ANALYSIS AND DESIGN OF MATERIALS INFORMATION SYSTEM IN DCW PATIALA

A Thesis
Submitted in partial fulfillment of the requirements
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of
MASTER OF ENGINEERING
In
COMPUTER SCIENCE

by

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DECLARATION

I hereby certify that the work presented in the thesis entitled **"ANALYSIS AND DESIGN OF MATERIALS INFORMATION SYSTEM IN DCW PATIALA"** in partial fulfillment of the requirements for the award of degree of Master of Engineering in Computer Science, is being submitted in the department of Computer Science and Engineering, Thapar Institute of Engineering and Technology (Deemed University), Patiala.

It is further certified that the work carried out for the thesis is an authentic record done under the supervision of Dr. P. K. Bansal and Dr. D. P. Goyal. The matter presented in the thesis has not been submitted by me for the award of any other degree of this or any other university.

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This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

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ABSTRACT

Decision-making constitutes an important and essential part of policy formulations for any organization operating in domestic or global environment. Instantaneous availability of outstanding information ensures accuracy of the decision. The multidimensional and voluminous data availability makes data handling and maintenance a difficult task. Management Information System becomes handy in the decision-making process of managers.

MIS is an integrated and user-machine Management Information System for providing information to support operations, management, and decision-making functions in an organization and utilizes computer hardware, software, manual procedures, models for analysis, planning, control and decision-making and a database. A system designer develops an information system according to the needs of an organization. But it has been observed that there remains a communication gap between the decision makers and system developers, mainly because of their different perceptions about the information system. This is responsible for various shortcomings in the developed systems.

In this study an attempt has been made to develop an information system of the organization, DCW Patiala, which would address the information needs of organization managers. Since there are a number of process development models that must be adhered to, while designing such information systems. Selection and complying of the appropriate model helps in efficient design. This study also analyzed and evaluated various process development models under different parameters. On the basis of the study, applicability and relevance, System Development Life Cycle Approach has been found to be the most suitable as compared to other models namely, prototyping, waterfall, iterative and thus applied for developing Materials Information System of the organization, DCW Patiala. Further the requirement analysis and feasibility study has also been undertaken for the organization in question. Depending upon stated

parameters and intensive discussions with the managers of organization, conceptual design, detailed technical design and appropriate database for the problem in hand has been prepared. A pseudocode has been given for various modules used in system development. The thus designed system has been found to their utmost satisfaction and addresses to all the communication gaps between the users and developers. Further, the developed information system, would be optimal for present needs, flexible enough to cope up with future changes, and would have minimum failure rate.

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CHAPTER 1
INTRODUCTION

1.1 NEED FOR MIS

Information system plays a vital role in every kind of organization. Be it Engineering Simulation, Printing and Publishing, Weather Forecasting, Medical Sciences, Management, Education etc., information system plays a dominant role. In the era of Globalization and Information Technology, information system plays very competitive role. These systems assist the decision-makers by providing useful information at various stages of decision-making. In these days decision makers in organization cannot rely on their guesswork or intuitions but they need right information at right time. In other words, useful information is an essential input for decision-making. Such information, which is timely required, efficient and accurate, can be provided by computer based information system in the organization. [12]

Management Information System is an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organization. The system utilizes computer hardware and software, manual procedures, models for analysis, planning, control and decision-making and a database. The area of MIS is well adopted in developed countries and is given due attention while analyzing, designing, implementing and maintaining a system. However in developing countries like India, many organizations have already acquired computer based information systems or are in the process of acquiring these systems. But before a huge amount is committed in developing and acquiring these systems, there is a need to study the process of information system development, as the success or failure of information system largely depend upon the development process. There are various process models used to develop software [8], but how these models are actually implemented in practice are required to be investigated so that

information systems are properly analyzed, designed, implemented and maintained.

