technology needs should be assessed monthly to plan for the changes. Also the competency level should be assessed frequently to plan training programs for the staff. A detailed technology needs assessment should be done each year in order to plan for technology change. A proper

assessment would be a detailed study on all the IM technologies within the organization. The performance and the requirements should be found by the daily maintained logs on the performance of each equipment.

**Table 22:** Monitoring Criteria

| Monitoring Criteria  | Equipment   |
|--|---|
| Memory utilization, CPU Usage, Time taken to execute applications  | Servers, Workstations, Desktops                               |
| Bandwidth Utilization Percentage, Latency, packet drop percentage. | Data communication Links, LAN, ISDN, Dial up connections etc. |
| Power load   | Power cables, UPS, Generators etc.                            |

### 8.5 Technology Evaluation

In order to plan for optimizing and enhancing the Infrastructure a detailed infrastructure study should be carried out yearly. This evaluation will consist of the performance level of the processes in infrastructure management and the quality of the services performed by the staff.

### 8.6 Technology Change



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The infrastructure technology changes needed can be identified by the assessments and detailed studies done during the year. The technology change plans should be prepared each year. The change plan should include the process changes, new technologies to implement, new equipment to purchase and install, recruitment and training. The change plan should be implemented and after implementation the changes should be evaluated.

### 8.7 Summary

A new strategy for effective and efficient infrastructure management in a software development firm was explained in detail. Strategy consisted of 6 parts such as technology transfer, technology evaluation, technology usage, technology needs assessment, technology change and resource planning.

The next chapter describes the conclusion of the whole research.

# 9

## Conclusions

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## 9.1 Achievement of the Aim and Objectives

### Aim

The aim the project was to observe the infrastructure management methods in Software firms in Sri Lanka and develop a methodology for effective infrastructure management for the IT firms in the country.

The aim was achieved with great satisfaction. A detailed survey was conducted to find the infrastructure management strategies used in the local IT industry as well as the most important factors that affect the infrastructure management in a software development firm. The relationships between the revenue and the infrastructure management components as well as the relationships between the infrastructure expenditure and the infrastructure management components were found and ultimately a new strategy to manage IT infrastructure effectively and efficiently was developed. Chapter 5 depicts the new strategy where as chapter 6 shows the results from the analyzed data.



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### Objectives

#### Identify Technology Transfer Mechanisms

The technology transfer mechanisms used for infrastructure and their drawbacks were identified. The efficiency of infrastructure management is high in companies where technology have been transferred using vertical technology transfer and horizontal technology transfer. The companies which used unpacked technology transfer haven't developed or obtained standards or guidelines for making infrastructure management efficient and as a result their infrastructure management have become less efficient. Therefore the efficiency of infrastructure management are less in companies where technology has been transferred using unpacked technology transfer

### **Identify Technologies Transferred**

The technologies transferred to selected companies were identified. These include process technology transfers such as technoware, humanware, orgaware and, inforeware and product technology transfers such as product design inforeware and product usage inforeware.

The order of efficiency of the technologies transferred are as follows.

Orgaware

Inforeware

Humanware

Technoware

### **Problems Faced in Transferring Technology**

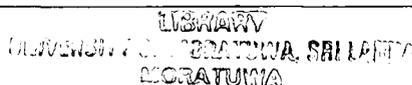
The problems faced in transferring technology were identified from the survey. The main problems are due to lack of English knowledge, insufficient training, lack of documentation, skilled labour shortage, government regulations and delays in government departments such as Customs.

### **Identify Technology Usage**

The technology level used by the companies in delivering their services or products were identified. Multinationals and the leading local software companies are using cutting edge technology for infrastructure which are reliable and efficient. It can be concluded that usage of cutting edge technology is vital for effective and efficient infrastructure management.

### **Identify Resource Planning Methods**

The hardware and software resource planning methods used by the firms were identified. The procurement process of the local companies is inefficient as they obtain the necessary equipment only when problems arise or people are recruited. Multinationals and the leading local software companies with higher revenue considerable amount of back up equipment to face breakdowns. They also procure according to a yearly plan. It can be concluded that for efficient resource planning yearly plans and backup equipment and procedures are necessary.



### **Identify Technology Needs Assessment Methods**

The technology needs assessment methods and the frequency the assessments were carried out by the companies were identified. For efficient technology needs assessment it is important to assess according to a planned schedule at least two times per year.

