



ASSUMPTION UNIVERSITY

INFORMATION SYSTEM DISASTER RECOVERY

by

MR. THANARAK PHATHANATHAVORN

Final Report of the Three - Credits Course
CS 6008 System Development Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer Information Systems
Assumption University

May 1993

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The Graduate School of Computer Information Systems of Assumption University had approved this final report of the three-credit course, CS6998 System Development Project, as a partial fulfillment of the requirements for the degree of Master of Science in Computer Information Systems.

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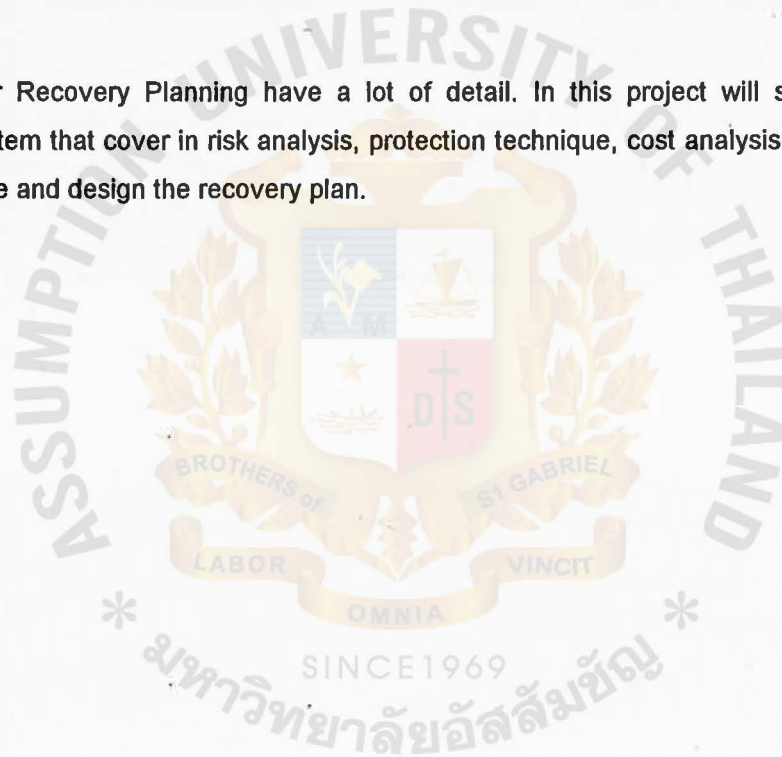
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ABSTRACT

Castrol(Thailand)Ltd. do business in lubricant in Thailand for more than 20 years. In the beginning Castrol get support of back office function support by Loxley, the share holder company. From 1987, Castrol setup their own Computer system. Up to now, the back office function as order processing, accounting, etc. process on the computer system.

Computer is company's back bone for the operation. Castrol's management team and the head office from UK. have seen the loss from disaster that may occurs to computer, then the MIS division have to established the project of disaster recovery. The level of protection and recovery will be on the proper situation with include the procedure to do when disaster occurs.

Disaster Recovery Planning have a lot of detail. In this project will specific in only Information System that cover in risk analysis, protection technique, cost analysis and select the proper technique and design the recovery plan.



ACKNOWLEDGMENT

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1. INTRODUCTION

1.1 Function of Castrol's Information Systems.

Castrol has been involved in the production of lubricant for more than 90 years. The company was established in England and brought to Thailand by Loxley(Bangkok). When the business became firmly rooted, Loxley(Bangkok) and Burma Castrol agreed to form Castrol(Thailand).

At first, the accounting and information systems were still operated by the mother company. In 1987, the computer team was organized to take charge of the information system which has to handle the growing business. The new team adopted Concurrent, the same system operated by Loxley.

In 1989, Castrol underwent a considerable change. The business has been expanded from Bangkok to upcountry. With the establishment of a depot in Chiangmai the existing system seemed unsuitable for the new environment. Therefore, in 1991 Castrol(thailand) has changed the computer system to IBM AS/400 and used the BPCS packages to handle the complexity of the expanded business. The company has introduced the on-line network to the warehouse and some depots. At present the system used is IBM AS/400 model D35 with 16 MB main memory and disk 3000 Mb for supporting the same business function with BPCS application. The company also plan to apply the computer system to manufacturing and on-line to all Depots in Thailand.

1.2 Project Description.

The Finance Department assigned this project to MIS division to analyze the disaster's impact and design the proper protection and recovery plan for Castrol.

1.3 Project Scope.

This project will in part of Information Systems function only. It is cover to the impact analysis, protection design, recovery design and propose to the management for future decision.

2. DISASTER BUSINESS IMPACT ANALYSIS

2.1 Disaster Impact Through Business.

In former times, the business Control handled was fairly uncomplicated. Since the company has greatly expanded, the computer technologies become more and more important to the success of the business.

In the past, business disasters did not cause great damage to the company. The organization of Control used to be simple, the number of transactions limited and responsibilities evenly distributed. With the introduction the computer system, the business functions have mostly been integrated and manned by the computer. If a disaster occurs to the computer system, the business may ground to a halt or face a shut-down. The reasons are as follows:

- Work load, transactions and complexity of jobs are much greater than in manual systems.
- The staff are too small to handle the whole business.
- Without the computerized operation order cannot be met.
- Familiar with the use of computer the staff may find it difficult to do without it.

2.2 The importance of Disaster Recovery.

In some cases, business disasters do not affect only the company in question. Their effects may also spread throughout the whole industry or even to the public if the operation of a major bank or the electricity authorities is abruptly interrupted. Thus, a disaster recovery plan becomes a necessity to some types of businesses because of the following reasons:⁽⁵⁾

- The smooth function of the business enables the owner to earn target income and generates reliable financial resources.
- A good disaster recovery plan can protect a company's reputation. Therefore, its clients become more trusted and loyal.
- Firms that have an internal audit department need disaster recovery planning.
- Business law in some countries requires that some businesses such as banking have disaster recovery plans.

2.3 Organization of the Company.

Before analyzing the impact of business disasters, the organization shown as below. Figure 2.1 shows how the board of directors is organized. Under the managing director there are six departments :-

1. Personnel department which is in charge of human resources and training.
2. Retail marketing department which is responsible for marketing and retail sales.
3. Commercial, Industrial and Marine marketing department which deals with corporate customers and shipping lines.
4. Technical department which takes care of customer service, laboratory, quality control, products development and testing.
5. Operation department which takes care of production, stock control and delivery.
6. Finance department which takes care of operating system, accounting control and financial supports.

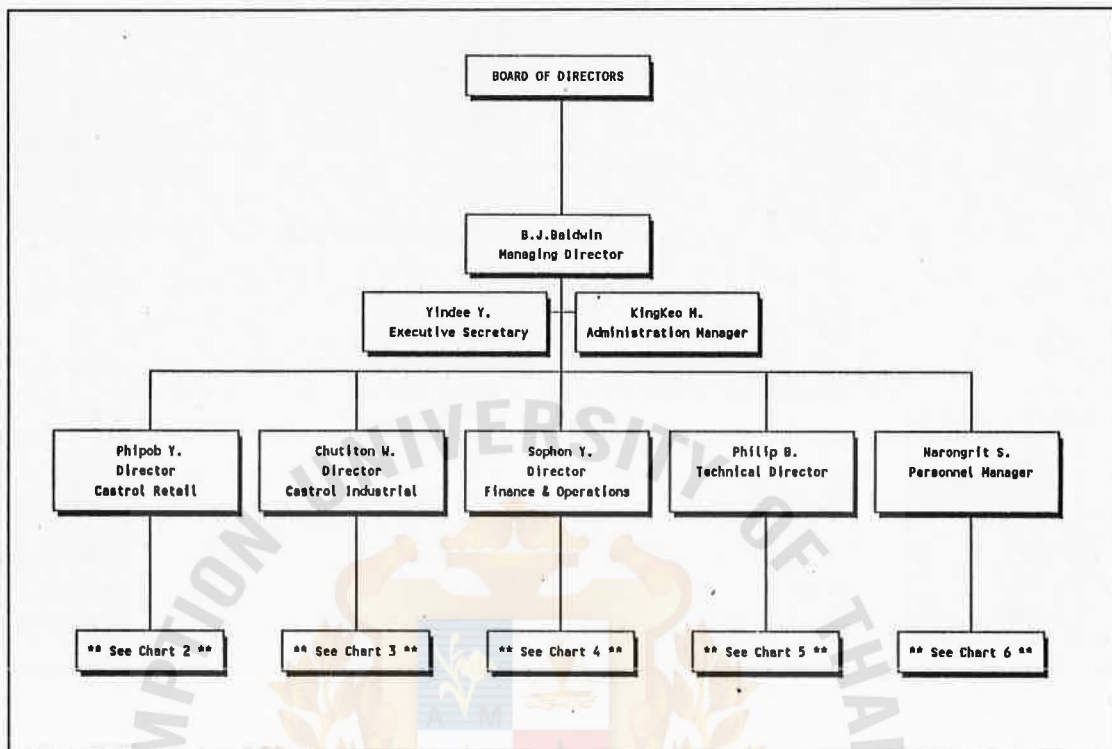


Figure 2.1 Castrol(Thailand)Limited's Organization Chart 1992

2.4 Impact Analysis.

For the analysis, I have conducted an interview with the department's head and made the questionnaire. The questionnaire, includes the following items:

- The direct effect to their departments in case of disaster to Information Systems function.
- The period that they can operate their duty without Information Systems support.
- The effect to the business in various times frames.
- The impact from their departments to the others.
- The impact from other department to their departments.
- The peak period for each department.
- Applications that they need for Information Systems support.
- Manual preparation.

The answer from questionnaires will be summarized as follows:

Impact.	Description of the impact to the company.
Peak time.	The busiest period of department operation.
Computer services.	The level of computer services required by department operation.
Spill-over.	The effect from department's function to other departments or outside.

2.5 Personnel Department.

The personnel department consists of 3 main functions: recruitment and payroll, training and health & safety.

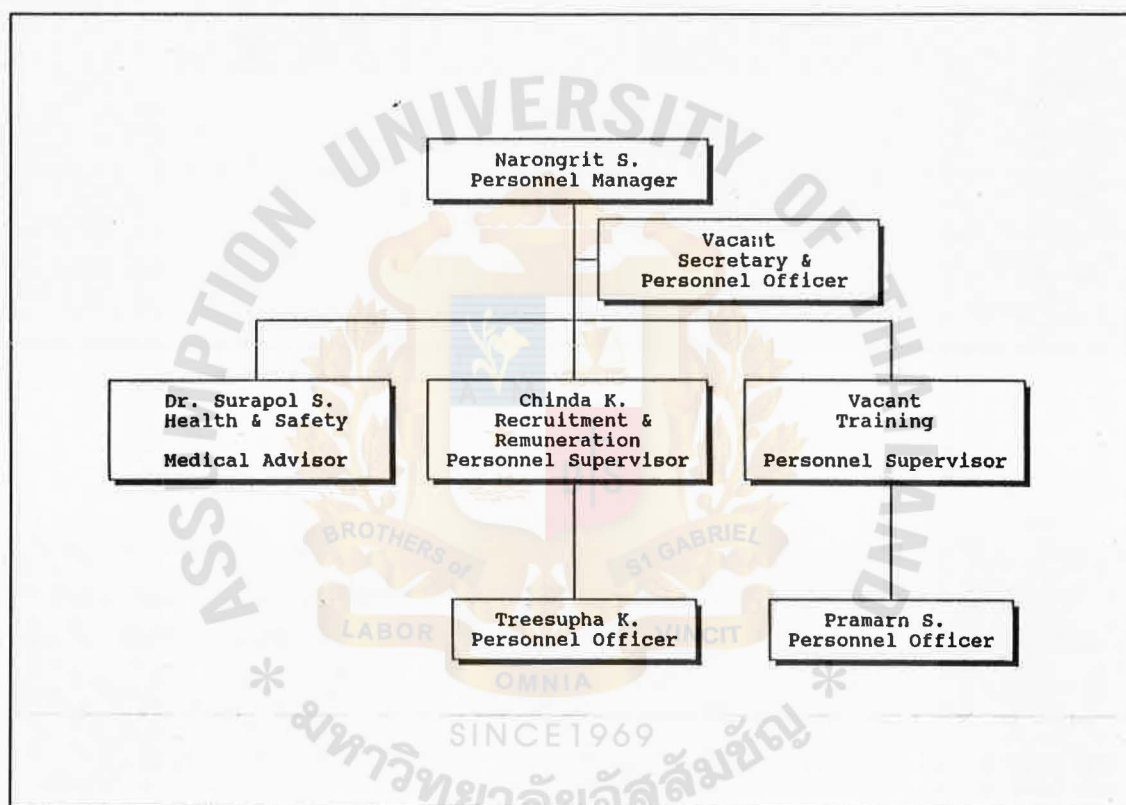


Figure 2.2 Personnel Department's Organization Chart 1992

Responsibilities:

to search and recruit human resources for each department.

to take care of payroll and employee's welfare and remuneration.

to set up the training program for personnel.

Computer Related works:

The main computer systems for personnel department are payroll and personnel systems. The systems are operated on PC because of security and distributed processing. Word processing, spread sheet, some presentation, and statistic analysis are also used. This department has 2 PC with DASD 80 Mb and one printer.

Backup systems:

The information on the payroll and personnel systems is processed every two week. The backup storage is kept at Thai Farmer Bank. For all of DASD they have totally backup to tape in mid of 1992.

Summary of The Personnel Department.

The Personnel Department takes care of 3 main functions as follows:

- to searching and recruit of human resources for each department.
- to take care of payroll and employee's welfare and remuneration.
- to set up the training program for personnel.

Since the company has 300 employees and pays twice a month, payroll becomes the most difficult task of this department. Calculation and pay scales make the payment procedure labor-intensive, if done manually.

Impact.

Without the payroll system, payment to employees may be late and have to change to monthly. That will affect the staff's morale.

Peak time.

On the 10 th and 25 th of every month for payroll process.

In December when bonuses are prepared and in January when salaries are adjusted.

Computer services.

Personal computer are used for processing.

Manual procedure requires more personnel.

Spill-over.

The effect from this department may occur to employees in other departments.

The Accounting department's process may be affected.

2.6 Consumer Marketing Department.

Consumer Marketing Department is the biggest source of the company income (around 70 % of the total). The major sales are motorcycle products especially 2 stroke. The organization are divided to Sales and Marketing. Sales constitute both franchised and non-franchised retailers in Bangkok and the provinces. The marketing division is divided into automotive market development, motorcycle market development, motor sport and Marketing service.

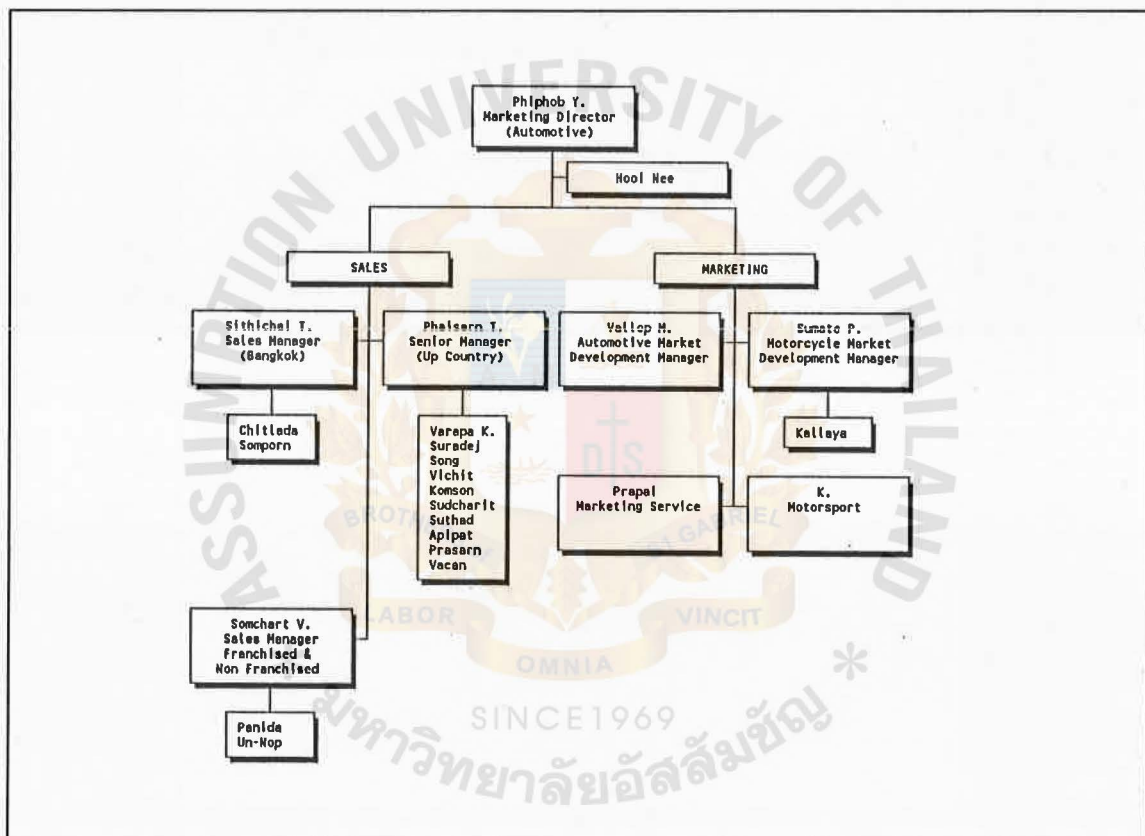


Figure 2.3 Consumer Marketing Department's Organization 1992

Summary of Consumer Marketing Department.

Consumer Marketing Department takes care of sales and marketing for franchised retailers and wholesalers. Faced with keen competitors, this department has to work hard to meet the company's target.

Impact.

Slow Invoice processing.