There have been various reasons of Information System project failure. Some of these are described as below: [11]

i) Overlooking analysis and design often leads to a system that is difficult to test and is in constant need of repair and modification. The actual division of time ends up being in following table along with its graph, fig 1.1:

Actual Practice

Stage	Percentage of time
Maintain	45%
Code	30%
Test	15%
Design	07%
Analyze	03%

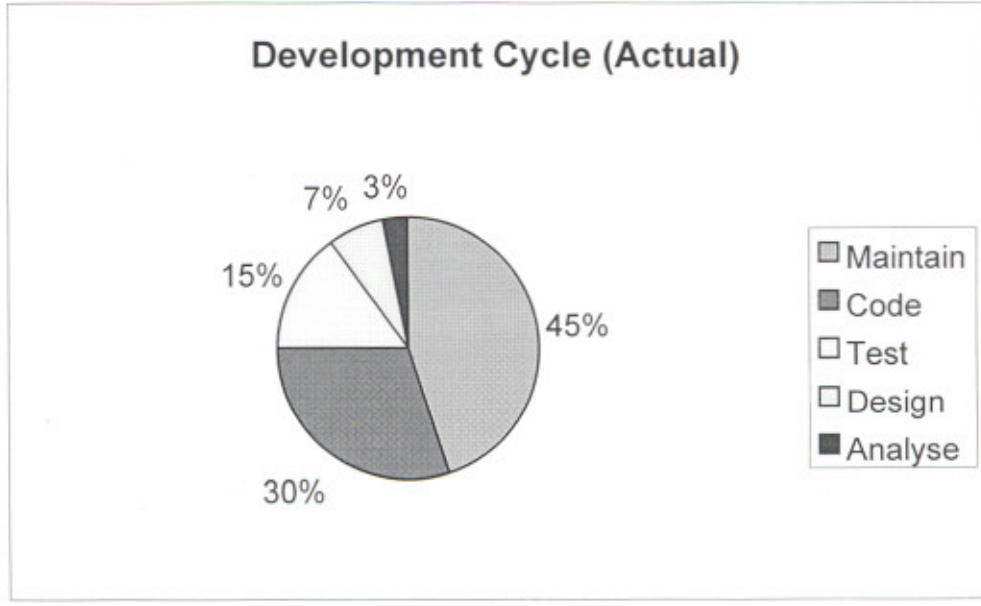


Fig 1.1 Actual division of s/w development time

Source : The Lance A Leventhal Microtrend series

ii) Another reason for software projects that run behind schedule and over budget is incorrect allocation of time, for different development stages. Many people expect coding to consume most of the time. They all but ignore requirements, analysis, design, test & maintenance. A typical estimated division of time is given as follow and shown graphically in fig 1.2:

Original Perception

Stage	Percentage of time
Code	70%
Design	10%
Test	10%
Analyze	05%
Maintain	05%

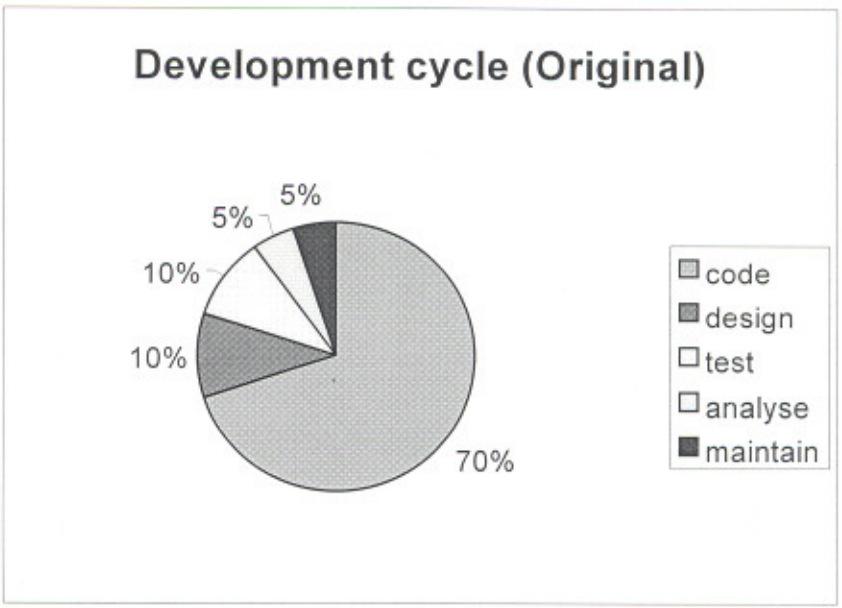


Fig 1.2 Estimated division of s/w development time

Source : The Lance A Leventhal Microtrend series

By recognizing the importance of analysis and design the developer can reduce the total effort involved and perhaps more important make it more predictable. The corrected emphasis should be as given in the following table along with its graph in fig 1.3 :

Corrected Emphasis

Stage	Percentage of time
Code	30%
Design	30%
Test	10%
Analyze	15%
Maintain	15%

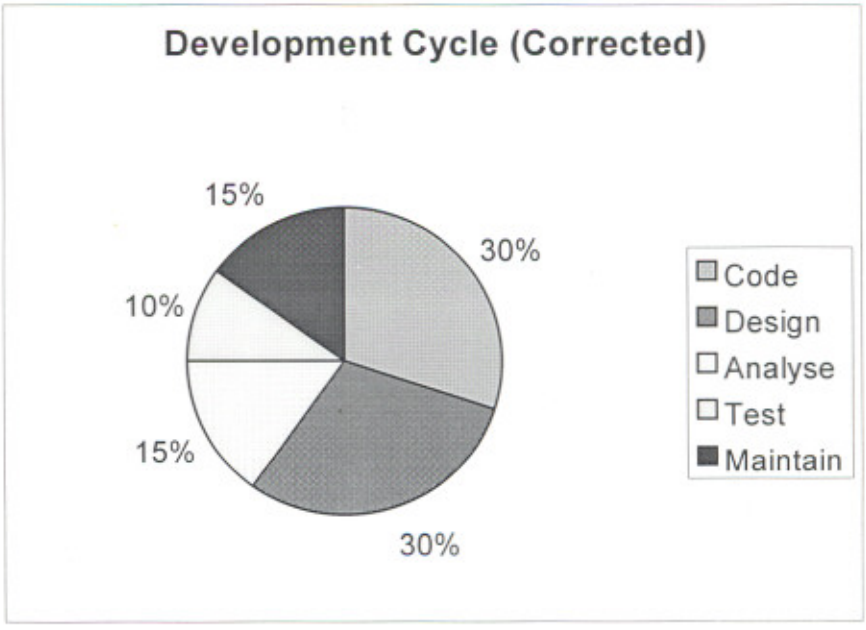


Fig 1.3 Corrected division of s/w development time

Source : The Lance A Leventhal Microtrend series

iii) Further, software project failure has also been attributed to the arbitrary selection of a suitable process model. The phased development process is central to the software engineering approach for solving software crisis. Various models for developing Information System are like: [4]

System development life cycle,

Prototyping,

Waterfall,

Iterative,

Spiral model, etc.

All these models have their own merits and demerits that will be discussed in detail, in the next chapter. Software Engineering approach to develop an Information System is given below.

1.2 THE SOFTWARE ENGINEERING APPROACH FOR DEVELOPING MIS

The basic objective of software engineering is to develop methods and procedures for information system development that can scale up for large systems and that can be used to consistently produce high quality software at low cost and with a small cycle time. The key objectives of software engineering approach are:

- Consistency
- Low cost
- High quality
- Small cycle time
- Scalability

The development process consists of various phases, each phase ending with a defined output. The basic phases required in any software development are briefly described as below: [8]

1. Requirement Analysis:- This phase is done in order to understand the problem, that has to be solved by developed software system. The main goal of

requirement analysis phase is to produce the software requirement specification documents. There are two major activities in this phase i.e. Problem analysis and Requirement specification. In problem analysis the analyst has to understand the problem and the existing system, parts of which have to be automated. Once problem is analyzed, then requirements must be specified like, format of inputs and outputs, design constraints etc.