### **Identify Technology Evaluation Methods**

It was found that none of the companies chosen for the sample uses any kind of technology evaluation method for technology evaluation. Therefore it was not possible to assess the technological capability of the firms and compare the outcome generated by them with the outcome of the capability assessing method introduced by Prof. Ramanadan. The capability assessing method for assessing the capability of a software company is described in the research framework section in chapter 4. It was not possible to apply prof. Ramanadan's model and evaluate the capability as the companies were reluctant to divulge detailed information about expenditure, investments, projects etc.



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### **Development of a Model For Infrastructure Management Analysis**

A model was formulated to analyze the identified methods of the firms. The key factors in the model are as follows.

- Technology Transfer
- Technology Needs Assessment
- Technology Evaluation
- Technology Usage
- Technology Change
- Resource Planning

### **Analyze The Identified Methodologies And Their Effectiveness**

The relationship between the infrastructure management components and the revenue and the r&d expenditure were found. The most important factor that affects revenue of a software development company is technology usage.

## **Formulate a Strategy and a Methodology For Effective Infrastructure Management**

A new strategy was developed for effective and efficient infrastructure management. The following are key procedures in the strategy.

### **Technology Transfer**

Usage of Standards

Usage of Guidelines and Documentations

### **Technology Usage**

Identify appropriate technology

Selection appropriate technology

Server Consolidation

Monitoring and Tuning networks and databases

Budgeting for infrastructure

Security Implementation for LAN, WAN

### **Resource Planning**



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Preparation of Purchase Plan

Procurement of PCs, Laptops and Desktops according to plan and guidelines

Utilization of Human Resources for Infrastructure Management Tasks

Efficient Inventory Management

Back Up

Competency Development

### **Technology Needs Assessment**

### **Technology Evaluation**

### **Technology Change**

## 9.2 Problems Encountered

A variety of problems were encountered when carrying out the project. Some of them are listed below.

### 9.2.1 Fact Finding

It was difficult to obtain the required data from the companies as most of the company's management doesn't divulge information about their processes and financial information. The required information were successfully gathered through personal contacts. It was easier to get the correct information due to business relationships with various software development firms. Firstly questionnaires were given to infrastructure management personnel to be filled. This was a failure as the correct information was not obtained since the personnel didn't spend time to fill the detailed questionnaire correctly and they didn't answer some questions because they had some doubts. Secondly interviews were held with several infrastructure management personnel and during the interview the questionnaires were filled by interviewer. It was possible to get the correct information as the interviewer could explain and get the required correct data for each question.

### 9.3 Recommendations for Future Research

The research can be further enhanced by increasing the scope so that whole infrastructure management of the software development companies can be analyzed. The management of other types of infrastructures such as building infrastructure can be included to the research to increase the scope.

The research was carried out to find the effects of only six components of IT infrastructure management for the revenue of the company. The research can be further extended to find more related factors affecting infrastructure management by a more detailed survey, which include procedures and processes of IT organizational management.

The relationship between the level of customer satisfaction and the infrastructure of a software development company can be identified by further research in this area. A survey can be carried out to find details about the customers of software development companies and the effects of infrastructure of the company in satisfying customers and increasing license revenue can be found.



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# Appendix I

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- **Standards**



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- **Guidelines and Documentations**

## Standards

- Standards for LAN/WAN designing.
- Standards for LAN/WAN implementation.
- Standards for electrical power circuit designing.
- Standards for electrical power circuit implementation.
- Standards for PABX configuration and selection.
- Naming standards for networking and email admin
- Security implementation standards.
- User Account standards.

## Guidelines and documentations

- Documentations of a framework which will be used for infrastructure management.
- Guidelines for LAN/WAN designing.
- Guidelines for LAN/WAN implementation.
- LAN design specifications.
- Guidelines for electrical power circuit designing.
- Guidelines for electrical power circuit implementation.
- Guidelines for PABX configuration and selection.
- Guidelines for network maintenance.
- Guidelines for server maintenance.
- Guidelines for database installation.
- Guidelines for database administration.
- Guidelines for communication equipment maintenance.
- Guidelines for workstation maintenance.
- Network performance tuning guidelines
- Server performance tuning guidelines
- Database performance tuning guidelines
- Email server performance tuning guidelines
- Data communication performance tuning guidelines
- QA guidelines for domain administration.
- QA guidelines for Server administration/installation.

- Reporting guidelines for infrastructure management
- Server procurement guidelines.
- Server benchmarking guidelines.
- Guidelines for installing software.
- Guidelines for operating data communication equipment.
- Guidelines for data communication equipment maintenance.
- Guidelines for software upgration.
- Guidelines for troubleshooting equipment.
- Guidelines for troubleshooting software.
- Guidelines for performance tuning workstations.