The company has to produce 300 invoices for the delivery order. It cannot be done by manual processing.

Lack of customer control.

With out computer system it is difficult to control customer credits and payment collections.

Lack of sales information.

The system collects sales information. This information constitutes our customers' record. The computer enable the company to have speedy storage and retrieval.

Effect to company sales volume and income.

The computer system facilitates delivery and increases sales volume.

Effect to company's image.

Efficient services are made possible by a computerized process.

Peak time.

At the end of every month.

Computer services.

This department uses computers only for information-retrieval. Order and invoice processing is handled by the finance department.

Spill-over.

Company's Customer.

Credit division.

2.7 CIM Department.

This department consists of Commercial market, Industrial market and Marine market. It is responsible for meeting the marketing target. To achieve the target, they must have the sales force, marketing support and information systems. The major customer of this department is the Industrial sector. In order to maintain and increase the market shares product and services must satisfy the customers. The product lines of this department are two-thirds of all the company product lines and the delivery process should require no more than 2 days. This department needs data processing and Information system. The purposes of using information systems are inventory and order status, sales analyst; sales target allocation and so on.

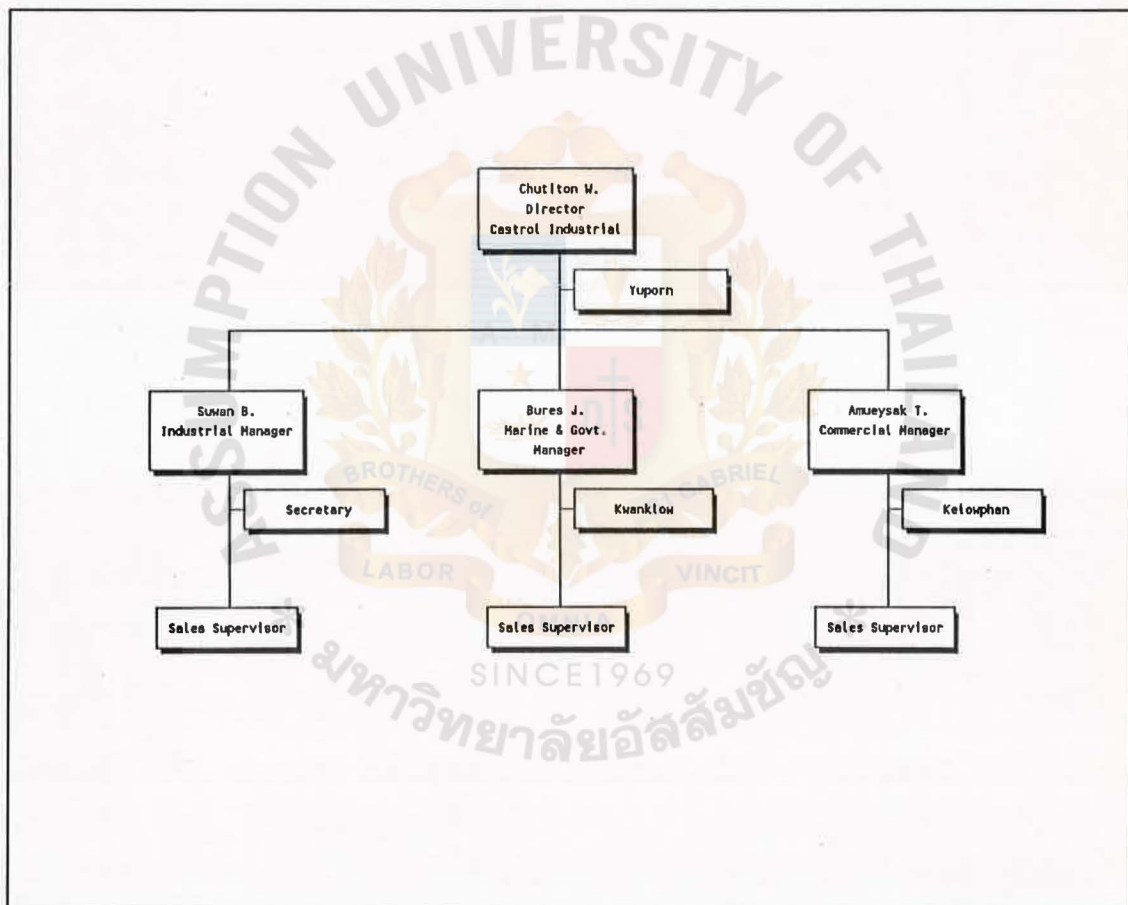


Figure 2.4 Commercial, Industrial and Marine Department's Organization Chart 1992

Summary of CIM Department.

CIM Department takes care of sales and marketing functions for Commercial, Industrial and Marine functions. The difficult for this department are accomplish the company's target with more and more competitor.

Impact.

Slow Invoice processing.

The company has to produce 300 invoices for the delivery order. It cannot be done by manual processing.

Lack of customer control.

With out computer system it is difficult to control customer credits and payment collections.

Lack of sales information.

The system collects sales information. This information constitutes our customers' record. The computer enable the company to have speedy storage and retrieval.

Effect to company sales volume and income.

The computer system facilitates delivery and increases sales volume.

Effect to company's image.

Efficient services are made possible by a computerized process.

Peak time.

At the end of every month.

Computer services.

This department uses computers only for information-retrieval. Order and invoice processing is handled by the finance department.

Spill-over.

Company's Customer.

Credit division.

2.8 Technical Department.

The Technical Department consists of 3 major divisions. The Technical support division takes care of providing the product technical information to sales and customers. The Laboratory division takes care of quality control, lab tests for customers and testing for new product specifications. The last is the Engine test division. This division will researches and test the new products, competitor products with the real engines.

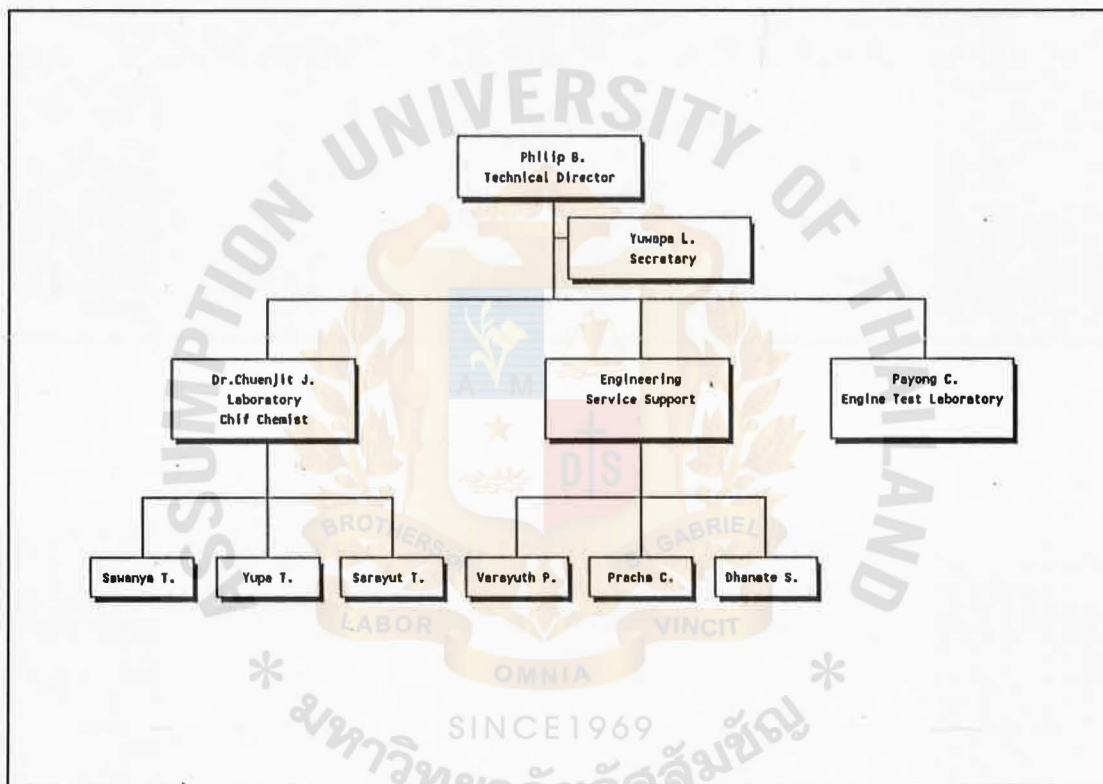


Figure 2.5 Technical Department's Organization Chart 1992

Summary of Technical Department.

Technical Department takes care of Lab (quality control), Customer support and the Engine test (R&D). The computer system uses PC connected with measuring instruments, it also edits measuring reports. In order to provide database to the marketing division, it manages the storage of information on rival products.

Impact.

Decrease of Lab analysis performance.

Difficulties in reporting.

Peak time.

No effect.

Computer services.

Minor.

Spill-over.

Production.

Customer.



2.9 Operation Department.

The Operation department consists of 5 major divisions. The Production division takes care of 250 finished products of 800 package sizes. Materials and packages have to meet the production target. The Distribution division delivers finished products to customers. The staff prepare delivery routes and vehicles. The warehouse division takes care of finished products in the warehouse. The inventory consists of 850 packages sizes, 2,500,000 liters of produce of which the value amounts value up to 100,000,000 baht. The Engineering division takes care of all machines and equipment. It co-operates with the production division, maintains product machinery and improves efficiency. The last is the Purchasing division. This division takes care of purchasing raw materials and some imported finished products.

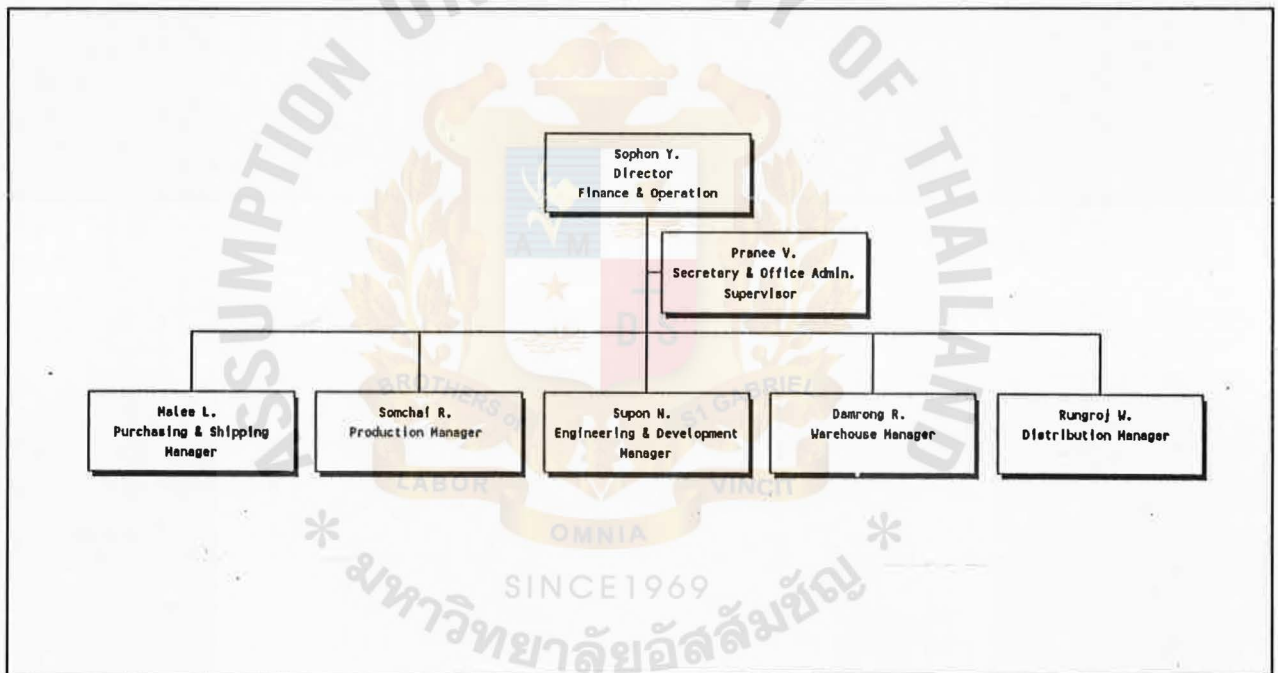


Figure 2.6 Operation Department's Organization Chart 1992

Summary of Operation Department.

The Operation Department takes care of Production function, Warehousing, Delivery and Engineering. The computer systems use are AS/400 and PC. They use computer for:

- Production Planning.
- Stock entry.
- Order Processing (part of invoicing).
- Distribution control.

Impact.

Decrease of Lab analysis performance.

Difficult in reporting.

Peak time.

Every Day, especially at the end of the month.

Computer services.

Inventory records for planning.

Invoice printing and deliveries confirmation.

Spill-over.

Customer.

Marketing.

2.10 Finance Department.

The Finance department consists of 4 divisions. They are the Credit Control Division, Accounting Division, Treasurer Division and MIS Division.

The Credit control Division takes care of order processing , customer credit control and collection. This division does major contact with sales and operations. Main task include opening new customer account, producing delivery orders, verifying customer credits, collecting payments, keeping track of bad debts and preparing the daily sales information for marketing and management.

The Accounting Division takes care of accounting procedure. It looks after the account receivable, the account payable, inventory, the company's fixed asset and the general ledger. More over, the information for financial reports is prepared.

The Treasurer Division takes care of the company's cash flow, cash deposit, voucher payment and currency exchange.

The MIS Division takes care of data processing and information systems. The staff develop a computer system to full fill each department's function.

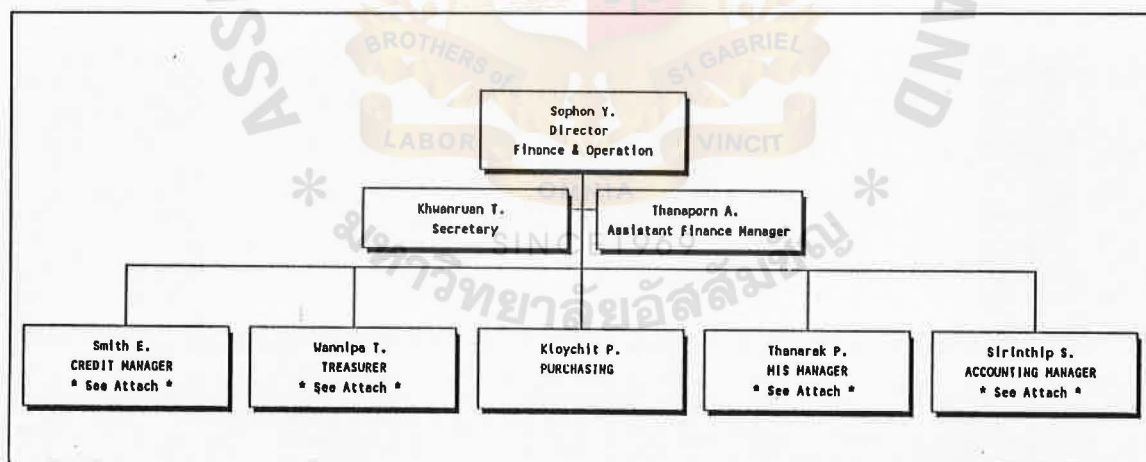


Figure 2.7. Finance Department's Organization Chart 1992

Summary of the Finance Department.

The Finance department is the company's house- keeping. It takes care of sales support function such as order processing, billing and payment collection. They take care of Accounting and Financial control. The computer is used in:

Order Processing

Billing

Credit Control

Collection Control

Account Receivable

Inventory Control

General Ledger

Fixed Asset

Value Added Tax

Impact.

Lower productivity.

Loss of revenue.

Loss of control.

Peak time.

The end of the month.

Computer services.

Major.

Spill-over.

Production.

Marketing.

2.11 Business impact summary.

The questionnaires can summarize the information mentioned above as follows:

Business Function	Loss Impact	Monthly Loss/ month	Manual Operation Cost/ month	Continue without Computer	Impact	Manual Procedure
Personnel	Productivity Employee Moral	20,000	32,000	2 Days	Medium	Not available
Retail	Revenue Market share Goodwill Loss Opportunity	30 - 70 M. Bath	NA	Operation Not directly with computer	Much	-
CIM	Revenue Market share Goodwill Loss Opportunity	10 - 30 M. Bath	NA	Operation Not directly with computer	Much	-
Technical	Productivity		10,000	No effect.	Less	Some.
Operation	Revenue Productivity	3.5 M. Bath	100,000	Stop Operation	Much	Not available
Finance	Productivity Regulation Revenue Goodwill	4.3 M Bath	180,000 240,000 Baht		Much	Some
Accounting	Productivity Regulation	1.8 M Baht	120,000 Baht	2 Weeks	Medium	Not completed
Credit	Goodwill Revenue Productivity	2.5 M Baht	50,000 100,000 Baht	8 Hours.	Much	Not Completed
Treasurer	Revenue Regulation Productivity		10,000 20,000 Baht	2 Weeks	Less	Available

Figure 2.8 Business impact summary table

Accounting

Application	Critical	Online/Batch	Transaction Rate/Month	Rank Order
Inventory	Y	O/B	20000-30000	1
Account Receivable	Y	O/B	3000-4000	1
Value Added Tax	N	O/B	6000-8000	2
General Ledger	N	O/B	10000	3
Fixed Asset	N	O/B	10	4

Figure 2.9 Accounting Application

Credit

Application	Critical	Online/Batch	Transaction Rate/Month	Rank Order
Order Processing	Y	O/B	3000	1
Credit Control	Y	O/B	3000	2
Collection & PDC	N	Batch	3000	3

Figure 2.10 Credit Application

Operation

Application	Critical	Online/Batch	Transaction Rate/Month	Rank Order
Billing Order/Invoice	Y	O/B	6000	1
Inventory	Y	O/B	200-300	1

Figure 2.11 Operation Application

Treasurer

Application	Critical	Online/Batch	Transaction Rate/Month	Rank Order
PDC	Y	O/B	400-500	2
Print Cheque	N	Batch	80-120	4

Figure 2.12 Treasurer Application

Personnel

Application	Critical	Online/Batch	Transaction Rate/Month	Rank Order
Payroll	Y	PC	700	1

Figure 2.13 Personnel Application

To be guide line, the operation priority is:

Application	Critical	Online/Batch	Rank Order
Order Processing	Y	Online	1
Inventory Control	Y	Online	1
Account Receivable	Y	Online	1
Invoice / Billing	Y	Online	1
Payroll	Y	PC	1
Value Added Tax	N	O/B	3
Fixed Asset	N	Batch	3
General Ledger	N	Batch	2
Collection and PDC	N	Online	2
Print Cheque	N	Batch	4

Figure 2.14 Priority List

Business impact summary.