2. Software Design:- The purpose of the design phase is to plan a solution of problem specified by the requirement analysis. The design of system is the most critical factor affecting the quality of software. The design activity is divided into two separate phases, system design and detailed design. System design identify the modules that should be in the system, the specifications of these modules and how they interact with each other to produce desired results. During detailed design the internal logic of each of the module is decided.

3. Coding:- Coding phase converts design specifications into an actual program. Well-written code can reduce the testing and maintenance effort. During coding phase stress should be on developing programs that are easy to read and understand, not simply on developing programs that are easy to write.

4. Testing and Debugging:- This phase involves verifying and validating the program through both internal and external testing by the customer in a controlled situation.

5. Maintenance:- This phase is responsible for correcting errors found during use and extending the program to handle new requirements and modifying the old requirements.

Keeping in view, the need to investigate the implementation of various process models for developing information system, in specific organization, Diesel Component Works has been selected for the purpose of study. The organization has been selected, because of a large public sector organization, where huge resources of the country are committed and thus efficient information systems have a direct bearing on the decision-making of its managers. Secondly, DCW was an organization, where the concept of information system have been applied and adopted.

1.3 PROFILE OF DCW

The Indian Railways network is owned and managed by the Central Govt. All the operations are controlled and directed by the Railways Board under the overall supervision of the Minister of Railways. The network of railways is divided into nine Zonal Railways each under the control of a General Manager. Each railway zone is organized on the divisional pattern of working. On a Zonal railway GM is assisted by additional GMs and HODs such as chief Engineer, chief Operating Superintendent, chief Mechanical Engineer, controller of stores etc. [9]

In addition there are six modern production units:-

1. Chittaranjan Locomotive works at Chittaranjan.
2. Integral coach factory at Parambur, Madras.
3. Diesel Locomotive Works at Varanasi.
4. Wheel and Axel plant at Bangalore.
5. Diesel Component Works at Patiala.
6. Rail Coach Factory at Kapurthala.

1.3.1 OBJECTIVES OF DCW

Indian Railway has a fleet of over 3500 diesel electric locomotives. A large number of high-tech mechanical, electrical and electronic systems go into a diesel locomotive to form a complex and composite system capable of meeting its exact performance requirements. The DCW was setup in 1984 with help of Word Bank Loan to provide maintenance of spares to diesel Locos and to substitute imports. DCW significantly raise the level of availability and enhance the service life of diesel locomotives in the Indian Railways. This support is being provided by DCW through:

a) Manufacturing and supply of high quality components and assemblies as spares.
b) Remanufacturing of critical assemblies for the unit exchange system of diesel loco maintenance regime of railways. E.g. Power Pack Systems.
c) Rebuilding Locomotives and Power Packs. This is done at the midlife of 18 to 20 years of the locomotive. Retrofitting the locomotives with the

systems incorporating the latest technology developments in this process results in higher performance and improved fuel efficiency.

d) Manufacture of components for import substitution and timely availability.

1.3.2 PRODUCTION

The total value of production that DCW has achieved during the year 1998-99 is the best ever out turn of Rs. 203.26 Crores against the Action Plan Target of Rs. 160.19 Crores i.e. 26.89% higher than the target and 10% higher than than the previous best performance of Rs. 184.79 Crores during 1997-98. The out-turn of Phase-I production and remanufacturing shops were Rs. 88.57 Crores. The out-turn of Phase–II rebuilding group of shops were Rs. 114.69 Crores. 78 Locomotives were remanufactured against the target of 72 during the financial year 1998-99. All these Locos are fitted with fuel efficient Kit. In addition dryers are also being provided on rebuilt locos on regular basis. 09 Nos. of Power Packs were also assembled and dispatched to various Zonal Railways. The total value of production ends up being in following table along with its graph in fig 1.4: [3]

VALUE OF PRODUCTION

(In Lacs of Rs.)