#### **Research and Selection**

- Check functionality of software and obtain the most appropriate and cost effective software for LAN/WAN maintenance.
- Obtain or develop control/monitoring software for infrastructure control.
- Carry out a research and find out the existing software development tools available and their functionality.
- Select the most appropriate software tools needed to meet the objectives of the company.
- Select the most cost effective and efficient software which should be obtained to start development.
- Obtain the selected Software applications.
- Obtain software manuals of all the software which will be used.



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## Appendix II

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**Ratings**

| Index | Classification | Rating/Score |
|-------|----------------|--------------|
|       | Very High      | 10           |
|       | High           | 7            |
|       | Average        | 5            |
|       | Below Average  | 4            |
|       | Low            | 3            |
|       | Very Low       | 2            |



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## Appendix III

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University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
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**Questionnaire for MBA Research:**

**Project Title:**

*Effective Infrastructure Management in Software Development Firms in Sri Lanka  
By Rasanga Chinthaka Keeriwela Gamage BSc. Hons.*

**Supervisor:** Prof. Ananda Jayawardena

**University:** University of Moratuwa, Moratuwa, Sri Lanka.

*The purpose of the project is to observe the infrastructure management methods in Large and Medium Scale Software firms in Sri Lanka and develop a methodology for effective infrastructure management for the IT firms in the country. The information contained in this questionnaire will remain completely confidential and used purely for academic purpose. Neither yourself nor your organization will be identified in any publication resulting from this research project.*

Name of the Organization: .....

Name of the Interviewee:..... Position: .....

Date and Time:.....

**Section 1: Technology Transfer**

The levels mentioned in the section 1 are during the technology transferring time at the beginning of the company.

TA11: Level of adequacy of the software manuals

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TA12: Level of adequacy of documentations of frameworks for infrastructure management.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TA13: Level of adequacy of guidelines for infrastructure implementation.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TA14: Level of adequacy of standards/guidelines for infrastructure design.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TO11: Level of adequacy of the software for infrastructure implementation.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TO12: Level of adequacy/appropriateness of the functionality of the software

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TM11: Level of adequacy of guidelines for database administration.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TMI2: Level of adequacy of guidelines for server maintenance.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TMI3: Level of adequacy of guidelines for network maintenance.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TMI4: Level of adequacy of guidelines for communication equipment maintenance.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TMI5: Level of adequacy of guidelines for workstation maintenance.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TPI1: Level of adequacy of network performance tuning guidelines

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TPI2: Level of adequacy of server performance tuning guidelines

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TPI3: Level of adequacy of database performance tuning guidelines

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TPI4: Level of adequacy of email server performance tuning guidelines

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TPI5: Level of adequacy of data communication performance tuning guidelines

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TDI1: Level of adequacy of LAN design specifications.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TDI2: Level of adequacy of QAE guidelines for domain administration.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TDI3: Level of adequacy of QAE guidelines for Server administration/installation.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

TDI4: Level of adequacy of QAE guidelines for Workstation administration/installation.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

HF11: Level of adequacy of reporting guidelines for infrastructure management

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

HB11: Level of adequacy of naming standards for networking and email admin

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

HB12: Level of adequacy of security implementation standards.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

HB13: Level of adequacy of active directory standards.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

OBI1: Level of adequacy of information for effective inventory management.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

OBI2: Level of adequacy of Order status information.

|           |      |         |               |     |          |
|-----------|------|---------|---------------|-----|----------|
| Very High | High | Average | Below Average | Low | Very Low |
|-----------|------|---------|---------------|-----|----------|

OBI3: Level of adequacy of infrastructure downtime information.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

OBI4: Level of adequacy of information on costs.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

OBI5: Level of adequacy of information for order scheduling.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

OEI1: Level of adequacy of infrastructure planning guidelines.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

OEI2: Level of adequacy of control/monitoring software for infrastructure control.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

POI1: Level of adequacy of guidelines for installing software.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

POI2: Level of adequacy of guidelines for operating equipment.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PMI1: Level of adequacy of guidelines for equipment maintenance.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PMI2: Level of adequacy of guidelines for software upgration.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PMI3: Level of adequacy of guidelines for troubleshooting equipment.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PMI4: Level of adequacy of guidelines for troubleshooting software.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PPI1: Level of adequacy of guidelines for performance tuning databases.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PPI2: Level of adequacy of guidelines for performance tuning servers.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PPI3: Level of adequacy of guidelines for performance tuning LAN.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