Disaster may cause company to loss revenue up to 100 million / month, loss of revenue, market share, image, etc. The cost of manual operation may amount to 350,000 bath / month. Increasing manual operation cannot substitute for computer systems. In some operation cannot do without a computer.

3. BACKUP AND RECOVERY

3.1 Disaster Occurrence.

A disaster can be caused by accidents (fire), natural (flood, Storm) or Sabotage. The data stored in the information system can be classified into: (2)

3.1.1 Site Failure (Flood, tornado, fire, etc.).

The failure or loss of site is caused by fire, flood, explosions, or sabotage. For this type of disaster, a remote site must be prepared. The plan must includes backup tapes and critical supplies kept at a different location.

3.1.2 System Failure.

The system failure means the failure of the computer system itself caused by:

- Power failure with data loss. This causes the system to end abnormally. Normally, an initial program load (IPL) of the system can correct these errors.
- Disk failure with data loss. If the disk unit cannot recover, the source data must restore. The number of restoration depends on the effect to disk and the disk storage planning (ASP design).
- Non-disk failures. Most failures will not cause the system to end abnormally. If the hardware failure causes the system to end abnormally, the hardware must normally be repaired before the system can perform an IPL.

3.1.3 Object Failure

The most common type of failure is the loss of an object or a group of objects, such as files, libraries, or programs.

An object can be lost or damaged due to several factors, including equipment errors, programming errors, or operation errors. Any of these occurrences can cause program processing to end abnormally.

3.2 Backup and Recovery Strategy

Recovery technique uses to restore data in a system to a usable stage. Such techniques are widely used in filing systems and database systems to cope with failures. There are many kinds of failures and therefore many kinds of recovery. There is always a limit to the kind of recovery that can be provided. Before dealing with AS/400 backup and recovery technique, some AS/400 Overview should be considered..

3.3 AS/400 Overview.

AS/400 is one of the IBM mid range computer with high capability. AS/400 operates under OS/400, the IBM's operating system, that manage all the environment including database management. AS/400 can perform many intelligent functions. Some of these functions are Single level Storage and Storage management.

3.3.1 Single Level Storage.

The idea of single level storage is that, at a low level within the machine, a single virtual address space (virtual storage) exists. This storage is large enough to contain all data to store on the system. Functions operating above this low level can always see data which are stored in contiguously addressable locations in this space, no matter how the data may be stored - whether on auxiliary storage or on main storage.

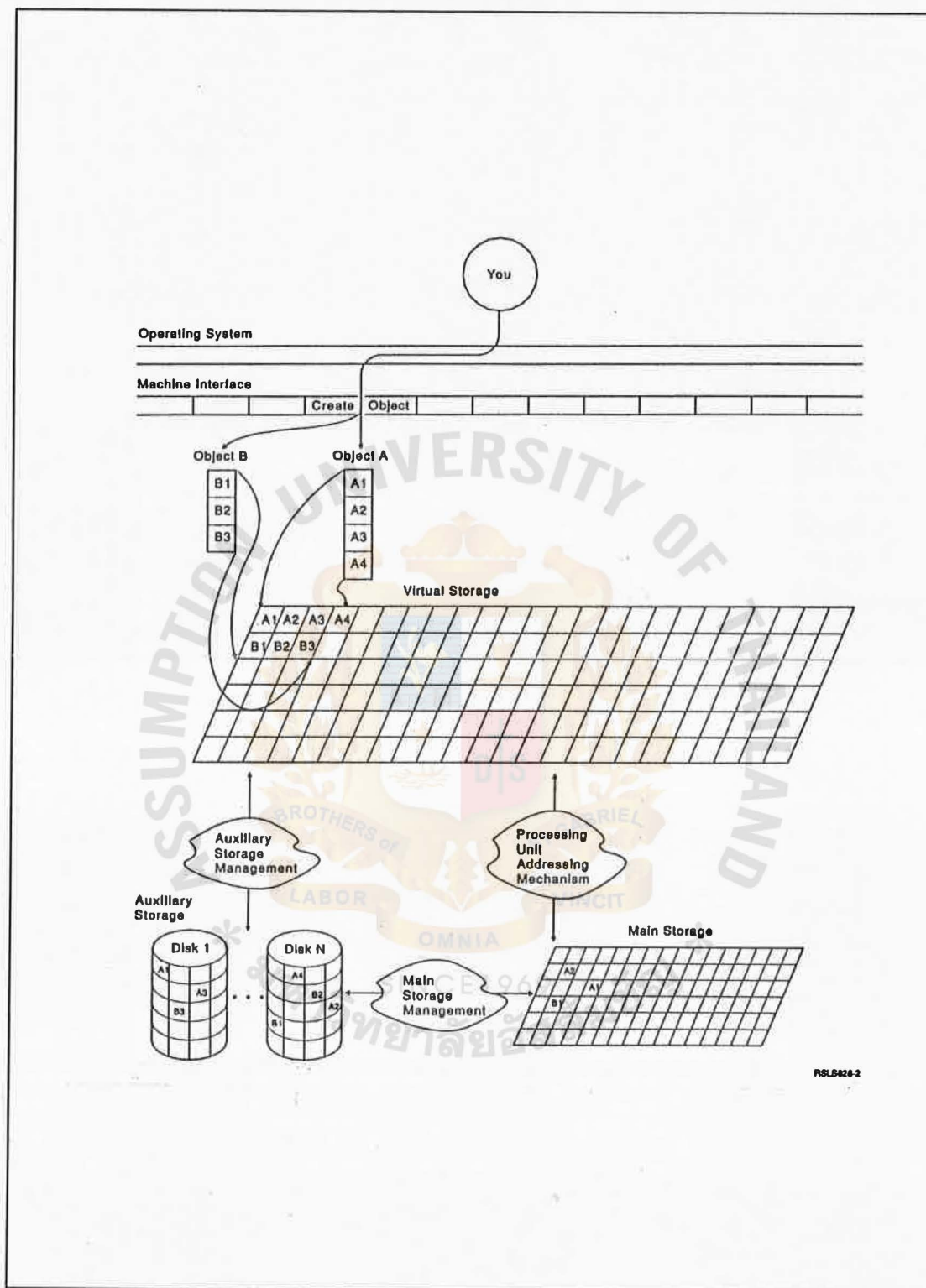


Figure 3.1. AS/400's Single Level Storage

The AS/400 machine interface (MI) instruction set provides an object-related interface. Spaces allocated for each object are connected in virtual storage. In reality, the data remain in auxiliary storage in disk extents that are not connected. Although program sees this data as being addressed directly in virtual storage, the data bring into main storage, when needed, for use by programs run by the processing unit.

The internal machine functions that support the virtual address space involve three primary parts:

Auxiliary storage management allocates and deallocates disk space for data placed in virtual storage.

Main storage management copies' data into main storage when it needs, and update before back to its permanent home on auxiliary storage.

Processing unit addressing automatically addresses the appropriate location in main storage when using virtual address.

3.3.2 Storage management.

Along with the study of single-level storage, it is important to understand how disk units are attached to the system before discussing the disk recovery tools.

Different models of disk units are attached to the AS/400 system. The storage areas within the disk units are referred to as storage units. The number of storage units and the storage capacity per storage unit varies by disk unit type and model.

Disks are assigned to an auxiliary storage pool (ASP) on a storage unit basis. The system treats each storage unit within a disk unit as a separate unit of auxiliary storage. When attach a new disk unit to the system, the system initially treats each storage unit within it as non configured storage units. Through dedicated service tool (DST) options the system can be allocated these storage units to either the system ASP or user ASP of our choosing. When allocating non-configured storage units, the serial number information assigned by the manufacturer must be used to ensure that are selecting the correct physical device. Additionally, we can identify the individual storage units within the disk unit through the Address field on the DST Display Disk Configuration.

When allocated a non-configured storage unit to an ASP, the system assigns a number to the storage unit. The storage unit number can be used instead of the serial number and address.

The two storage units (mirrored pair) assign to the same unit number when mirrored protection have set up. The serial number and the address distinguish the two units in a mirror pair.

To known which physical disk is being identified with each unit number. The unit number assignment is noted to ensure that correct identification is made. To verify the unit number assignment, the DST Display Configuration Status can used to show the serial numbers and address of each unit. The systems always use the storage unit addressed by the system as unit 1 be the system to store licensed internal code. The amount of storage used on unit 1 is quite large and varieties depend on the configuration of our system. It is also identified as the load source unit because unit 1 contains the initial programs and data used during IPL of the system,

3.4 AS/400 Backup and Recovery Technique.

The AS/400 system provides many backups and recovery options. Each option has benefits and complexity. To setup the strategy, let see some option.

3.4.1 Save and Restore Operations.

The save and restore operations provide a means to recover from a program or system failure; save the system storage; exchange information between systems; and store infrequently used objects off-line. Normally, objects are frequently saved and infrequently restored. The objects can store and restore by using diskette; magnetic tape; and a Save file.

The most important advantage of Backup and Restore is Transferable. The save and restore is the method of backup some or all data outside the computer systems. It means that the backup can be transferred to the other systems.

The limitation are:

1. Interruption. This backup process can function only when the object library is free from users, so when backup all user cannot use the systems.
2. Up to dated. Backup process may be proper only for some applications such as batch processing. In on-line processing, only backup process is not enough because the backup can keep data of the past period and cannot recover those of the present period when the system fails.

To do the Save and Restore Operations, there are some strategies to consider:

3.4.1.1. Complete System Save Strategy:

A complete system save strategy is one that ends up saving all possible data on the system over a set of period of time. A complete system save strategy may mean saving the entire system daily, or it may mean breaking the save up into parts, where some objects are only save weekly, monthly or more. There are several approaches can use:

1. Basic Strategy. There are two basic strategies to save all data on the system.

Save Storage (SAVSTG command) is the fastest way to backup the entire system.

Advantages:

1. Simple, only one command saves all.
2. Usually fast for small system.

Disadvantages:

1. Cannot restore individual objects.
2. Requires IPL after complete save
3. Requires dedicated system.

Save System/Non system (SAVSYS, SAVLIB & SAVDLO). In the large systems with large amounts of data; the first save strategic may not be adequate for their recovery requirements. The save system and non system is a method to save an individual object for matching the base starting point of use or recovery. The commands used include SAVSYS, SAVLIB LIB(*NONSYS) and SAVDLO.

Advantages:

1. Can restore an individual object.
2. Can provide flexibility for partial recovery.
3. Does not require for an IPL.

Disadvantages:

1. Requires a dedicated system.
2. Is slower than the save storage method.
3. Uses more commands than save storage.

2. Complex Approach. The complex complete system save method is very similar to the previous basic methods, except that it greatly lengthens the time between a complete save of the system and more frequent daily and weekly saves. On this method, the backup have separated the data in the storage in various parts and design the backup timing for each part in accordance with data change.

Advantage:

1. Requires medium to shorter backup time.
2. Saves less data and allows for unattended backup.
3. Does not require a daily and weekly save operations in a restricted system. It provides high flexibility.

Disadvantages:

1. Complex recovery procedures.
2. Extra planning required.
3. Multiple commands using.

3.4.1.2. Limited, Incomplete Save Strategy.

An incomplete system save strategy is one that periodically saves only user profiles and security objects. In the event the entire system must be restored, the IBM-supplied software have to installed again, just as if it were a new system. This save strategy is sufficient as long as recovery time is not an issue.

Advantage:

Fast, Shortest backup time.

Disadvantages:

1. Complex and long recovery procedures.
2. Requirement of complete manual recovery if the whole system is needed.
3. Limited individual object recovery.

Cost of Save and Restoration.

To evaluate the cost of save and restore operation the following data items have to be obtained.

1. Tape unit with adequate speed and capacity.
2. Additional disk units for on-line backup.
3. Operator time or overtime.
4. Programming effort to automate the save and restore processes.
5. Documentation of save and restore procedures.



3.4.2 Journal Management

Journal is one of AS/400 options to keep track with the information change. It identifies an activity for a specific record (added, changed or deleted) and for save operations for a file or file member. The journal management consists of 2 objects:

Journal receiver: Journal receiver is an object that contains written entries (call journal entries) that record changes to a file or access path.

Journal: Journal identifies the journal database files, the current journal receiver, and all journal receivers that are on the system for the journal. Only database files can be journaled.

The journal management is a way to recover database files. When a change is made to a journal file, the changes are first recorded in the journal receiver. If the system ends abnormally or the files become damaged before the actual change to the record, it has been saved in the journal receiver. If the database file is damaged, the file can be restore from the save media and then applied to the journal changed.

The benefit of Journal:

Reduces the frequency and amount of data saved when used in conjunction with user ASPs.

Limitations are:

1. Requires larger storage.
2. May affect performance due to increased I/O and processing unit activity.

Journal.

The Journal management consists of:

1. Journal receiver. Journal receiver is an object that contains the entries (called journal entries). These entries include:
 - The after image of each record changed.
 - Optionally, the before image of each record changed.
 - System-created entries.
 - Any user-created entries.
2. Journal. Journal is an object that identifies the protected files and access paths(key). The system also uses the journal to record information about the journal receivers and the database file.

When using journal management, the benefit can be:

1. Recover a file member from some form of damage to the member.
2. Recover access paths after an abnormal system ends.
3. Provide an audit trail of file or file member activity.
4. Analyze problems of testing tools.
5. Provide an activity trail.
6. Review the security plans for the files.

Performance and Space considerations.

To use journal management the fact should be considered that:

1. Space requirements increase if both before and after images are journaled, but the performance is minimally affected.
2. Space requirements increase if access paths are journaled. The actual increase is application dependent. The minimum increase occurs when the primary value of the access path are changed. Journaling access paths has minimal effect on performance. The system packages before and after record images and any access path changes into a single write operation to disk.
3. Space requirements also increase when the number of journal files and/or the number of the journal file access paths increases.

The size of journal receiver can be calculated by using the formula:

$$(78 \times \text{average record sizes}) \times (\text{number of transactions per day})$$

This formula is used for after image journal. To applied for the before image journal, the space must be increased. Whether it can do double record depends on type of operation. For example, the delete and update operation will do double record but create operation will not. Journaling access paths requires more auxiliary storage than Journaling physical files with after image only.

From the calculation, size of journal entries up to 10 Mb/ day. (See Appendix A)

3.4.3 Access Path Journal.

Access Path Journal is a powerful tool that prevents the rebuilding of lengthy access path during IPL (Initial Program Load). The Access Path Journal requires the underlying physical files that are already journaled.

The benefit for Access Path Journal:

1. Avoids rebuilding access paths after most abnormal system end.
2. Succeeds even if main storage cannot be copied to storage unit 1 of the system ASP during an abnormal system ends.
3. Generally faster and more dependable than using the manual option to rebuild access path on the data management utility commands.

Limitation.

Normally requires a significant increase in the storage requirements for journaling. The additional processing time is normally minor.

Performance considerations for commitment control.

Using commitment control requires resources that can affect system performance.

Several factors affect performance of commitment control:

1. **Journaling.** Journaling a file requires system resources. To specify only after images, commitment control changes this to both before and after images while commitment control is in effect. Usually this is a space, not performance, consideration.
2. **Journal entries caused by commit or rollback operation.** Each commits or rollbacks of a transaction write 2 entries to the journal whether or not the user has made changes to the database. The number of entries written can increase significantly for a large volume of small transactions.
3. **Rollback operation.** Since commitment control must rollback the pending changes recorded in the database, additional system resources are required whenever a rollback occurs.
4. **Start Commitment Control and End Commitment control commands.** Each time a commitment control environment is established by command, the system creates a commitment definition to save internal control information. The end commitment environment command will destroys the commitment definition. Therefore, avoid using this command for each transaction.
5. **Change the journal used for commitment control.** The same journal must be used for all files under commitment control. If all files under commitment control are closed, and a commit or rollback operation is performed, then file that are journaled to a different journal can be placed under commitment control without ending commitment control environment.
6. **Record locking.** Record locking can effect other applications. The number of records locked with a particular job increases the overall system resources used for the job. Additional applications that need to access to the same record must wait for the transaction to end.

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3.4.5 Auxiliary Storage Pools.

An Auxiliary Storage Pool (ASP) is a group of units defined from all the disk units that make up auxiliary storage. ASPs provide the means of isolating objects on a specific disk unit to prevent the loss of data caused by a failure on other disk units not included in the ASP.

All of AS/400 systems must have one ASP to be called system ASP(ASP 1). It contains the licensed internal code, licensed programs, and system libraries. The system ASP also contains all other configured disk units that are not assigned to a user ASP.

A user ASP is created by grouping together a physical set of disk units and assigning them a number 2 through 16. User ASPs can be used to isolate libraries and objects within these libraries from the system ASP. If a library exists in a user ASP, all objects in the library must be in the same ASP as their library.

The benefits of Auxiliary Storage Pools:

1. Reduces amount of data loss if a disk unit failure occurs.
2. Libraries can be placed in user ASPs. This allows for separation of critical or highly used objects.
3. Improves performance. To do extensive journaling, a journal receiver can be placed in a user ASP that can be used exclusively for journaling.
4. Can significantly reduce the number of transactions lost since the last save of the system. ASP allows us to separate our files and journals' receivers in another user ASP, reducing the changes that both will lose.