YEAR	PRODUCTION
1987-88	651
1988-89	1415.25
1989-90	3001.25
1990-91	5421.56
1991-92	8710.98
1992-93	11177.24
1993-94	11221
1994-95	15473.29
1995-96	16165.81
1996-97	16562.98
1997-98	18479.38
1998-99	20325.85

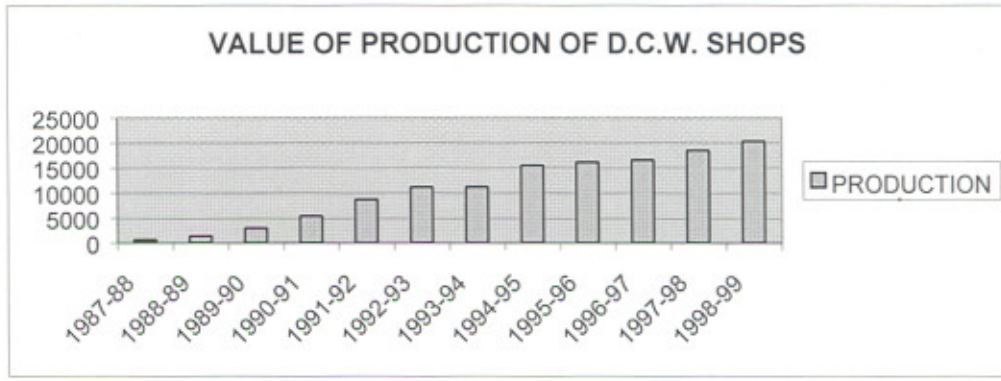


Fig 1.4 Total value of production

Source : The Annual Report 1998-1999 of DCW

The shop-wise production for year 1998-99 ends up being in following table along with its graph in fig 1.5:

SHOPWISE VALUE OF PRODUCTION

(In Lacs of Rs.)

SHOP	PRODUCTION
CBS	793.58
CLS	514.75
LMS	2485.87
TMS	4380.93
HMS	487.07
PH-II	11177.24

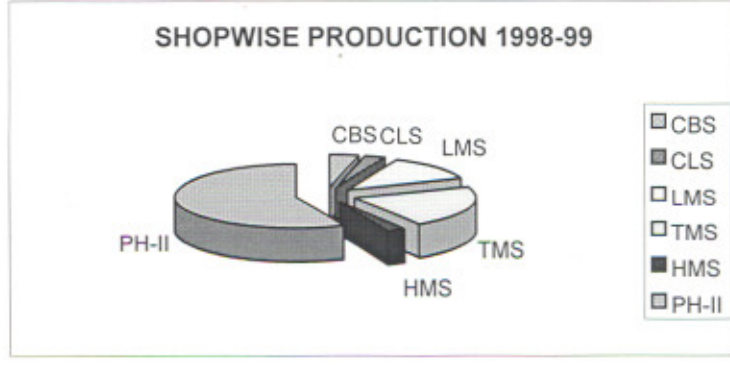


Fig 1.5 Shop-wise Production for 1998-99

Source : The Annual Report 1998-1999 of DCW

1.3.2.1 INDUSTRIAL ENGINEERING AND PRODUCTIVITY

a) DCW is manufacturing outgoing cable leads, Mica bushes and Mica 'V' Cones for Traction Motors. This has resulted in substantial savings, as these were earlier being purchased from BHEL.

b) During the financial year 1998-99 savings of Rs. 1.62 crores has been achieved due to in house manufacturing of various trade –items.

c) The average locomotive remanufacturing cycle time achieved was 38.92 days against the target of 40 days in 1998-99.

d) DCW has fabricated a cleaning tank for loco under-frame cleaning. The size of the tank is 17 x 4 x 2mtrs, This has resulted in improved cleaning of under frames as well as fuel tanks which were earlier not cleaned properly due to inaccessibility of many internal areas.