PPI4: Level of adequacy of guidelines for performance tuning workstations.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

**Section 2: Technology Usage**

MTU1: Level of adequacy of workstation configurations for software development

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU2: Level of adequacy of servers.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU3: Level of adequacy of third party Software.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU4: Level of adequacy of software functionality for development.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU5: Level of adequacy of LAN for effective data transmission.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU6: Level of adequacy of data communication links for effective data transmission.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU7: Level of adequacy of equipment for data recovery.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU8: Level of adequacy of equipment/software for data security.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MTU9: Level of adequacy of amount spent yearly on infrastructure.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

**Section 3: Resource Planning**

MRP1: Level of adequacy of inventory.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MRP2: Level of adequacy of back up equipment.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MRP3: Level of adequacy of skilled humanware for infrastructure management.

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MRP4: Lead time for equipment delivery. (days)

|           |   |      |        |         |        |               |        |     |   |          |                 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|---|----------|-----------------|
| Very High | 1 | High | 3 or 4 | Average | 5 or 6 | Below Average | 7 or 8 | Low | 9 | Very Low | Greater than 10 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|---|----------|-----------------|

MRP5: Level of adequacy of training on infrastructure management

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

MRP6: Level of adequacy of training on infrastructure implementation, monitoring and

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

**Section 4: Technology Needs Assessment**

MTN1: No of times technology needs assessments are done a year.

|           |         |      |        |         |        |               |        |     |        |          |           |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|
| Very High | 9 or 10 | High | 8 or 7 | Average | 6 or 7 | Below Average | 5 or 4 | Low | 3 or 2 | Very Low | 1 or less |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|

MTN2: No of times employee competency assessments done a year

|           |         |      |        |         |        |               |        |     |        |          |           |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|
| Very High | 9 or 10 | High | 8 or 7 | Average | 6 or 7 | Below Average | 5 or 4 | Low | 3 or 2 | Very Low | 1 or less |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|

**Section 5: Technology Evaluation**

TEV1: Total number of detailed infrastructure studies completed during the last five years

|           |         |      |        |         |        |               |        |     |        |          |           |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|
| Very High | 9 or 10 | High | 8 or 7 | Average | 6 or 7 | Below Average | 5 or 4 | Low | 3 or 2 | Very Low | 1 or less |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|

TEV2: Cost overrun as a percentage of the budgeted infrastructure cost due to lapses during detail infrastructure studies

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV3: Cost of adaptation activities as a percentage of the cost of technology purchased

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV4: Cost of reverse engineering activities as a percentage of the cost of all technologies purchased

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV5: Time overrun during detail engineering as percentage of the scheduled time

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV6: Time taken to diagnose and correct a system failure

|           |   |      |        |         |        |               |        |     |        |          |                 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------------|
| Very High | 1 | High | 2 or 3 | Average | 4 or 5 | Below Average | 6 or 7 | Low | 8 or 9 | Very Low | Greater than 10 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------------|

TEV7: Level of customers technical support is provided

|           |          |      |          |         |          |               |          |     |         |          |          |
|-----------|----------|------|----------|---------|----------|---------------|----------|-----|---------|----------|----------|
| Very High | Over 250 | High | Over 200 | Average | Over 150 | Below Average | Over 100 | Low | Over 50 | Very Low | Below 50 |
|-----------|----------|------|----------|---------|----------|---------------|----------|-----|---------|----------|----------|

TEV8: Average time taken to respond to customer's queries (hours)

|           |   |      |        |         |        |               |        |     |        |          |                 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------------|
| Very High | 1 | High | 2 or 3 | Average | 4 or 5 | Below Average | 6 or 7 | Low | 8 or 9 | Very Low | Greater than 10 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------------|

TEV9: Average time taken to attend to the problem specified by the customer. (hours)

|           |   |      |        |         |        |               |        |     |        |          |                 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------------|
| Very High | 1 | High | 2 or 3 | Average | 4 or 5 | Below Average | 6 or 7 | Low | 8 or 9 | Very Low | Greater than 10 |
|-----------|---|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------------|

TEV10: No of major contracts for which technology acquisition activities were performed without any external assistance during the last five years

|           |         |      |        |         |        |               |        |     |        |          |           |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|
| Very High | 9 or 10 | High | 8 or 7 | Average | 6 or 7 | Below Average | 5 or 4 | Low | 3 or 2 | Very Low | 1 or less |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|