Limitations.

1. System cannot directly recover lost data from a disk unit media failure, required operations by user to recover.
2. Libraries or objects must be placed in a user ASP with a parameter on the create and restore command.
3. Can require additional disk devices.
4. System must clean system ASP during the initial configuration unless the new disk devices are installed.

3.4.6 Checksum Protection.

Checksum protection is a function that protects data stored in an auxiliary storage pool from being lost because of damage or a disk unit media failure. When checksum protection is in effect and a disk unit media failure occurs on a protection unit, the system automatically reconstructs the data after the disk unit is repaired.

The benefits of Checksum protection are:

1. Loss data is automatically reconstructed after disk unit device media failure in the system ASP.
2. It reduces the number of objects that are damaged.

Limitation:

1. Requires additional processing unit resources.
2. Requires additional main storage.
3. Can require additional disk device to prevent slower performance

3.4.7 Mirrored Protection.

Mirrored protection is a function that increases the availability of the AS/400 system in the event of a failure of a disk-related hardware component. It can be used on any model of the AS/400 system and is a part of licensed internal code. Different levels of mirrored protection are possible, depending on what hardware is duplicated.

The advantages for Mirrored Protection are :

1. Fully backup the programs and data up to date.
2. Ensure that system still operates in case of disk crashes.
3. The performance may increase in case of information retrieval, because all disks will help each other to retrieve the data.

The disadvantages are :

1. Double disk storage must be used for mirroring. This involves a costly process.
2. In case of Controller failure or CPU failure, the disk mirroring cannot supported.

3.4.8 Uninterruptible Power Supply.

The Uninterruptible power supply provides auxiliar operating system, accounting control nit, and as many other devices on the system as possible. With the AS/400 system, the Uninterruptible power supply provides the system with the ability to :

1. Continue operations during brief power interruptions.
2. Provide normal ending of operations so that the next time the system performs an IPL, there is minimal recovery time.

The advantages for Uninterruptible Power Supply are :

1. Ensure that systems and terminals can be operated when the power failure occurs.
2. Reduce the recovery time in the event of blackout.
3. The backup time can be controlled by increasing the battery.

The disadvantage is :

The costs of the Uninterruptible power supply are quite still quite high.

3.4.9 Battery Power Unit for the 9402, 9404, and 9406 Model D up.

A battery power unit exists as an option feature for the 9402 and 9404 system units(the AS/400 low end Model) and as a standard feature for the 9406 system units (the AS/400 high end). The battery will supports the system unit and all disk units in the system unit for a minimum of five minutes.

The advantages for Battery Power Unit are :

1. It reduces the recovery time when the power is cut.
2. The cost is not high when compared with the UPS and it comes with the feature for the AS/400 high end model.

The disadvantages are:

1. It can backup only CPU and disk in the system unit only. If the power failure occurs and do not have the UPS for terminal, the CPU will finally be interrupted.
2. In case of application still running, it may cause the abnormal end and get an incorrect result.

3.4.10 Dual Systems.

A dual system approach can be used to record changes on a secondary system as they occur on the primary system, so that the secondary system can take over critical application programs if the primary system fails.

The advantages for dual systems are:

1. Totally backup both CPU and storage.
2. Ensure that the systems are available all times.

The disadvantages are :

1. The cost will doubly increase.
2. To be ensure backup, the site should be separated. So the cost will extremely high because of site preparation and information updating.

3.4.11 Backup site.

In case of site failure and total of Information Systems are destroyed, the backup site is the solution. Normally when this case occurs, the business function must use a manual process until the comparable machine can be installed to replace the lost one. When the new machine is installed, DP staff will load the software and data backup and users will frantically input interim data until files and records are up to date. The drawbacks of this procedure are numerous. First, the plan can work only in an environment where critical systems are not needed. Certainly, very few companies which use computer systems will find their automated systems so easily replaced with manual. Second, this option does not provide, in advance, for a facilities in which the new machine can be installed. Locating a suitable facilities may not be a very difficult task, but the preparation of such facilities, including the installation of the raised floor, air conditioning, UPS, electrical wiring, communication line or fire protection, will be a major undertaking. In short, the backup site can be found one but may not afford the facilities cost. To preparation can be planned for backup site by : (4)

3.4.11.1 Cold site.

The cold site or shell site is the backup site which have already prepared the facilities with the requisite physical capabilities to serve as an alternate data processing site except the CPU.

High cost of security and protective systems is a drawback. However, the facilities may be used for other purposes, including off-site storage or new employee training when they are not used for disaster recovery.

3.4.11.2 Commercial Cold Site.

This option is identical to the cold site except that a commercial cold site is a leased facilities. For this approach, it assumes that the company can absorb the impact of being without computer until the new one installed. Many companies cannot accept this option. As with any cold site option, there is no way to test the effectiveness of this recovery option until a disaster actually occurs.

3.4.11.3 Reciprocal Backup Agreement.

Using a cold site or commercial cold site, must wait for the new CPU. That means the company must do manual processing no less than 2 weeks. The reciprocal backup agreement is the method of backup the computer system and facilities between two organizations. These two organizations must have similar computer configuration with spare processing time and storage in event of serving the other organization's tasks. The benefit of this strategy is having the backup site which can operate during a short stoppage.

The problems with this strategy, even at the time that it was popular, are two folded. First, it is extremely difficult for a company to find a partner who has the right hardware, spare capacity, and the inclination to participate in such an agreement. Location is also a factor. The potential partner cannot locate near the company seeking the arrangement, since the disaster affects both companies.

Second, if a suitable partner is found, it will be difficult to find a mutually agreeable time to test the arrangement. An untested strategy is nearly as bad as having no strategy at all. It is also difficult to maintain the relationship on mutually acceptable terms. These arrangement also carry the risk of domino typed disasters. The relocation of the first organized processing capability might also disrupt the second organized operations. The second site will need to activate its emergency service levles, requiring that its business operate in disaster recovery mode until the first is recovered.

Today, these arrangements are rarely seen, except perhaps in large companies with numerous subsidiaries. Even in these cases, it is rare that enough spare processing time or equipment capabbility exists to support a mutual backup arrangement.

3.4.11.4 Service Bureau.

In the convention of reciprocal backup agreement, each organization are no experience in this business. Therefore, some software vendors providing service bureaus typically market the service to customers who prefer not to invest in their own computer systems and software. For a service bureau arrangement to be effective, several items where user terminals and printers can be set up. Second, the customer's data backups must have been saved from the disaster that destroyed the originals, and these data backup must be in the proper format for speedy integration with the service bureau database.

3.4.11.5 Hot Site.

Hot site is rather like generic service bureau. Typically, it has ready and fully equipped data processing facilities to which a number of companies having compatible hardware subscribe. Machine time is made available to subscribers for the purpose of testing their recovery procedures, and this testing schedule can be quickly interrupted so facilities can be made available to any customer who declares a disaster. Unlike a service bureaus, a hot site is usually equipped to run any application that is compatible with its hardware and operating system. Hot sites are often equipped with technical support personnel to assist the company operations team in their efforts to restore the system.

3.4.11.6 Redundant Systems.

Redundant systems are the single most reliable system backup strategy. Most companies cannot afford the cost of building and equipping two identical data centers. Those that can enjoy the comfort will have full confidence in their ability to recover from almost any disaster.

In the event of a disaster, redundant systems with separate facilities far enough so as not to have been affected by the same disaster are brought on line. Nevertheless, being the most reliable method of system backup, redundancy is also the most expensive.



4. DESIGN OF DISASTER RECOVERY PLANNING

4.1 Disaster Recovery Strategy.

Before designing the disaster recovery, must have the major goals. The goals of this are:

1. To minimize interruptions of the normal operations.
2. To limit the extent of disruption and damage.
3. To provide smooth degradation.
4. To minimize the economic impact of the interruption.
5. To establish alternative means of operation in advance.
6. To train personnel with emergency procedures.
7. To provide the smooth and rapid restoration of service.

To plan disaster recovery, have to design for each step on :

1. Design on hardware configuration.
2. Design on computer environment.
3. Backup site consideration.
4. Backup procedure.
5. Recovery Procedure.

4.2 Design Hardware Configuration.

In a computer system, the most valuable item in the system is not hardware but the data in the storage. Therefore, the critical area to consider are DASD. The configuration on the system shows 7 units of DASD. The system have disk model 2800, 4 units of 320 Mb and model 9332, 3 units of 600 Mb. To design hardware configuration should consider on :

4.2.1. Design Auxiliary Storage Pools.

To minimize the recovery from disk failure, the ASP should be separated into several units.⁽³⁾

1. System ASP #1 consists of OS, system software, utility, compiler, work area and system configuration. The information in this ASP have a little change except the work area. The space required is 200-300 Mb. The one of 2800 320 Mb. model can be allocated for this ASP.
2. User ASP #2 consists of application program, executable object and source code. In this ASP for a stable application, the information will have few changes. The space required for this ASP is around 600-900 Mb. Two of 9332 model must be allocated.
3. User ASP #3 consists of application data. In this ASP the information is allways update. The space required for this ASP is around 400-600 Mb. Two of 2800 model or one of 9332 model must be allocated.
4. User ASP #4. For Journal management information and backup disk. The space required for journal is equal to 10 Mb. per day and backup 270 Mb. The last of 9332, 600 Mb disk unit have to arranged for this ASP.

4.2.2. Mirroring design.⁽⁴⁾

To mirror the whole system the storage size have to be double. This proves costly. The area considered are ASP 1 (system ASP) and ASP 3 (application data). For the best avaiiable protection, it is recommended that no user ASPs be used and the system ASP be mirrored. So, the 2800 model is used for mirroring the system ASP.

4.2.3. Checksum protection design.⁽⁴⁾

The checksum probably works best if an update storage remains small. It may consume 20 % of the storage. This area in the other ASP must be allocated. The proper ASP to checksum is ASP 2 (application program) and the checksum size is around 80-120 Mb.

4.2.4. Journal management design.

To keep track of data change on daily operation, journal should apply to the files in application systems. The size of journal is around 10 Mb./day.

From the calculation, the system will have:

1. A storage separated into 4 ASP in order to:
 - Reduce the risk of disk failure that will totally affect the system.
 - Separate System, Application program and Application data from one another so as to easily control the backup and monitor with data growth.
 - Have the Journal ASP located in a temporary area in case of another ASP is overflow.
2. Mirror will be assigned only to the system ASP.

The mirror for system ASP only will reduce cost of total mirror to the system.

In system ASP, there are all system files and system configuration. If this unit fails, the information in another ASP will be difficult to recover although the checksum or separate is applied it from another ASP.

The size of system files is limited. It may not have to double the storage in case of full system storage .

3. Application Program will be protected by frequent backup.

The checksum protection is quite a good strategic for protection but the bigger the information space, the more the storage size has to be expanded.

The backup of application program is feasible if the number of application changes is small.

4. Application Data will be protected by Journal management.

Since data are the most valuable item in the system, journal is use to recover the loss of information belonging to the period before a disaster occurs.

The cost of journal management is much cheaper than mirror protection. Therefore, journal is more acceptable to all businesses that do not work at peak time.

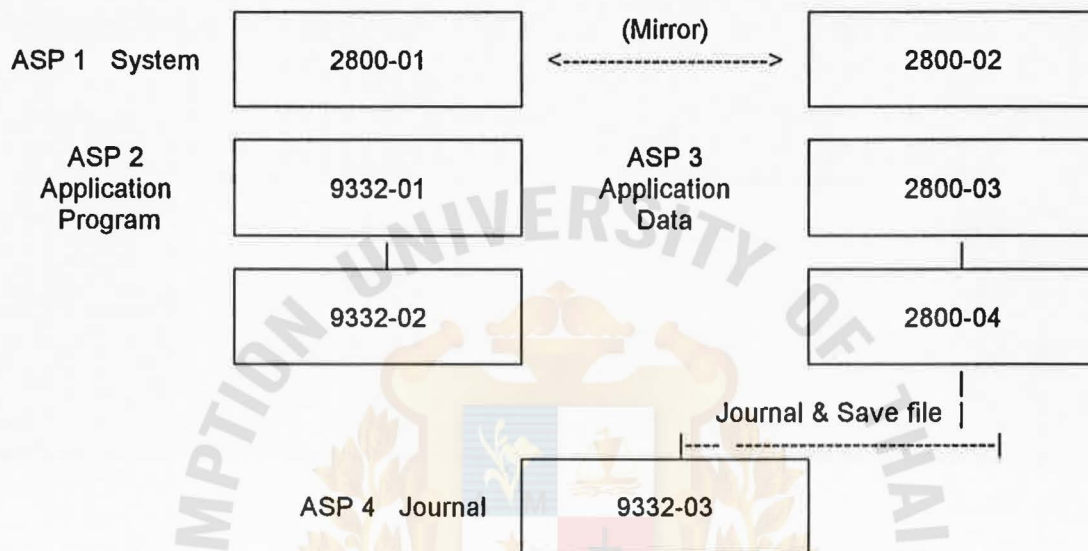


Figure 4.1 Design Disk's configuration.

4.3 Design of Computer Environment.

Regarding the computer environment it should consider about:

1. Computer room location. The computer room should be located on the secure place. It should be safe from flood, collision, etc.
2. Power supply system. The uninterruptible power supply should be installed with grounding system. The power consumption of the computer is around 3 KVA (by measurement). So the size of UPS should not less than 3 KVA with can absorb the over load on the system startup for 300 %. The size of battery should consider for backup time. For our selection, the 10 KVA of UPS with 20 min. backup in full load was chosen. The reason are that the 10 KVA of UPS can handle the system even in the future if the bigger system is selected. The number of minute backup we can use a small number but for this system we can backup more longer than 30 min. and the more KVA the less price (baht / KVA).
3. Cooling system. The air conditioning should also have backup. The design to have centralized air condition and separate air condition system.
4. Fire protection system. The Halon 1301 for fire protection have been setup in computer room.

4.4 Backup Site Consideration.

It is fortunate that IBM started the service of the HOT SITE backup for the AS/400 in 1992. They provide the bigger hardware configurations than our unit and all facilities provided.

4.5 Backup Procedure.

The backup will be separated into 5 types.

1. Data file and journal
2. Application Program (modify)
3. Application Package
4. Security Data
5. AS/400 System

The time frame for backup are:

1. Daily backup for data file and journal.

Automatic of daily backup of data file take place every day when IPL the computer system start. The process command are:

```
SAVLIB LIB(BPCSFV20) DEV(*SAVF) SAVF(SAVFLIB/BPCSFSAVF)
SAVLIB LIB(BPCSFMOD) DEV(*SAVF) SAVF(SAVFLIB/MODFSAVF)
```

After the IPL, the operator must copy the backup file

```
SAVSAVFDTA SAVF(SAVFLIB/BPCSFSAVF) DEV(TAP01) ENDOPT(*LEAVE)
SAVSAVFDTA SAVF(SAVFLIB/MODFSAVF) DEV(TAP01) ENDOPT(*LEAVE)
```

2. Monthly backup for data file and journal.

Monthly backup for data file take place before the end of the month.

```
SAVLIB LIB(BPCSFV20 BPCSFMOD) DEV(TAP01) ENDOPT(*LEAVE)
```

3. Bi-weekly backup for Application program (modify) and security data.

Bi-weekly backup for Application program (modify) and Security data is:

```
SAVLIB LIB(BPCSMODV20 ASSETLIB MODLIB) DEV(TAP01) ENDOPT(*LEAVE)
SAVSECDTA DEV(TAP01)
```

4. Half yearly backup for Application package.

Half yearly Backup for Application Package is:

SAVLIB LIB(BPCSSV20 BPCSOV20 BPCSPTFV20) DEV(TAP01)
ENDOPT(*LEAVE)

Note. The package are not changed but the backup should do in order to refresh the data in tape.

System backup.

1. The system backup should save at the company.
2. Total system should backup when:

Upgrade new release.

Have change the PTF (Program Temporal Fixed).

The backup command is:

SAVSYS

SAVLIB(*NONSYS)

The tape for backup must be separated into several versions:

- 5 versions for daily backup from Monday to Friday (Circulation).
- 2 versions for Bi-weekly backup of Application program (modify) & Security data.
- 1 version for Monthly backup of month end (keep permanent for 1 Year).
- 1 version for SAVSYS tape.
- 1 version for SAVLIB(*NONSYS) tape.

4.6 Restoration Procedure.

In case of disaster, the restoration procedure involving the backup data must be:

1. Load the license and internal code (by IBM or SE).

2. IPL the system and signon with

User : QSECOFR

Password : QSECOFR

at console.

3. Change message queue of the QSECOFR to be BREAK mode.

4. Send command to end all subsystem.

5. Restore system and system configuration in case of System ASP crash.

6. Restore user profiles from tape "SECURITY DATA" on Application Program (modify).

7. Restore the following object and data:

- Application Package from tape Half Year Backup. (Only object and PTF)
- Application Program (modify) from Bi-week Backup.
- Data file and Journal from tape Daily Backup.

8. Apply the roll forward journal to the backup data.

9. After completing the above process, it can start all subsystem.

4.7 Cash flow analysis.

It can classify losses in the following manners:

Tangible Loss.

Loss in incurred by 1-3 days stoppage	440,000 for employee salary/ 3 days.
A week-longed stoppage	740,000 for employee salary/ week.
	25,000,000 for revenue per week.
	(based on the turnover of 100 m/month)

Intangible Loss.

loss of control on respecting customer Credits, respecting payment collection, Inventory and Account Receivable.

Difficulties in preparing invoices and receipts.

Marketing department cannot get sales information.

Delay on transmit the document from office to warehouse that will structen to the distribution's operation.

In medium term, it may loss of market share for customer account that require services.

The Protection and Recovery Consideration.