e) Reclamation / Reconditioning of components is being done in a big way for use on remanufactured locomotive. This has resulted in substantial reduction in requirement of new components.

f) Electronics Lab played an important role in maintaining CNC machines by reclaiming 173 PCBs worth Rs. 79.16 lacs during the financial year 1998-99. [3]

1.3.2.2 INTRODUCTION TO NEW PRODUCTS:

1. For the first time DCW has manufactured motorized Bogie for direct use by Zonal Railways. During the year 1998-99, eight Motorized bogies have been supplied to Railways. This system will be very useful for the shed maintenance because with stand-by motorized bogies as a unit exchange spare, the down time of locomotive, with bogie defects, will reduce considerably.

2. One loco no. 17663TKD/N. Railway was rebuilt in Dec'98. It was fitted with GE Turbo along-with the twin after cooler & modified turbo supports. M/s GE Transportation Systems/USA supplied these items.

3. At present Electro-Hydraulic Governor supplied by M/s. EDC, New Delhi is being fitted on the locomotives after rebuilding. However, one number wood ward Governor was fitted on Loco no 17985 as desired by the concerned diesel shed.

The said governor was overhauled and tested at DCW for the fitment of locomotive.

1.3.3 TECHNOLOGICAL UPGRADATION

One of the aims of the Locomotive rebuilding program is to upgrade the technological and design features of the locomotives besides bringing the locomotives to as good as new condition. Following modifications are carried out on the rebuilt locomotives:

- Conversion of 28 LV-1 brake system to 28 LAV-1 twin pipe air brake system along with fitment of higher capacity compression exhauster of KE-6 type.
- Conversion of static type to electronic type excitation systems. Pressurization of cooling water system.
- Opening and cleaning of fuel tank.
- Provision of airflow indicator.
- Provision of additional filter in turbo super charger system.
- Fuel efficient Kit fitment.
- Provision of internal air filter.

DCW has implemented fuel-efficient modifications. For this, DCW has designed new power packs fitted with complete fuel-efficient kit and with help of these power packs, it becomes possible to incorporate fuel-efficient modifications along with high efficiency turbo charger and steel cap piston, on rebuilt locomotives.

For the first time in DCW one Power Pack No 703, was fitted with unit camshaft. This unit camshaft was manufactured by LMS. The advantage of unit camshaft is that in case one of the cam lobe at particular location is damaged during running, the same camshaft segment can be taken out from the assembly from that particular location itself, after removing FIP support. It will avoid the removal of complete sub-assemblies at free end. In conventional design, the complete

camshaft and sub-assemblies at the free end have to be removed whenever any cam lobe is damaged.

DCW has started fitment of barrel shaped piston rings supplied by M/s Kaydon, USA during rebuilding of locomotives. The sheds have reported that barrel shaped piston rings are giving encouraging results with respect to lube oil consumption. [3]

1.3.4 EXPORT

Efforts of export were sustained during 1998-99. DCW was able to widen its export base by export in various Diesel Loco Spares to several countries like Tanzania, Malaysia and Sri Lanka through RITES and IRCON. A record export of spares worth as Rs. 134.65 lacs was achieved during the year 1998-99. [3]

1.3.5 QUALITY ASSURANCE

DCW believes that product quality has to be incorporated, during manufacturing. In accordance with this belief the quality assurance system forms an integral part of the workshop activities. All incoming materials are inspected for material composition, hardness, microstructure and other physical properties as well as for dimensions. There is a full-fledged laboratory equipped with physical, chemical, metallurgical and spectrographic facilities to support the quality program.

The work on implementation of ISO 9002 System in DCW, which was started in 1997, was pursued further more vigorously. The quality system, which was established on 17-11-97 was audited by internal auditors at frequent intervals and various management review meetings were called to ensure the continuity of the system. The quality system was audited twice by the external auditors of certification body, M/s Seahorse Quality System, Mumbai on behalf of M/s TNO Certification, The Netherlands. The certification body found the system fully satisfactory and hence DCW was awarded ISO-9002 certificate in Sept'98. With

this certificate the DCW has joined the illustrious-band of companies in this country.