TEV11: Level of personal hired, with more than 10 years of experience as a percentage of the total personal hired during the last five years

|           |            |      |              |         |              |               |              |     |              |          |               |
|-----------|------------|------|--------------|---------|--------------|---------------|--------------|-----|--------------|----------|---------------|
| Very High | 1% or less | High | More than 1% | Average | More than 4% | Below Average | More than 6% | Low | More than 8% | Very Low | More than 10% |
|-----------|------------|------|--------------|---------|--------------|---------------|--------------|-----|--------------|----------|---------------|

TEV12: Average time overrun during the resource acquisition process as a percentage of the scheduled time

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV13: Degree of reliability in the information system

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV14: Information communication effectiveness

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV15: The quality of engineering work performed

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV16: Level of customer satisfaction

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV17: Extensiveness of database for technologies related to industry and infrastructure projects

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

TEV18: Extensiveness of the human resource database

|           |  |      |  |         |  |               |  |     |  |          |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|
| Very High |  | High |  | Average |  | Below Average |  | Low |  | Very Low |  |
|-----------|--|------|--|---------|--|---------------|--|-----|--|----------|--|

**Section 6: Technology Change**

MTC1: No of times the infrastructure technologies were changed during the past five years.

|           |         |      |        |         |        |               |        |     |        |          |           |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|
| Very High | 9 or 10 | High | 8 or 7 | Average | 6 or 7 | Below Average | 5 or 4 | Low | 3 or 2 | Very Low | 1 or less |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|

MTC2: No of times the infrastructure technologies were changed during a year.

|           |         |      |        |         |        |               |        |     |        |          |           |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|
| Very High | 9 or 10 | High | 8 or 7 | Average | 6 or 7 | Below Average | 5 or 4 | Low | 3 or 2 | Very Low | 1 or less |
|-----------|---------|------|--------|---------|--------|---------------|--------|-----|--------|----------|-----------|

1. How was the company started?
2. What was the infrastructure implemented at the beginning?
3. What was the reason for implementing such an infrastructure?
4. What was the purpose of the infrastructure?
5. How much was spent at the beginning?
6. Was the technology obtained from another company or developed in house?
7. What were the technologies obtained from outside?
8. What were the technologies developed in house?
9. What were the human resources used at the beginning for infrastructure mgt.?
10. What were the methods/tools obtained from outside for infrastructure mgt.?
11. What were the problems faced in infrastructure mgt at the beginning?
12. What are the Servers used for software development at present?
13. What are the configurations of the workstations used by the users at present?
14. What are the methods used for data communication at present?
15. What is the level of Internet usage for research/work at present?
16. What are the software tools used for development at present?
17. What is the nature of the software being developed?
18. When and how often are the workstations replaced?
19. When and how often are the servers replaced?
20. When and how often are the band with of the data com links upgraded?
21. How often are workstations purchased?
22. How often are servers purchased?
23. What is the LAN/WAN topology used within the organization?
24. What is the maximum bandwidth in the backbone?
25. What are the switches used. (Brand, speed etc)?
26. What is the router used and for what purpose?
27. What are the security measures taken to secure the LAN/WAN?
28. What are the enhancements needed to the LAN/WAN?
29. When do you plan to make the enhancements if they are needed?
30. Do you have the resources to make the changes?
31. What are the measures taken to improve the quality of data communication?
32. What are the measures needed to improve the quality of data communication?
33. What is the level of quality needed in data communication?
34. Do you think you are making use of the appropriate technology? If so why?
35. How do you plan the workstation and server procurement? (When, qty, config)
36. How do plan the changes to LAN? (enhancements, new LAN, equipment, software etc)
37. How do you plan the changes to the data communication? (Internet, Leased lines etc)
38. How do you plan human resources to manage infrastructure?
39. What are the technology needs assessment methods used for changing infrastructure/ implementing new infrastructure?
40. What is the method used for infrastructure technology evaluation?

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# Appendix IV

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## People Interviewed

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# Abbreviations

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|      |                                     |
|------|-------------------------------------|
| ISDN | Integrated Services Digital Network |
| VPN  | Virtual Private Network             |
| SW   | Software                            |
| LAN  | Local Area Network                  |
| WAN  | Wide Area Network                   |
| DHCP | Dynamic Host Configuration Protocol |
| DNS  | Domain Name Server                  |
| ADSL | Asymmetric Digital Subscriber line  |



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