Estimating the protection and recovery costs by using the following methods:

Basic Backup.

Investment.

No extra Investment required.

Risk of loss.

In case of disk crash downtime will be 1-2 days

Employee's salary 300,000

Site loss the new machine can arrived in 14 days

Loss of revenue 30-50 million.

Employee's salary 1.2 million.

New hardware cost 7.64 million.

Dual systems.

Investment.

Hardware as computer system.	6,000,000
------------------------------	-----------

Environment. Floor spaces (12 sqr Meter)	240,000
--	---------

Interior	100,000
----------	---------

Air condition	100,000
---------------	---------

Fire Protection system	300,000
------------------------	---------

Communication Backup	300,000
----------------------	---------

Operation cost.

Maintenance 8%	480,000 /Yr.
----------------	--------------

Operator	120,000 /Yr.
----------	--------------

Benefit from dual systems.

Down time will less than 1 hr. in worse case.

Full Mirror protection.

Investment

Hardware as increase DASD	3,600,000
---------------------------	-----------

Operation. Maintenance 8%	288,000
---------------------------	---------

Double cost increasing for future storage expansion.

Benefit from full mirror protection.

Reduce down time from disaster to DASD. The recovery time will be in seconds.

Note.

This method will not protect form other hardware failure and site loss.

The mixed method.

Investment.

Hardware as increase DASD 1200 MB in 3 th and 4 th year.	1,200,000
--	-----------

Operation cost.

Backup site.	72,000 /Yr.
--------------	-------------

Maintenance 8%	96,000 /Yr.
----------------	-------------

Benefit from the mixed method.

Ensure that in worse case the system can be recovered in 8 hours.

It can analysis in term of cash flow in each model. The 'One time investment' are hardware, spaces, decorate, air and UPS. The 'Operation Cost' are maintenance (8%), operator's salary, backup site fee. The tax relief 30% can be used for hardware investment. The loss from disaster can be:

- Assume site loss can be occurred once in 20 years. The new machine will arriving in 2 weeks. The loss up to 100 million baht per month. The loss will pre-distribute in yearly with 10 % add up.
- Assume hardware break down can be once in 5 years for each device. Total disk are 6 units. The recovery time may be 3 days. The approximate loss is 440,000 baht.

PROJECT CASH FLOWS – INCREMENTAL

Local Currency : BAHT'000

CASTROL (THAILAND) LIMITED.

PROJECT Basic Backup + BACKUP SITE

		0	1	2	3	4	5	6	7	8	9	10
YEAR		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CAPITAL FLOWS	HARDWARE											0
	SPACE											
	DECORATE											
	ELETRIC/AIR/UPS											
	COMM											
	MAITAINANCE											
	OPERATOR		-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
	LOSS		-528	-581	-639	-703	-773	-850	-935	-1029	-1132	-1245
	TAX RELIEF ON ALLOWANCE		0	0	0	0	0					
	NET CAPITAL FLOWS	0	-600	-653	-711	-775	-845	-922	-1007	-1101	-1204	-1317
	AFTER ALLOWANCE											

TOTAL PROJECT CASH FLOWS	0	-600	-653	-711	-775	-845	-922	-1007	-1101	-1204	-1317
NPV OF CASH FLOWS @ 15% DIVISIONAL DISC. RATE	-4151										

CAPITAL ALLOWANCES			0	0	0	0	0				
--------------------	--	--	---	---	---	---	---	--	--	--	--

FIGURE 4.2 BASIC BACKUP ANALYSIS

PROJECT CASH FLOWS – INCREMENTAL

Local Currency : BAHT'000

CASTROL (THAILAND) LIMITED.

PROJEC DUAL SYSTEM

	YEAR	0	1	2	3	4	5	6	7	8	9	10
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CAPITAL FLOWS	HARDWARE	-6000										
	SPACE	-240										
	DECORATE	-100										
	ELETRIC/AIR/UPS	-1000										
	COMM	-300										
	MAITAINANCE		-480	-480	-480	-480	-480	-480	-480	-480	-480	-480
	OPERATION		-120	-120	-120	-120	-120	-120	-120	-120	-120	-120
	LOSS											
	TAX RELIEF ON ALLOWANCE		458	458	458	458	458					
	NET CAPITAL FLOWS	-7640	-142	-142	-142	-142	-142	-600	-600	-600	-600	-600
	AFTER ALLOWANCE											
TOTAL PROJECT CASH FLOWS		-7640	-142	-142	-142	-142	-142	-600	-600	-600	-600	-600
NPV OF CASH FLOWS												
@ 15% DIVISIONAL DISC. RATE		-9116										
CAPITAL ALLOWANCES			-1528	-1528	-1528	-1528	-1528					

FIGURE 4.3 DUAL SYSTEM ANALYSIS

PROJECT CASH FLOWS – INCREMENTAL

Local Currency : BAHT'000

CASTROL (THAILAND) LIMITED.

PROJEC FULL MIRROR SYSTEM

09

		0	1	2	3	4	5	6	7	8	9	10
YEAR		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CAPITAL FLOWS	HARDWARE	-3600										0
	SPACE											
	DECORATE											
	ELECTRIC/AIR/UPS											
	COMM											
	MAINTENANCE		-288	-288	-288	-288	-288	-288	-288	-288	-288	-288
	OPERATION		-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
	LOSS		-8	-8	-9	-10	-11	-12	-13	-14	-15	-17
	TAX RELIEF ON ALLOWANCE		216	216	216	216	216					
	NET CAPITAL FLOWS	-3600	-152	-152	-153	-154	-155	-372	-373	-374	-375	-377
	AFTER ALLOWANCE											
TOTAL PROJECT CASH FLOWS		-3600	-152	-152	-153	-154	-155	-372	-373	-374	-375	-377
NPV OF CASH FLOWS												
@ 15% DIVISIONAL DISC. RATE		-4735										
CAPITAL ALLOWANCES			-720	-720	-720	-720	-720					

FIGURE 4.4 FULL MIRROR SYSTEM ANALYSIS

PROJECT CASH FLOWS – INCREMENTAL

Local Currency : BAHT'000

CASTROL (THAILAND) LIMITED.

PROJEC MIXED APPROACH

		0	1	2	3	4	5	6	7	8	9	10
YEAR		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CAPITAL FLOWS	HARDWARE				-600	-600						
	SPACE											
	DECORATE											
	ELETRIC/AIR/UPS											
	COMM											
	MAITAINANCE					-48	-96	-96	-96	-96	-96	-96
	OPERATION		-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
	LOSS		-235	-258	-284	-312	-344	-378	-416	-457	-503	-553
	TAX RELIEF ON ALLOWANCE		0	0	36	72	72	72	72	0		
	NET CAPITAL FLOWS	0	-307	-330	-920	-960	-440	-474	-512	-625	-671	-721
	AFTER ALLOWANCE											
TOTAL PROJECT CASH FLOWS		0	-307	-330	-920	-960	-440	-474	-512	-625	-671	-721
NPV OF CASH FLOWS												
@ 15% DIVISIONAL DISC. RATE		-2860										
CAPITAL ALLOWANCES				0	-120	-240	-240	-240	-240	-120		

FIGURE 4.5 MIXED APPROACH ANALYSIS

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

Conclusion

This project has been made as a proposal to the management of Castrol(Thailand). At this moment, this project has already been partially implemented. The implemented processes are:

Backup Procedure process.

Backup Site service from IBM.

Recovery Procedure.

The reasons that the project has not been fully executed are:

1. The MIS division have not enough human resource. There are a lot of more urgent development projects that required the staff's attention.
2. Reconfiguration of the storage is time consuming. To accomplish the whole project, the computer division has to allocate at least 3 days downtime.
3. The reconfiguration may affect the utilization of storage space. During the development period, it must more reserved space for testing that requires a considerable storage size.
4. The BPCS packages are not design for journal management. The MIS team have to test and modify the entire packages. This involves more extra effort.

Recommendation

The major loss from disaster will occur after the system stopped for a week. The best way is to prevent and reduce the chance that a disaster may occur.

Firstly, the physical protection should be established such as fire and security protection systems.

Secondly, it must establish the backup procedure and practice it regularly. After the backup, it should consider about the tape storage place. Some copies should be kept out site and far away from the office building. Some should be kept in the fire-proof area.

Regarding the estimated cost incurred by loss. The company should consider the backup site that has full facilities supporting the business operations.

After selecting a backup site, all of the backup and restore procedure must be documented. The document should be kept in various places for safety and can be picked up easily during the emergency.

Lastly, all procedure and document must be reviewed and tested at least once a year. It will ensure that the procedure is still reliable.

REFERENCE

1. "Establishing a Recovery Plan", IBM AS/400 Newsletter Fall 1992, Page 8-12
2. IBM AS/400, BACKUP AND RECOVERY GUIDE Version 2, First edition(May 1991), International Business Machines Corporation 1991
3. "Managing Auxiliary Storage Pools", IBM AS/400 Newsletter Winter 1992, Page 1-8
4. Toigo, Jon William, DISASTER RECOVERY PLANNING Managing Risk and Catastrophe in Information Systems, Yourdon Press, Prentice Hall building, Englewood Cliffs, New Jersey 07632



APPENDIX A

Journal Size Calculation

.Library	File	Description	Recl.	create	delete	Update	Size
BPCSFMOD	ATX	A/P Tax History	119	1000	1000		239,078
BPCSFMOD	CM	Credit Monitoring (By Date)	40			4000	320,078
BPCSFMOD	ECR	Credit Hold Release File (By Order)	20	2400	2400		98,478
BPCSFMOD	PBL	BILL DETAIL	31	15000	15000		945,078
BPCSFMOD	PCV	CHEQUE VOUCHER DESCRIPTION	126	1000	1000		253,078
BPCSFMOD	RCMT	Customer Master (in thai)	365			14800	10,804,078
BPCSFMOD	RQH	Cheque Header File (Add Company no.)	146	800	800	1600	701,678
BPCSFMOD	RQL	Cheque Detail File	97	4000	4000	8000	2,332,078
BPCSFMOD	RTX	A/R Tax Amount Invoiced	105	1000		1000	211,078
BPCSFMOD	SMTD	M-T-D Sales	26			4000	208,078
BPCSFMOD	SSH	Sales History	300			10000	6,000,078
BPCSFMOD	SSHS	Sales History Sample	465			4000	3,720,078
BPCSFMOD	TTD	Transport Detail File	85	2800			2,878
BPCSFV20	BBH	Billing Release Header	559	4000	4000		4,476,078
BPCSFV20	BBL	Billing Release Line Items	201	10000	10000		4,030,078
BPCSFV20	ECH	Customer Order Header	479	4000	4000	28000	30,660,078
BPCSFV20	ECL	Customer Order Line Items	183	10000	10000	70000	29,290,078
BPCSFV20	ELA	Lot Allocation to Orders	50	10000	10000		1,010,078
BPCSFV20	ESR	Picker Release Physical File	61	4000	4000		492,078
BPCSFV20	GGM	General Ledger Master File	623			5500	6,853,078
BPCSFV20	GJD	Journal Detail	120	15000	15000		3,615,078
BPCSFV20	GJH	Journal Header	140	1000	1000		281,078
BPCSFV20	GJW	Journal Work File	101	15000	15000		3,045,078
BPCSFV20	GJWB	A/R Journal Work File	109	15000	15000		3,285,078
BPCSFV20	IIM	Item Master File	971			20000	38,840,078
BPCSFV20	ILI	Location Inventory	68			20000	2,720,078
BPCSFV20	ITH	Transaction History File	200	10000	10000		4,010,078
BPCSFV20	ITHSV	Transaction History Saved File.	200	10000	10000		4,010,078
BPCSFV20	IWI	Warehouse Inventory File	197			30000	11,820,078
BPCSFV20	IWM	Warehouse Master File	386			30000	23,160,078
BPCSFV20	RAR	A/R Detail File	191	4800	4800	800	2,144,078
BPCSFV20	RCM	Customer Master File	604			12000	14,496,078
BPCSFV20	RTX	A/R Tax Amount Invoiced	62	4000			4,078
BPCSFV20	SIH	Invoice History	429	4000	4000		3,436,078
BPCSFV20	SIL	Invoice Line History	65	10000	10000		1,310,078
BPCSFV20	SSM	Salesperson Master File	378			4000	3,024,078
							221,848,608

Journal monthly consume
Assume company operate
So, Daily Journal become

=

221.85 MB.
22 days / month
10.08 MB.



APPENDIX B.

Library usage. CASTROL (THAILAND) LTD
AS/400 D35 LIB.USAGE

NO.	LIBRARY	Type	SIZE	OBJECT
1	BPCSFV20	3	336,083,456	1,287
2	BPCSPTFV31	2	298,409,472	686
3	SAVFLIB	4	227,061,696	2
4	BPCSOV31	2	116,537,344	2,400
5	QSYS	1	115,983,872	10,228
6	BPCSSV31	2	115,175,936	5
7	BPCSMODV20	2	106,055,168	1,517
8	BPCSFMOD	3	104,327,680	331
9	BPCSPTFV20	2	80,918,528	501
10	BPCSOV20	2	80,709,632	1,383
11	BPCSF	4	65,361,920	1,459
12	BPCSFV31	4	61,648,384	1,620
13	BPCSUSRSJ1	2	44,735,488	364
14	BPCSHIS	2	33,117,184	8
15	QUSRTOOL	1	26,530,816	23
16	QHLPYSYS	1	15,784,960	207
17	QPDA	1	15,779,328	359
18	QDOC	1	15,575,552	541
19	SSACNV	4	11,867,136	210
20	*** Journal ***	4	10,000,000	2
21	MODLIB			
22	QUSRSYS	1	7,993,856	529
23	QSSP	1	6,734,848	331
24	QS36F	1	6,309,888	11
25	QGPL	1	6,152,192	287
26	QIWSFS	1	5,909,504	136
27	QMGU	1	5,613,056	232
28	QSDE	1	4,808,192	100
29	QFNTCPL	1	4,631,552	1,200
30	BPCSUSRV31	4	4,291,072	273
31	QSYSPRV	1	3,877,888	1,267
32	QIWS	1	3,418,624	130
33	QRPQ	1	3,329,536	87
34	ASSETLIB	2	3,291,136	73
35	TAATOOL	1	3,100,672	57
36	QORYLIB	1	2,708,504	53
37	SOMCHAI	4	2,115,584	24
38	QSYS38	1	1,808,384	588

39	#RPGLIB	1	1,776,640	57
40	QRP38	1	1,404,416	37
41	THAI36	1	1,150,564	36
42	QRP38	1	1,105,920	37
43	QRPGLIB	1	1,053,696	29
44	NUANANONG	4	988,160	21
45	QGDDM	1	812,032	214
46	NEW38	1	694,784	20
47	#LIBRARY	1	664,064	13
48	BPCSGPL	2	415,232	11
49	QSYS2	1	286,720	50
50	PCSTHAI	1	272,896	14
51	#DFULIB	1	151,552	8
52	CHGSYS	1	136,192	5
53	#DSULIB	1	78,848	9
54	EVERYONE	4	70,144	26
55	#SEULIB	1	66,048	8
56	RUNGROJ	4	47,616	1
57	#CGULIB	1	41,472	6
58	#SDALIB	1	41,472	6
59	QOALIB	1	40,448	19
60	QDSNX	1	31,744	2
61	QRECOVERY	1		
62	QSRV	1		

TOTAL CONSUME		1,978,042,044	29,228
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TYPE

1 = System

2 = Application program & History

3 = Application Data

4 = Other

APPENDIX C**Auxiliary Storage Pools Design.**

CASTROL (THAILAND) LTD.

NO.	LIBRARY	ASP	SIZE	OBJECT
1	QSYS	1	115,983,872	10,228
2	QUSRTOOL	1	26,530,816	23
3	QHLPSSYS	1	15,784,960	207
4	QPDA	1	15,779,328	359
5	QDOC	1	15,575,552	541
6	QUSRSYS	1	7,993,856	529
7	QSSP	1	6,734,848	331
8	QS36F	1	6,309,888	11
9	QGPL	1	6,152,192	287
10	QIWSFS	1	5,909,504	136
11	QMGU	1	5,613,056	232
12	QSDE	1	4,808,192	100
13	QFNTCPL	1	4,631,552	1,200
14	QSYSRPRV	1	3,877,888	1,267
15	QIWS	1	3,418,624	130
16	QRPG	1	3,329,536	87
17	TAATOOL	1	3,100,672	57
18	QQRYLIB	1	2,708,504	53
19	QSYS38	1	1,808,384	588
20	#RPLIB	1	1,776,640	57
21	QRPG38	1	1,404,416	37
22	THAI36	1	1,150,564	36
23	QRPGP	1	1,105,920	37
24	QRPGLIBP	1	1,053,696	29
25	QGDDM	1	812,032	214
26	NEW38	1	694,784	20
27	#LIBRARY	1	664,064	13
28	QSYS2	1	286,720	50
29	PCSTHAI	1	272,896	14
30	#DFULIB	1	151,552	8
31	CHGSYS	1	136,192	5
32	#DSULIB	1	78,848	9
33	#SEULIB	1	66,048	8
34	#SDALIB	1	41,472	6
35	#CGULIB	1	41,472	6
36	QOALIB	1	40,448	19
37	QDSNX	1	31,744	2
Total for System			265,860,732	16,936

Disk Model 2800 320 Mb.	83.08%
-------------------------	--------

NO.	LIBRARY	ASP	SIZE	OBJECT
40	BPCSPTFV31	2	298,409,472	686
41	BPCSOV31	2	116,537,344	2,400
42	BPCSSV31	2	115,175,936	5
43	BPCSMODV20	2	106,055,168	1,517
44	BPCSPTFV20	2	80,918,528	501
45	BPCSOV20	2	80,709,632	1,383
46	BPCSUSRS31	2	44,735,488	364
47	BPCSHIS	2	33,117,184	8
48	MODLIB	2	8,953,344	88
49	ASSETLIB	2	3,291,136	73
50	BPCSGPL	2	415,232	11
Total for Application			888,318,464	7,036

NO.	LIBRARY	ASP	SIZE	OBJECT
51	BPCSFV20	3	336,083,456	1,287
52	BPCSFMOD	3	104,327,680	331
Total for Data			440,411,136	1,618
Disk Model 2800 x 2 640 Mb.			68.81%	

NO.	LIBRARY	ASP	SIZE	OBJECT
53	SAVFLIB	4	227,061,696	2
54	BPCSF	4	65,361,920	1,459
55	BPCSFV31	4	61,648,384	1,620
56	Disk Model 9332 x 2 1200 Mb.		74.03%	210
57	BPCSUSRV31	4	4,291,072	273
58	SOMCHAI	4	2,115,584	24
59	NUANANONG	4	988,160	21
60	EVERYONE	4	70,144	26
61	RUNGROJ	4	47,616	1
62	*** Journal ***	4	10,000,000	2
Total for miscellaneous			383,451,712	3,638
Disk Model 9332 600 Mb.			63.91%	
TOTAL CONSUME			1,978,042,044	29,228

- ASP
- 1 = System
 - 2 = Application program & History
 - 3 = Application Data
 - 4 = Other

Designing ASP

At first, all of ASP should not be used over 90% in order to improved performance and prevent from disk over flow. If the disk is over flow, the system may stop and let us to clear disk to be more space that will interrupt computer servicing function.

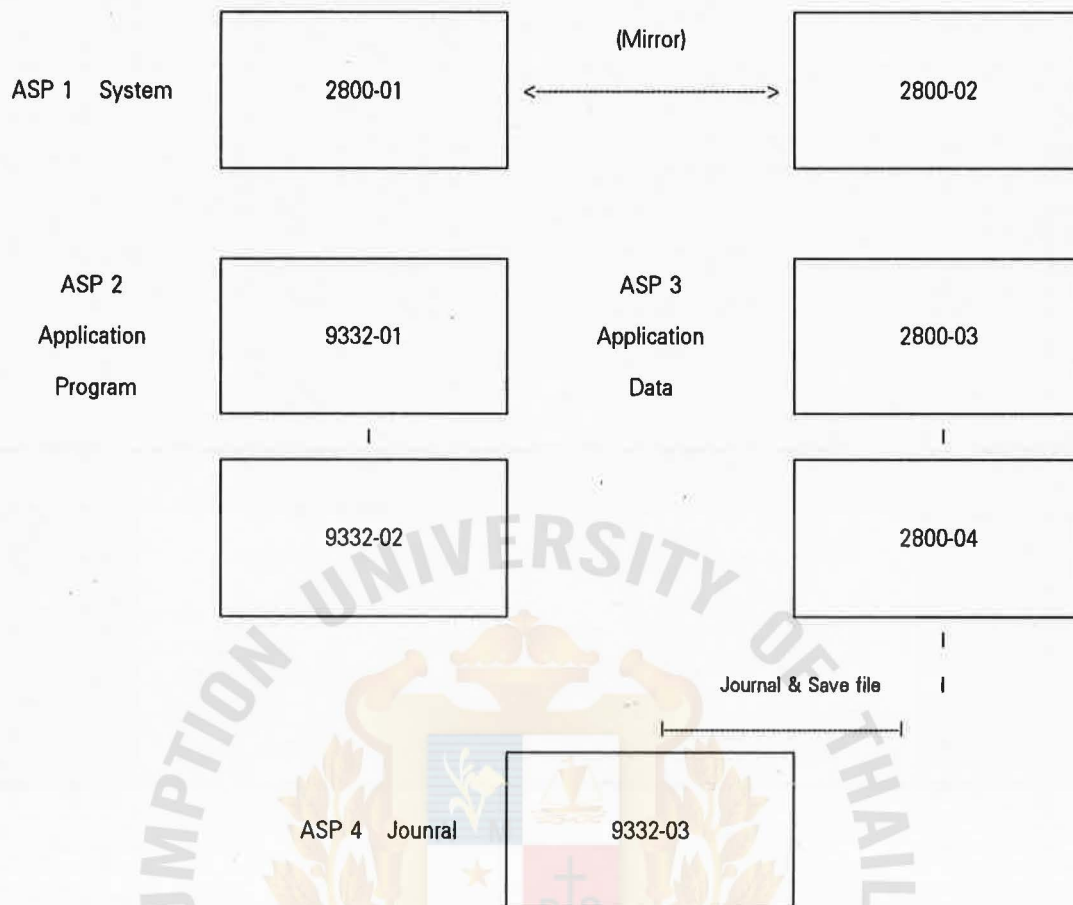
The first ASP must be System ASP that contain operating system and systems program. We design protection by mirroring because:

This ASP must mostly reliable in order to keep system available and sizes of storage can be limited.

The 2nd ASP should be Application that contain application programs, executable object and testing program. Because of size around 900 Mb. using mirror seem waste. The method using can be checksum protection that may consume 20% of this ASP size by put in other ASP. The space for checksum approximately 240 Mb. Other method is backup more frequently. This method will save cost but we may lost some development programs on backup period.

The 3rd ASP should be Application's Data. We design to use Journal management with frequently backup. The size of journal around 10 Mb. per day. To preventing of diskfull, daily backup must be done. For using journal, we must assign the 4 th ASP for Journal file and other temporary files.

Design hardware configuration.



On this moment disk consume as:

System ASP	=	266 Mb.
Application ASP	=	888 Mb.
Application Data	=	440 Mb.
Journal and Other	=	383 Mb.

We must concern to the disk consumption that increasing day by day. Assume the application and data increasing 10% every year. The effect will come to Journal and backup file as the table.

	ASP Size	Data Size	1st Yr.	2nd Tr.	3rd Yr.	4th Yr.	5th Yr.
System ASP + Mirror	320	266	266	266	266	266	266
Application Program	1200	888	888	888	888	888	888
Application Data	640	440	484	532	586	644	709
Journal and Other	600	383	421	463	510	561	617
		1977	2059	2150	2249	2359	2479

Percent Utilization	ASP Size	Data Size	1st Yr.	2nd Tr.	3rd Yr.	4th Yr.	5th Yr.
System ASP	320	83.13%	83.13%	83.13%	83.13%	83.13%	83.13%
Application Program	1200	74.00%	74.00%	74.00%	74.00%	74.00%	74.00%
Application Data	640	68.75%	75.63%	83.19%	91.51%	100.66%	110.72%
Journal and Other	600	63.83%	70.22%	77.24%	84.96%	93.46%	102.80%

Unprotect Utilization		65.90%	68.64%	71.66%	74.98%	78.63%	82.65%
-----------------------	--	--------	--------	--------	--------	--------	--------

Disk consume in Year.

In the table, we must increase number of disk in 3th year for Application Data ASP that cost = 300,000 baht and in 4th year for Journal ASP for 300,000 baht. Compare with unprotect, in 5 years the storage can used without expansion.

In case of checksum the utilization will be:

Checksum	ASP Size	Data Size	1st Yr.	2nd Yr	3rd Yr.	4th Yr.	5th Yr.
	320	266	266	266	266	266	266
	1200	888	888	888	888	888	888
	640	440	484	532	586	644	709
	600	623	661	703	750	801	857
		2217	2299	2390	2489	2599	2719

Percent Utilization		Data Size	1st Yr.	2nd Yr	3rd Yr.	4th Yr.	5th Yr.
ASP 1		83.13%	83.13%	83.13%	83.13%	83.13%	83.13%
ASP 2		74.00%	74.00%	74.00%	74.00%	74.00%	74.00%
ASP 3		68.75%	75.63%	83.19%	91.51%	100.66%	110.72%
ASP 4		103.83%	110.22%	117.24%	124.96%	133.46%	142.80%

It 's mean that we must increase storage for the ASP 4 before we decide to use checksum.
Assume we increasing the 340 Mb. in ASP 4 the calculation will be:

Checksum	ASP Size	Data Size	1st Yr.	2nd Yr	3rd Yr.	4th Yr.	5th Yr.
	320	266	266	266	266	266	266
	1200	888	888	888	888	888	888
	640	440	484	532	586	644	709
	940	623	661	703	750	801	857
		2217	2299	2390	2489	2599	2719

Percent Utilization		Data Size	1st Yr.	2nd Yr	3rd Yr.	4th Yr.	5th Yr.
		83.13%	83.13%	83.13%	83.13%	83.13%	83.13%
		74.00%	74.00%	74.00%	74.00%	74.00%	74.00%
		68.75%	75.63%	83.19%	91.51%	100.66%	110.72%
		66.28%	70.35%	74.83%	79.76%	85.19%	91.15%

It's mean that we still need for another expand in 5 th year. Over all with the Application data, we need to expand 3 units of 340 Mb. disk in 5 years.

APPENDIX D

Journal management Testing Create Journal System

The first is create testing file name "TESTF" by using Data Description Specification to create.

5738SS1 V2R1M0 910524	Data Description	JOURNAL/TESTF	29/03/93 9:40:45	Page 1
-----------------------	------------------	---------------	------------------	--------

File name	TESTF
Library name	JOURNAL
File attribute	Physical
Source file containing DDS	QDDSSRC
Library name	JOURNAL
Source member containing DDS	TESTF
Source member last changed	29/03/93 9:40:21
Source listing options	*SOURCE *LIST *NOSECLVL
DDS generation severity level	20
DDS flagging severity level	00
File type	*DATA
Authority	*LIBCRTAUT
Replace file	*NO
Text	Test file for Journal Management
Compiler	IBM AS/400 Data Description Processor

SEQNBR	*...+...1...+...2...+...3...+...4...+...5...+...6...+...7...+...8	Date
--------	---	------

100	A*****		
200	A* CASTROL(THAILAND)LTD.	FILE FOR TEST JOURNAL MANAGEMENT	29/03/93
300	A*****		
400	A*		
500	A* FILE	- TESTF	29/03/93
600	A* APPLICATION	- JOURNAL TESTING	29/03/93
700	A* DESCRIPTION	- NONE	29/03/93
800	A* DATE WRITTEN	- 29 MARCH 1993	29/03/93
900	A*		
2400	A*****		
2600	A	R IPA100TX	TEXT('Test file for Journal Mgmt') 29/03/93
10000	A*		* 29/03/93
10100 A01	A*		* 18/10/91
10200	A*		
10300	A	FLD1	6A Field 29/03/93
10400	A		COLHDG('First field') 29/03/93
10500	A*		* 18/10/91
10600	A	FLD2	6P 0 TEXT('Field No2. ') 29/03/93
10700	A		COLHDG('2 nd. field') 29/03/93
10800	A	FLD3	6A TEXT('Field No.3') 29/03/93
10900 A01	A		COLHDG('3 rd. field') 29/03/93
11000	A*		* 18/10/91

***** END OF SOURCE *****

		Expanded Source			
	Field	Buffer position	length	Out	In
SEQNBR *...+...1...+...2...+...3...+...4...+...5...+...6...+...7...+...8					
2600	R IPA100TX		TEXT('Test file for Journal Mgmt')		
10300	FLD1	6A B	TEXT('Field No.1') +	6	1 1
10400			COLHDG('First field')		
10600	FLD2	6P 0B	TEXT('Field No2. ') +	4	7 7
10700			COLHDG('2 nd. field')		
10800	FLD3	6A B	TEXT('Field No.3') +	6	11 11
10900			COLHDG('3 rd. field')		

***** END OF EXPANDED SOURCE *****

		Message Summary			
Total	Informational	Warning	Error	Severe	
		(0-9)	(10-19)	(20-29)	(30-99)
0		0	0	0	0
* CPC7301	00	Message . . . : File TESTF created in library JOURNAL.			

***** END OF COMPILATION *****

Second is to create journal receiver by command CRTJRNRCV

Create Journal Receiver (CRTJRNRCV)

Type choices, press Enter.

Journal receiver

Library

Auxiliary storage pool ID

Journal receiver threshold

*NONE

Text 'description'

Preferred storage unit . .

Authority

... TESTJRNRCV Name

... JOURNAL Name, *CURLIB

... *LIBASP 1-16, *LIBASP

... *NONE 1-1919999,

... TEST FOR JOURNAL RECEIVER

Additional Parameters

... *ANY 1-255, *ANY

... *LIBCRTAUT Name, *LIBCRTAUT, *CHANGE...

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display

F24=More keys

The thrid create journal file by using CRTJRN

Create Journal (CRTJRN)

Type choices, press Enter.

Journal

Library

Journal receiver

Library

Auxiliary storage pool ID . .

Journal threshold msgq . .

Library

Text 'description'

... testjrn

... journal

... testjrnrcv

... journal

... *LIBL

... 1

... QSYSOPR

... *LIBL

Test Journal Management

Name

Name, *CURLIB

Name

Name, *LIBL, *CURLIB

1-16, *LIBASP

Name

Name, *LIBL, *CURLIB

Bottom

F3=Exit F4=Prompt F5=Refresh F10=Additional parameters F12=Cancel

F13=How to use this display

F24=More keys

Start Journal Physical File (STRJRNPF)

```
Physical file to be journaled . testf      Name
Library . . . . . *LIBL Name, *LIBL, *CURLIB
                        + for more values
                        *LIBL
Journal . . . . . testjrn Name
Library . . . . . *LIBL Name, *LIBL, *CURLIB
Record images . . . . . *both      *AFTER, *BOTH
Journal entries to be omitted . *NONE      *NONE, *OPNCLO
```

F3=Exit F4=Prompt F5=Refresh F12=Cancel F13=How to use this display
F24=More keys

Display Journal Receiver Attributes

```
Receiver . . . . . : TESTJRNRCV Library . . . . . : JOURNAL
Auxiliary storage pool : 1
Threshold . . . . . : 100
Journal . . . . . : TESTJRN
    Library . . . . . : JOURNAL
Status . . . . . : ATTACHED
Number of entries . . : 2
Length of longest data : 72
First sequence number : 1
Last sequence number  2
Size . . . . . 110592
Text . . . . . : Test Journal Receiver
Attach date . . . . : 29/03/93      Attach time . . . . : 10:32:04
Detach date . . . . : 00/00/00      Detach time . . . . : 00:00:00
Save date . . . . . : 00/00/00      Save time . . . . . : 00:00:00
```

F3=Exit F6=Display associated receivers F12=Cancel

We have test by create data to TESTF 4 records and update once as :

5738SS1 V2R1M0 910524 AUDIT LOG 31/03/93 14:41:37 PAGE 1
Library/File JOURNAL/TESTF
Member TESTF
Job Title WORK WITH DATA IN A FILE

	*RECNR	First field	2 nd. field	3 rd. field
Added	1	TEST1	0	1TEST
Added	2	TEST2	0	2TEST
Added	3	TEST3	0	3TEST
Added	4	TEST5	0	4TEST
Changed	4	TEST5	0	4TEST

TEST4

4 Records Added
1 Records Changed
0 Records Deleted

***** END OF DFU AUDIT REPORT *****

We will see the change in journal receiver by command "DSPJRN".

Display Journal Entries

Journal : TESTJRN Library : JOURNAL

Type options, press Enter.

5=Display entire entry

Opt	Sequence	Code	Type	Object	Library	Job	Time
	1	J	PR			DSP02	14:33:55
	4	F	JM	TESTF	JOURNAL	DSP02	14:36:45
	5	R	PT	TESTF	JOURNAL	DSP02	14:43:27
	6	R	PT	TESTF	JOURNAL	DSP02	14:43:38
	7	R	PT	TESTF	JOURNAL	DSP02	14:43:44
	8	R	PT	TESTF	JOURNAL	DSP02	14:43:51
	9	R	UB	TESTF	JOURNAL	DSP02	14:44:27
	10	R	UP	TESTF	JOURNAL	DSP02	14:44:27
	11	F	SR	TESTF	JOURNAL	DSP02	14:47:56
	12	F	RC	TESTF	JOURNAL	DSP02	14:47:57
	13	F	SA	TESTF	JOURNAL	DSP02	14:54:51
	14	F	AY	TESTF	JOURNAL	DSP02	14:54:52
	15	F	SR	TESTF	JOURNAL	DSP02	15:36:45
	16	F	RC	TESTF	JOURNAL	DSP02	15:36:47
	17	F	SR	TESTF	JOURNAL	DSP02	15:37:58
	18	F	RC	TESTF	JOURNAL	DSP02	15:37:59
	19	F	SR	TESTF	JOURNAL	DSP02	15:41:57
	20	F	RC	TESTF	JOURNAL	DSP02	15:41:58
	21	F	SA	TESTF	JOURNAL	DSP02	14:44:13
	22	F	AY	TESTF	JOURNAL	DSP02	15:44:13
	23	J	IN				7:08:01
	24	J	IN				7:07:57
	25	J	IN				7:37:57

F3=Exit F12=Cancel

In the journal we can monitor to the detail inside as :

Display Journal Entry			
Journal ..	.....	TESTJRN	Library JOURNAL
Sequence ..	.....	4	
Code .....	.....	F - Data base file operation	
Type .....	.....	JM - Start journaling for member	
Object ...	.....	TESTF	Library JOURNAL
Member ...	.....	TESTF	
Position to	.....	(Column)	
	Entry specific data		
Column	*...+...1...+...2...+...3...+...4...+...5		
00001	'1'		

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data

F10=Display only entry details F12=Cancel F24=More keys

Display Journal Entry			
Journal ..	.....	TESTJRN	Library JOURNAL
Sequence ..	.....	5	
Code .....	.....	R - Operation on specific record	
Type .....	.....	PT - Record added	
Object ...	.....	TESTF	Library JOURNAL
Member ...	.....	TESTF	
Position to	.....	(Column)	
	Entry specific data		
Column	*...+...1...+...2...+...3...+...4...+...5		
00001	'TEST1 '1TEST'		

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data

F10=Display only entry details F12=Cancel F24=More keys

		Display Journal Entry	
Journal	TESTJRN	Library	.....:JOURNAL
Sequence	6		
Code	R - Operation on specific record		
Type	PT - Record added		
Object	TESTF	Library	.....:JOURNAL
Member	TESTF		
Position to	(Column)		
	Entry specific data		
Column	*...+...1...+...2...+...3...+...4...+...5		
00001	'TEST2 2TEST'		

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data
F10=Display only entry details F12=Cancel F24=More keys

		Display Journal Entry	
Journal	TESTJRN	Library	.....:JOURNAL
Sequence	7		
Code	R - Operation on specific record		
Type	PT - Record added		
Object	TESTF	Library	.....:JOURNAL
Member	TESTF		
Position to	(Column)		
	Entry specific data		
Column	*...+...1...+...2...+...3...+...4...+...5		
00001	TEST3 3TEST'		

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data
F10=Display only entry details F12=Cancel F24=More keys

	Display Journal Entry		
Journal	TESTJRN	Library	.....:JOURNAL
Sequence	8		
Code	R - Operation on specific record		
Type	PT - Record added		
Object	TESTF	Library	.....:JOURNAL
Member	TESTF		
Position to	(Column)		

	Entry specific data
Column	*...+...1...+...2...+...3...+...4...+...5
00001	'TEST5 4TEST'

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data
F10=Display only entry details F12=Cancel F24=More keys

	Display Journal Entry		
Journal	TESTJRN	Library	.....:JOURNAL
Sequence	9		
Code	R - Operation on specific record		
Type	UB - Update, before-image		
Object	TESTF	Library	.....:JOURNAL
Member	TESTF		
Position to	(Column)		

	Entry specific data
Column	*...+...1...+...2...+...3...+...4...+...5
00001	'TEST5 4TEST'

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data
F10=Display only entry details F12=Cancel F24=More keys

Journal	Display Journal Entry		
Sequence	TESTJRN	Library	.....:JOURNAL
Code	10		
Type	R - Operation on specific record		
Object	UP - Update, after-image		
Member	TESTF	Library	.....:JOURNAL
Position to	TESTF		
	(Column)		

	Entry specific data
Column	*...+....1....+....2....+....3....+....4....+....5
00001	'TEST4 4TEST'

Bottom Press Enter to continue.

F3=Exit F6=Display only entry specific data

F10=Display only entry details

F12=Cancel F24=More keys



APPENDIX E

Hardware Configuration list.

Rack Configuration List

Page 1

5738SS1 V2R1M0 910524

CASTROL 05/04/93 15:47:09

System ID . . . : 9406-0010068-19900502-144442

			Location				
Description	Type-Model	Number	Serial ID	Rack Location	EIA Slot	Device Card	Resource
1.6M Rack		9309-002	10-00A2686	A			
600MB Disk Unit		9332-600	10-5E44A	A	7	DC04	
600MB Disk Unit		9332-600	10-6ED4A	A	4	DC03	
600MB Disk Unit		9332-600	10-6F73A	A	1	DC02	
1.6M SPCN Rack		9406	10-73X3586	01			
9406 System Unit			10-40898	01	14		
Main Card Enclosure		9406-D35	10-40898	01	1		
8MB Main Storage		3055	00-0000000	01	1C	CMS01	
Multi-function IOP		2615	10-1749018	01	1C	CMB01	
EIA 232/V.24 Adapter		6152	10-1744125	01	1C	LIN03	
Port 1						LIN031	
EIA 232/V.24 Adapter		6152	10-1751109	01	1B	LIN02	
Port 1						LIN021	
Tape Unit IOP		2621	42-1741020	01	12	SI03	
Twinaxial WSC		6140	10-1743112	01	13	CTL02	
Comm Processor		2623	78-2849022	01	14	CC02	
EIA 232/V.24 Adapter		2609	78-2867019	01	4A	LIN04	
Port 1						LIN041	
Port 2						LIN042	
Mag Stge Device Ctl		6112	10-1731040	01	17	SI04	
8MB Processor Card		2540	10-1747019	01	13	MP02	
8MB Main Storage		3119	00-0000000	01	15	MS02	
I/O Regulator		2700		01	17		
I/O Regulator		2700		01	21		
320MB Disk Unit		2800-001	00-15406	01	23	DC05	
320MB Disk Unit		2800-001	00-15435	01	23	DC06	
320MB Disk Unit		2800-001	00-14890	01	25	DC07	
320MB Disk Unit		2800-001	00-15448	01	25	DC08	
1.6M SPCN Rack		9309-002	10-00A2686	02			
Reel Tape Unit		9348-001	00-0000000	02	21	TAP02	

* = Load Source Disk Unit

** = Alternative IPL Tape Unit

Note: Position A is the bottom second level card position, position B is immediately above position A, and so on.

***** END OF COMPUTER PRINTOUT *****

APPENDIX F Questionnaire

F1. Personnel Department

The effect for personnel department:

1. The most significant impact to the department that would result from the loss of this department process:

- | | |
|---|--|
| <input type="checkbox"/> Loss of Revenue | <input type="checkbox"/> Loss of Shareholder Value |
| <input type="checkbox"/> Loss of Profit | <input type="checkbox"/> Loss of Goodwill |
| <input type="checkbox"/> Loss of Market Share | <input type="checkbox"/> Loss of Investor Confidence |
| <input checked="" type="checkbox"/> Legal/Regulatory Violations | <input checked="" type="checkbox"/> Loss of Productivity |
| <input type="checkbox"/> Other _____ | |

2. The department process can continue to function without I/S support within:

Assume the loss of I/S support occurs during the peak period.)

- | | |
|---|--|
| <input type="checkbox"/> Less than 1 day. | <input type="checkbox"/> Up to 2 weeks. |
| <input checked="" type="checkbox"/> Up to 2 days. | <input type="checkbox"/> Up to 1 month. |
| <input type="checkbox"/> Up to 4 days. | <input type="checkbox"/> Up to 3 months. |
| <input type="checkbox"/> Up to 1 weeks. | |
| <input type="checkbox"/> Other _____ | |

3. The estimate of non recoverable losses to the company if the department process could not be provided.

- | | |
|---|--|
| <input type="checkbox"/> Less than 10,000 B. | <input type="checkbox"/> Between 5,000,000 to 9,999,999 B. |
| <input checked="" type="checkbox"/> Between 10,000 to 99,999 B. | <input type="checkbox"/> Between 10,000,000 to 99,999,999 B. |
| <input type="checkbox"/> Between 100,000 to 999,999 B. | <input type="checkbox"/> 100,000,000 or More. |
| <input type="checkbox"/> Between 1,000,000 to 4,999,999 B. | |

The loss recurring : Per Hour Per Day Per Week Per Month One Time

4. The following categories, indicate the relative impact of the loss of this department process for each time frame slots below.

Assume the outage is continuous and occurs during a time of peak business activity.

CATASTROPHIC: Out of business and / or endanger public safety.

SIGNIFICANT: Major impact on the long-term financial status of the company and / or endanger public safety.

MODERATE: Major impact on the short term financial status of the company.

MINOR: No impact to the financial of the company.

- | | |
|---------|-----------------------------------|
| 1 Hr. | <input type="checkbox"/> Minor |
| 8 Hr. | <input type="checkbox"/> Minor |
| 48 Hr. | <input type="checkbox"/> Minor |
| 72 Hr. | <input type="checkbox"/> Minor |
| 1 Week | <input type="checkbox"/> Moderate |
| 1 Month | <input type="checkbox"/> Moderate |

5. The loss of this department process would keep us from supplying the following services to our external customers:

☐ Bank _____

6. The loss of this department process would keep us from supplying the following services to our internal customers:

☐ Employee & Accounting Department. _____

7. The peak time and / or critical time of year and / or day of the week, if any, for this department process.

<input checked="" type="checkbox"/> January	<input type="checkbox"/> Monday	<input type="checkbox"/> End of Week
<input type="checkbox"/> February	<input type="checkbox"/> Tuesday	<input checked="" type="checkbox"/> Half Month
<input type="checkbox"/> March	<input type="checkbox"/> Wednesday	<input checked="" type="checkbox"/> End of Month
<input type="checkbox"/> April	<input type="checkbox"/> Thursday	<input type="checkbox"/> End of Quarter
<input type="checkbox"/> May	<input type="checkbox"/> Friday	<input type="checkbox"/> End of Fiscal Year
<input type="checkbox"/> June	<input type="checkbox"/> Saturday	<input type="checkbox"/> End of Calendar Year
<input type="checkbox"/> July	<input type="checkbox"/> Sunday	<input type="checkbox"/> Other _____
<input type="checkbox"/> August		
<input type="checkbox"/> September		
<input type="checkbox"/> October		
<input checked="" type="checkbox"/> November		
<input checked="" type="checkbox"/> December		

8. The applications that I/S support this department process:

Application	Critical	On-line/Batch	Transaction	Rank
Payroll	Y	Stand alone	700 Tr./ M	
Paper Work	N	Batch		

9. This department process is distributed in single geographic locations.

10. The specialized equipment or customized supplies required in supporting this department process are:

☐ Personal Computer _____

11. This department process dependent upon and / or required for _____ department process.

12. Dose this department process have documented manual procedures that could be used without I/S support?

☐ Yes (Answer 13-14)
☒ No (Answer 15)

13. The manual procedures were last tested on : _____

14. The operation cost of the manual procedures are : _____

15. Does it practical to develop the manual procedures, and how many of work days require to develop them?

5 days. In practical, it is time consume to process with manual procedure.

16. The other factors that should be impact of the loss of this department process are:

F2. Consumer Marketing Department.

1. The most significant impact to the department that would result from the loss of this department process:

- | | |
|--|--|
| <input checked="" type="checkbox"/> Loss of Revenue | <input type="checkbox"/> Loss of Shareholder Value |
| <input checked="" type="checkbox"/> Loss of Profit | <input checked="" type="checkbox"/> Loss of Goodwill |
| <input checked="" type="checkbox"/> Loss of Market Share | <input type="checkbox"/> Loss of Investor Confidence |
| <input type="checkbox"/> Legal/Regulatory Violations | <input type="checkbox"/> Loss of Productivity |
| <input type="checkbox"/> Other _____ | |

2. The department process can continue to function without I/S support within:

Assume the loss of I/S support occurs during the peak period.

- | | |
|---|--|
| <input type="checkbox"/> Less than 1 day. | <input type="checkbox"/> Up to 2 weeks. |
| <input type="checkbox"/> Up to 2 days. | <input checked="" type="checkbox"/> Up to 1 month. |
| <input type="checkbox"/> Up to 4 days. | <input type="checkbox"/> Up to 3 months. |
| <input type="checkbox"/> Up to 1 weeks. | |
| <input type="checkbox"/> Other _____ | |

3. The estimate of non recoverable losses to the company if the department process could not be provided.

- | | |
|--|---|
| <input type="checkbox"/> Less than 10,000 B. | <input type="checkbox"/> Between 5,000,000 to 9,999,999 B. |
| <input type="checkbox"/> Between 10,000 to 99,999 B. | <input checked="" type="checkbox"/> Between 10,000,000 to 99,999,999 B. |
| <input type="checkbox"/> Between 100,000 to 999,999 B. | <input type="checkbox"/> 100,000,000 or More. |
| <input type="checkbox"/> Between 1,000,000 to 4,999,999 B. | |

The loss recurring : Per Hour Per Day Per Week Per Month

4. The following categories, indicate the relative impact of the loss of this department process for each time frame slots below.

Assume the outage is continuous and occurs during a time of peak business activity.

- | | |
|---------------|--|
| CATASTROPHIC: | Out of business and / or endanger public safety. |
| SIGNIFICANT: | Major impact on the long-term financial status of the company and / or endanger public safety. |
| MODERATE: | Major impact on the short term financial status of the company. |
| MINOR: | No impact to the financial of the company. |

- | | |
|---------|--------------------------------------|
| 1 Hr. | <input type="checkbox"/> Minor |
| 8 Hr. | <input type="checkbox"/> Minor |
| 48 Hr. | <input type="checkbox"/> Minor |
| 72 Hr. | <input type="checkbox"/> Moderate |
| 1 Week | <input type="checkbox"/> Moderate |
| 1 Month | <input type="checkbox"/> Significant |

5. The loss of this department process would keep us from supplying the following services to our external customers:

☐ Customer _____

6. The loss of this department process would keep us from supplying the following services to our internal customers:

☐ Finance and Operation _____

7. The peak time and / or critical time of year and / or day of the week, if any, for this department process.

<input type="checkbox"/> January	<input type="checkbox"/> Monday	<input type="checkbox"/> End of Week
<input type="checkbox"/> February	<input type="checkbox"/> Tuesday	<input type="checkbox"/> Half Month
<input type="checkbox"/> March	<input type="checkbox"/> Wednesday	<input checked="" type="checkbox"/> End of Month
<input type="checkbox"/> April	<input type="checkbox"/> Thursday	<input checked="" type="checkbox"/> End of Quarter
<input type="checkbox"/> May	<input type="checkbox"/> Friday	<input type="checkbox"/> End of Fiscal Year
<input type="checkbox"/> June	<input type="checkbox"/> Saturday	<input checked="" type="checkbox"/> End of Calendar Year
<input checked="" type="checkbox"/> July	<input type="checkbox"/> Sunday	<input checked="" type="checkbox"/> Other <u>Half year</u>
<input type="checkbox"/> August		
<input type="checkbox"/> September		
<input type="checkbox"/> October		
<input type="checkbox"/> November		
<input checked="" type="checkbox"/> December		

8. The applications that I/S support this department process :

Application	Critical	On-line/Batch	Transaction	Rank
Order Processing	Y	On-line	4000 Ord./ M	
Sales Information	Moderate	On-line Batch		

9. This department process is distributed in 10 geographic locations.

10. The specialized equipment or customized supplies required in supporting this department process are:

AS/400 Terminal and reports

11. This department process dependent upon and / or required for Credit and Distribution department process.

12. Dose this department process have documented manual procedures that could be used without I/S support?

☐ Yes (Answer 13-14)
☒ No (Answer 15)

13. The manual procedures were last tested on: _____

14. The operation cost of the manual procedures are: _____

15. Does it practical to develop the manual procedures, and how many of work days require to develop them?

No manual procedure required.

16. The other factors that should be impact of the loss of this department process are:

F3. CIM Department. CIM

The effect of CIM department:

1. The most significant impact to the department that would result from the loss of this department process:

- | | |
|--|--|
| <input checked="" type="checkbox"/> Loss of Revenue | <input type="checkbox"/> Loss of Shareholder Value |
| <input checked="" type="checkbox"/> Loss of Profit | <input checked="" type="checkbox"/> Loss of Goodwill |
| <input checked="" type="checkbox"/> Loss of Market Share | <input type="checkbox"/> Loss of Investor Confidence |
| <input type="checkbox"/> Legal/Regulatory Violations | <input type="checkbox"/> Loss of Productivity |
| <input type="checkbox"/> Other _____ | |

2. The department process can continue to function without I/S support within:

Assume the loss of I/S support occurs during the peak period.

- | | |
|---|--|
| <input type="checkbox"/> Less than 1 day. | <input type="checkbox"/> Up to 2 weeks. |
| <input type="checkbox"/> Up to 2 days. | <input checked="" type="checkbox"/> Up to 1 month. |
| <input type="checkbox"/> Up to 4 days. | <input type="checkbox"/> Up to 3 months. |
| <input type="checkbox"/> Up to 1 weeks. | |
| <input type="checkbox"/> Other _____ | |

3. The estimate of non recoverable losses to the company if the department process could not be provided.

- | | |
|--|---|
| <input type="checkbox"/> Less than 10,000 B. | <input type="checkbox"/> Between 5,000,000 to 9,999,999 B. |
| <input type="checkbox"/> Between 10,000 to 99,999 B. | <input checked="" type="checkbox"/> Between 10,000,000 to 99,999,999 B. |
| <input type="checkbox"/> Between 100,000 to 999,999 B. | <input type="checkbox"/> 100,000,000 or More. |
| <input type="checkbox"/> Between 1,000,000 to 4,999,999 B. | |

The loss recurring : Per Hour Per Day Per Week Per Month

4. The following categories, indicate the relative impact of the loss of this department process for each time frame slots below.

Assume the outage is continuous and occurs during a time of peak business activity.

- CATASTROPHIC: Out of business and / or endanger public safety.
SIGNIFICANT: Major impact on the long-term financial status of the company and / or endanger public safety.
MODERATE: Major impact on the short term financial status of the company.
MINOR: No impact to the financial of the company.

- | | |
|---------|--------------------------------------|
| 1 Hr. | <input type="checkbox"/> Minor |
| 8 Hr. | <input type="checkbox"/> Minor |
| 48 Hr. | <input type="checkbox"/> Minor |
| 72 Hr. | <input type="checkbox"/> Moderate |
| 1 Week | <input type="checkbox"/> Moderate |
| 1 Month | <input type="checkbox"/> Significant |

5. The loss of this department process would keep us from supplying the following services to our external customers :

☐ Customer _____

6. The loss of this department process would keep us from supplying the following services to our internal customers:

☐ Finance and Operation _____

7. The peak time and / or critical time of year and / or day of the week, if any, for this department process.

<input type="checkbox"/> January	<input type="checkbox"/> Monday	<input type="checkbox"/> End of Week
<input type="checkbox"/> February	<input type="checkbox"/> Tuesday	<input type="checkbox"/> Half Month
<input type="checkbox"/> March	<input type="checkbox"/> Wednesday	<input checked="" type="checkbox"/> End of Month
<input type="checkbox"/> April	<input type="checkbox"/> Thursday	<input checked="" type="checkbox"/> End of Quarter
<input type="checkbox"/> May	<input type="checkbox"/> Friday	<input type="checkbox"/> End of Fiscal Year
<input type="checkbox"/> June	<input type="checkbox"/> Saturday	<input type="checkbox"/> End of Calendar Year
<input checked="" type="checkbox"/> July	<input type="checkbox"/> Sunday	<input checked="" type="checkbox"/> Other <input type="checkbox"/> Half Year <input type="checkbox"/>
<input type="checkbox"/> August		
<input type="checkbox"/> September		
<input type="checkbox"/> October		
<input type="checkbox"/> November		
<input checked="" type="checkbox"/> December		

8. The applications that I/S support this department process:

Application	Critical	On-line/Batch	Transaction	Rank
Order Processing	Y	On-line	4000 Ord./ M	
Sales Information	Moderate	On-line Batch		

9. This department process is distributed in 10 geographic locations.

10. The specialized equipment or customized supplies required in supporting this department process are:

AS/400 Terminal and reports

11. This department process dependent upon and / or required for Credit and Distribution department process.

12. Does this department process have documented manual procedures that could be used without I/S support?

☐ Yes (Answer 13-14)
☒ No (Answer 15)

13. The manual procedures were last tested on: _____

14. The operation cost of the manual procedures are: _____

15. Does it practical to develop the manual procedures, and how many of work days require to develop them?

No manual procedure required.

16. The other factors that should be impact of the loss of this department process are:

F4. Technique Department

This department using only personnel computer for there functions. The systems using are lab reports and data capture from instruments.

1. The most significant impact to the department that would result from the loss of this department process:

- | | |
|--|--|
| <input type="checkbox"/> Loss of Revenue | <input type="checkbox"/> Loss of Shareholder Value |
| <input type="checkbox"/> Loss of Profit | <input type="checkbox"/> Loss of Goodwill |
| <input type="checkbox"/> Loss of Market Share | <input type="checkbox"/> Loss of Investor Confidence |
| <input type="checkbox"/> Legal/Regulatory Violations | <input checked="" type="checkbox"/> Loss of Productivity |
| <input type="checkbox"/> Other _____ | |

2. The department process can continue to function without I/S support within:

Assume the loss of I/S support occurs during the peak period.

- | | |
|--|--|
| <input type="checkbox"/> Less than 1 day. | <input type="checkbox"/> Up to 2 weeks. |
| <input type="checkbox"/> Up to 2 days. | <input type="checkbox"/> Up to 1 month. |
| <input type="checkbox"/> Up to 4 days. | <input type="checkbox"/> Up to 3 months. |
| <input type="checkbox"/> Up to 1 weeks. | |
| <input checked="" type="checkbox"/> Other _This function can operated individually._ | |

3. The estimate of non recoverable losses to the company if the department process could not be provided.

- | | |
|---|--|
| <input type="checkbox"/> Less than 10,000 B. | <input type="checkbox"/> Between 5,000,000 to 9,999,999 B. |
| <input checked="" type="checkbox"/> Between 10,000 to 99,999 B. | <input type="checkbox"/> Between 10,000,000 to 99,999,999 B. |
| <input type="checkbox"/> Between 100,000 to 999,999 B. | <input type="checkbox"/> 100,000,000 or More. |
| <input type="checkbox"/> Between 1,000,000 to 4,999,999 B. | |

The loss recurring : Per Hour Per Day Per Week Per Month

4. The following categories, indicate the relative impact of the loss of this department process for each time frame slots below.

Assume the outage is continuous and occurs during a time of peak business activity.

- CATASTROPHIC: Out of business and / or endanger public safety.
SIGNIFICANT: Major impact on the long-term financial status of the company and / or endanger public safety.
MODERATE: Major impact on the short term financial status of the company.
MINOR: No impact to the financial of the company.

- | | |
|---------|--------------------------------|
| 1 Hr. | <input type="checkbox"/> Minor |
| 8 Hr. | <input type="checkbox"/> Minor |
| 48 Hr. | <input type="checkbox"/> Minor |
| 72 Hr. | <input type="checkbox"/> Minor |
| 1 Week | <input type="checkbox"/> Minor |
| 1 Month | <input type="checkbox"/> Minor |

5. The loss of this department process would keep us from supplying the following services to our external customers :

☐ Customer _____

6. The loss of this department process would keep us from supplying the following services to our internal customers:

☐ Production Department _____

7. The peak time and / or critical time of year and / or day of the week, if any, for this department process.

<input type="checkbox"/> January	<input type="checkbox"/> Monday	<input type="checkbox"/> End of Week
<input type="checkbox"/> February	<input type="checkbox"/> Tuesday	<input type="checkbox"/> Half Month
<input type="checkbox"/> March	<input type="checkbox"/> Wednesday	<input type="checkbox"/> End of Month
<input type="checkbox"/> April	<input type="checkbox"/> Thursday	<input type="checkbox"/> End of Quarter
<input type="checkbox"/> May	<input type="checkbox"/> Friday	<input type="checkbox"/> End of Fiscal Year
<input type="checkbox"/> June	<input type="checkbox"/> Saturday	<input type="checkbox"/> End of Calendar Year
<input type="checkbox"/> July	<input type="checkbox"/> Sunday	<input checked="" type="checkbox"/> Other <u>Does not required.</u>
<input type="checkbox"/> August		
<input type="checkbox"/> September		
<input type="checkbox"/> October		
<input type="checkbox"/> November		
<input type="checkbox"/> December		

8. The applications that I/S support this department process:

Application	Critical	On-line/Batch	Transaction	Rank
Paper Work	N			

9. This department process is distributed in single geographic locations.

10. The specialized equipment or customized supplies required in supporting this department process are:

Personal Computer

11. This department process dependent upon and / or required for marketing department process.

12. Dose this department process have documented manual procedures that could be used without I/S support?

☒ Yes (Answer 13-14)
☐ No (Answer 15)

13. The manual procedures were last tested on: on development.

14. The operation cost of the manual procedures are: 10,000 baht.

15. Does it practical to develop the manual procedures, and how many of work days require to develop them?

16. The other factors that should be impact of the loss of this department process are:

F5. Operation Department.

The computer systems that support for operation still on warehouse, distribution and some part on production. The application using is inventory control, invoice printing and delivery control.

1. The most significant impact to the department that would result from the loss of this department process:

- | | |
|--|--|
| <input type="checkbox"/> Loss of Revenue | <input type="checkbox"/> Loss of Shareholder Value |
| <input type="checkbox"/> Loss of Profit | <input type="checkbox"/> Loss of Goodwill |
| <input type="checkbox"/> Loss of Market Share | <input type="checkbox"/> Loss of Investor Confidence |
| <input type="checkbox"/> Legal/Regulatory Violations | <input checked="" type="checkbox"/> Loss of Productivity |
| <input type="checkbox"/> Other _____ | |

2. The department process can continue to function without I/S support within:

Assume the loss of I/S support occurs during the peak period.

- | | |
|--|--|
| <input type="checkbox"/> Less than 1 day. | <input type="checkbox"/> Up to 2 weeks. |
| <input type="checkbox"/> Up to 2 days. | <input type="checkbox"/> Up to 1 month. |
| <input type="checkbox"/> Up to 4 days. | <input type="checkbox"/> Up to 3 months. |
| <input checked="" type="checkbox"/> Up to 1 weeks. | |
| <input type="checkbox"/> Other _____ | |

3. The estimate of non recoverable losses to the company if the department process could not be provided.

- | | |
|--|---|
| <input type="checkbox"/> Less than 10,000 B. | <input type="checkbox"/> Between 5,000,000 to 9,999,999 B. |
| <input type="checkbox"/> Between 10,000 to 99,999 B. | <input checked="" type="checkbox"/> Between 10,000,000 to 99,999,999 B. |
| <input type="checkbox"/> Between 100,000 to 999,999 B. | <input type="checkbox"/> 100,000,000 or More. |
| <input type="checkbox"/> Between 1,000,000 to 4,999,999 B. | |

The loss recurring : Per Hour Per Day Per Week Per Month

4. The following categories, indicate the relative impact of the loss of this department process for each time frame slots below.

Assume the outage is continuous and occurs during a time of peak business activity.

- CATASTROPHIC: Out of business and / or endanger public safety.
SIGNIFICANT: Major impact on the long-term financial status of the company and / or endanger public safety.
MODERATE: Major impact on the short term financial status of the company.
MINOR: No impact to the financial of the company.

- | | |
|---------|--------------------------------------|
| 1 Hr. | <input type="checkbox"/> Minor |
| 8 Hr. | <input type="checkbox"/> Minor |
| 48 Hr. | <input type="checkbox"/> Minor |
| 72 Hr. | <input type="checkbox"/> Minor |
| 1 Week | <input type="checkbox"/> Moderate |
| 1 Month | <input type="checkbox"/> Significant |

5. The loss of this department process would keep us from supplying the following services to our external customers:

Customer, Supplier, Carrier / Transportation.

6. The loss of this department process would keep us from supplying the following services to our internal customers:

Marketing

7. The peak time and / or critical time of year and / or day of the week, if any, for this department process.

<input type="checkbox"/> January	<input type="checkbox"/> Monday	<input type="checkbox"/> End of Week
<input type="checkbox"/> February	<input type="checkbox"/> Tuesday	<input type="checkbox"/> Half Month
<input type="checkbox"/> March	<input type="checkbox"/> Wednesday	<input checked="" type="checkbox"/> End of Month
<input type="checkbox"/> April	<input type="checkbox"/> Thursday	<input checked="" type="checkbox"/> End of Quarter
<input type="checkbox"/> May	<input type="checkbox"/> Friday	<input type="checkbox"/> End of Fiscal Year
<input type="checkbox"/> June	<input type="checkbox"/> Saturday	<input type="checkbox"/> End of Calendar Year
<input type="checkbox"/> July	<input type="checkbox"/> Sunday	<input type="checkbox"/> Other _____
<input type="checkbox"/> August		
<input type="checkbox"/> September		
<input type="checkbox"/> October		
<input type="checkbox"/> November		
<input checked="" type="checkbox"/> December		

8. The applications that I/S support this department process:

Application	Critical	On-line/Batch	Transaction	Rank
Inventory Control	Y	On line Batch	10,000 Tr./ M	
Order Processing	Y	On line Batch	4,000 Order/M	

9. This department process is distributed in single geographic locations.

10. The specialized equipment or customized supplies required in supporting this department process are :

AS/400 workstations, Printer, _____

11. This department process dependent upon and / or required for marketing, credit department process.

12. Dose this department process have documented manual procedures that could be used without I/S support?

☒ Yes (Answer 13-14)
☐ No (Answer 15)

13. The manual procedures were last tested on: on development.

14. The operation cost of the manual procedures are: 100,000 baht / month.

15. Does it practical to develop the manual procedures, and how many of work days require to develop them?

16. The other factors that should be impact of the loss of this department process are:

F6. Finance Department

1. The most significant impact to the department that would result from the loss of this department process:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Loss of Revenue | <input type="checkbox"/> Loss of Shareholder Value |
| <input checked="" type="checkbox"/> Loss of Profit | <input checked="" type="checkbox"/> Loss of Goodwill |
| <input checked="" type="checkbox"/> Loss of Market Share | <input type="checkbox"/> Loss of Investor Confidence |
| <input checked="" type="checkbox"/> Legal/Regulatory Violations | <input checked="" type="checkbox"/> Loss of Productivity |
| <input type="checkbox"/> Other _____ | |

2. The department process can continue to function without I/S support within:
(Assume the loss of I/S support occurs during the peak period.)

- | | |
|---|--|
| <input type="checkbox"/> Less than 1 day. | <input type="checkbox"/> Up to 2 weeks. |
| <input checked="" type="checkbox"/> Up to 2 days. | <input type="checkbox"/> Up to 1 month. |
| <input type="checkbox"/> Up to 4 days. | <input type="checkbox"/> Up to 3 months. |
| <input type="checkbox"/> Up to 1 weeks. | |
| <input type="checkbox"/> Other _____ | |

3. The estimate of non recoverable losses to the company if the department process could not be provided.

- | | |
|---|--|
| <input type="checkbox"/> Less than 10,000 B. | <input type="checkbox"/> Between 5,000,000 to 9,999,999 B. |
| <input type="checkbox"/> Between 10,000 to 99,999 B. | <input type="checkbox"/> Between 10,000,000 to 99,999,999 B. |
| <input type="checkbox"/> Between 100,000 to 999,999 B. | <input type="checkbox"/> 100,000,000 or More. |
| <input checked="" type="checkbox"/> Between 1,000,000 to 4,999,999 B. | |

The loss recurring : Per Hour Per Day Per Week Per Month

4. The following categories, indicate the relative impact of the loss of this department process for each time frame slots below.

Assume the outage is continuous and occurs during a time of peak business activity.

CATASTROPHIC: Out of business and / or endanger public safety.

SIGNIFICANT: Major impact on the long-term financial status of the company
and / or endanger public safety.

MODERATE: Major impact on the short term financial status of the company.

MINOR: No impact to the financial of the company.

- | | |
|---------|---------------------------------------|
| 1 Hr. | <input type="checkbox"/> Minor |
| 8 Hr. | <input type="checkbox"/> Minor |
| 48 Hr. | <input type="checkbox"/> Moderate |
| 72 Hr. | <input type="checkbox"/> Moderate |
| 1 Week | <input type="checkbox"/> Significant |
| 1 Month | <input type="checkbox"/> Catastrophic |

5. The loss of this department process would keep us from supplying the following services to our external customers :

☐ Customer , Government divisions, Suppliers. _____

6. The loss of this department process would keep us from supplying the following services to our internal customers :

☐ Sales and Marketing, Operation department _____

7. The peak time and / or critical time of year and / or day of the week, if any, for this department process.

<input checked="" type="checkbox"/> January	<input type="checkbox"/> Monday	<input type="checkbox"/> End of Week
<input type="checkbox"/> February	<input type="checkbox"/> Tuesday	<input type="checkbox"/> Half Month
<input type="checkbox"/> March	<input type="checkbox"/> Wednesday	<input checked="" type="checkbox"/> End of Month
<input type="checkbox"/> April	<input type="checkbox"/> Thursday	<input checked="" type="checkbox"/> End of Quarter
<input type="checkbox"/> May	<input type="checkbox"/> Friday	<input checked="" type="checkbox"/> End of Fiscal Year
<input checked="" type="checkbox"/> June	<input type="checkbox"/> Saturday	<input type="checkbox"/> End of Calendar Year
<input type="checkbox"/> July	<input type="checkbox"/> Sunday	<input checked="" type="checkbox"/> Other <input type="checkbox"/> Launching new Product .
<input type="checkbox"/> August		
<input type="checkbox"/> September		
<input type="checkbox"/> October		
<input type="checkbox"/> November		
<input checked="" type="checkbox"/> December		

8. The applications that I/S support this department process:

Application	Critical	On-line/Batch	Transaction	Rank
Order Processing	Y	On-line	4000 Ord/M	
Credit Control	Y	On-line	4000 Ord/M	
PDC Collection	N	On-line	800 / M	
A/R	Y	On-line	10000 / M	
		Batch		
Inventory	Y	On-line	10000 / M	
		Batch		
G/L	Y	Batch	1500 / M	
Fixed Asset	N	Batch	20 / M	
VAT	Y	On-line	6000 / M	

9. This department process is distributed in 5 geographic locations.

10. The specialized equipment or customized supplies required in supporting this department process are:

AS/400 Terminal and Printer, Pre-printed forms

11. This department process dependent upon and / or required for none department process.

12. Dose this department process have documented manual procedures that could be used without I/S support?

☒ Yes (Answer 13-14)
☐ No (Answer 15)

13. The manual procedures were last tested on : long time ago.

14. The operation cost of the manual procedures are: 180,000 - 240,000 baht.

15. Does it practical to develop the manual procedures, and how many of work days require to develop them?

16. The other factors that should be impact of the loss of this department process are:

APPENDIX G

Save and Restore Cost Calculation.

From hardware configuration.

IBM 9348 Model 1 Magnetic Tape Unit.

Rack-mounted, front-loading, auto loading, 2400 ft. Industrial standard 1/2 inch reel to reel tape.

Dual system density 1600/6250 bpi.

Instantaneous data rate of 200 Kb/sec or 781 Kb/sec.

Model D35 through D45 support to up to two 9348s and models D50 through D80 support up to four.

Visual readout gauge.

Number of objects (files) in the systems up to 30,000 with consumes to 2,000 Mb.

We assume using the tape density 6250 with capacity 171 Mb and throughput up to 781 Kb/s.

G1 In case 1.

$$\begin{aligned}\text{Number of tape used} &= 2000 \text{ Mb} / 171 \text{ Mb} \\ &= 12 \text{ reels}\end{aligned}$$

$$\begin{aligned}\text{For streaming mode} &= 2000 \times 1024 / 781 \\ &= 44 \text{ Min.}\end{aligned}$$

G2 In case 2.

The space using can be separate to :

Systems = 370 Mb.

Data = 673 Mb.

Application = 300 Mb.

Test Environment = 370 Mb.

Backup data = 280 Mb.

Number of tape used, for Systems = $370 / 171$

= 3 reels

Number of tape used for Non System = $1343 / 171$

= 8 reels

For time consuming may be more because of mode of tape write will be start stop mode.

G3 In case 3.

For complexes approach, we may design the procedure as :

Systems Save Semi Annual

Storage using = 3 reels.

Time using = $370 \times 1024 / 200$

= 32 min.

Application Save Quarterly or Monthly

Storage using = 2 reels.

Time using = $300 \times 1024 / 200$

= 26 min.

Data

Save Daily

Storage using = $280 / 171 = 2$ reels.

Time using = $280 \times 1024 / 200$

= 24 min.

G4 In case 4.

For limited, Incomplete save, we usually save only data and information change.

Data

Save Daily

Storage using = $280 / 171 = 2$ reels.

Time using = $280 \times 1024 / 200$

= 24 min.

Note. All of the case calculation, the number of minute is data transfer time which less than the actual time. In reality, the times spend more than this and varying from model to model because of different processing speed.