DCW has the pride and privilege of being amongst the youngest of the production units of Indian Railways and the first to engage in remanufacture work to reach this coveted milestone. DCW has now the greater responsibility to maintain this honor. DCW is committed to maximize its customers satisfaction through continuous improvement to maintain its quality policy. In order to give focused attention to customer grievances a new section viz, customer relations section has been set up. [3]

1.4 DISADVANTAGES OF EXISTING SYSTEM

The study carried out in organization, shows that managers do not get timely information for making urgent decisions. Further it has also been observed that more of the manual work, time consumption and duplicity is involved in one of the materials department of organization. So the need has been felt, to develop an information system that would address the information needs of managers.

1.5 SCOPE OF THE STUDY

The aim of this study is to develop an information system that fulfills information requirements of the decision makers and keeping in view the various objectives like consistency, low cost, high quality, flexibility, small cycle time and scalability etc. for system development, this study has discussed and evaluated different development process models. For the purpose of this study Materials department of DCW Patiala has been selected.

1.6 ORGANIZATION OF THE THESIS

Chapter 1 cover the introduction to Information System, brief history of an organization DCW Patiala, scope of study and organization of the thesis.

Different process models have been discussed and evaluated in chapter 2, which in one or other way have significant role in developing an Information System.

The requirements and their analysis of an existing system has been presented in chapter 3. The last section of this chapter also covers in brief, the proposed computerized Information System model.

Chapter 4 covers the detailed system and database design of the proposed Information System. In the later section of the chapter complete pseudocode has been given.

Finally, the concluding part of the thesis is given in the chapter 5 and it also includes the proposals for further study needed in this area.

CHAPTER 2

DEVELOPMENT METHODOLOGIES

2.1 INTRODUCTION

The development methodologies include waterfall model, the spiral model, iterative model, prototyping approach and system development life cycle approach for developing an information system. This chapter critically evaluates all these process models, which in one or other way have significant role in developing an information system.

2.2 WATERFALL METHOD

The simplest process model is the waterfall method, [8] which states that the phases are organized in a linear order. There are various variations of the waterfall method depending on the nature of activities and the flow of the control between them. In a typical model, a project begins with feasibility analysis, on successfully demonstrating the feasibility of a project, the requirement analysis and project planning starts. The design starts after the requirement analysis is complete and the coding begins after the design is complete. Once the programming is completed, the code is integrated and testing is done. On successful completion of testing, the system is installed. After this, the regular operation and maintenance of the system takes place. The model is shown in the figure 2.1. With the waterfall model, the sequence of activities performed in a software development project is:

- Requirement analysis
- Project planning
- System design
- Detailed design
- Coding and unit testing
- System integration and testing.

But one of the important consequences of linear ordering is to clearly identify the end of a phase and beginning of next phase. This is usually done by some verification and validation means that will ensure that the output of a phase is consistent with its input, and that the output of the phase is consistent with the overall requirement of the system.

The consequence of the need for certification is that each phase must have some defined output that can be evaluated and certified. That is, when activities of a phase are completed, there should be some product that is produced by that phase. And the goal of that phase is to produce this product. The outputs of the earlier phases are often called work products.

For a successful project resulting in a successful product, all phases listed in the waterfall method must be performed anyway. Any different ordering of the phases will result in a less successful software product. A successful software product is one that satisfies all the objectives of the development project.

2.2.1 Project outputs in Waterfall model

The output of the project employing the waterfall model is not the final program. There are a number of intermediate outputs that must be produced to produce a successful product. The following set of documents generally forms the minimum set that should be produced in each project:

- Requirement document
- Project plan
- System design document
- Detailed design document
- Test plan and test reports
- Final code
- Software manuals
- Review reports

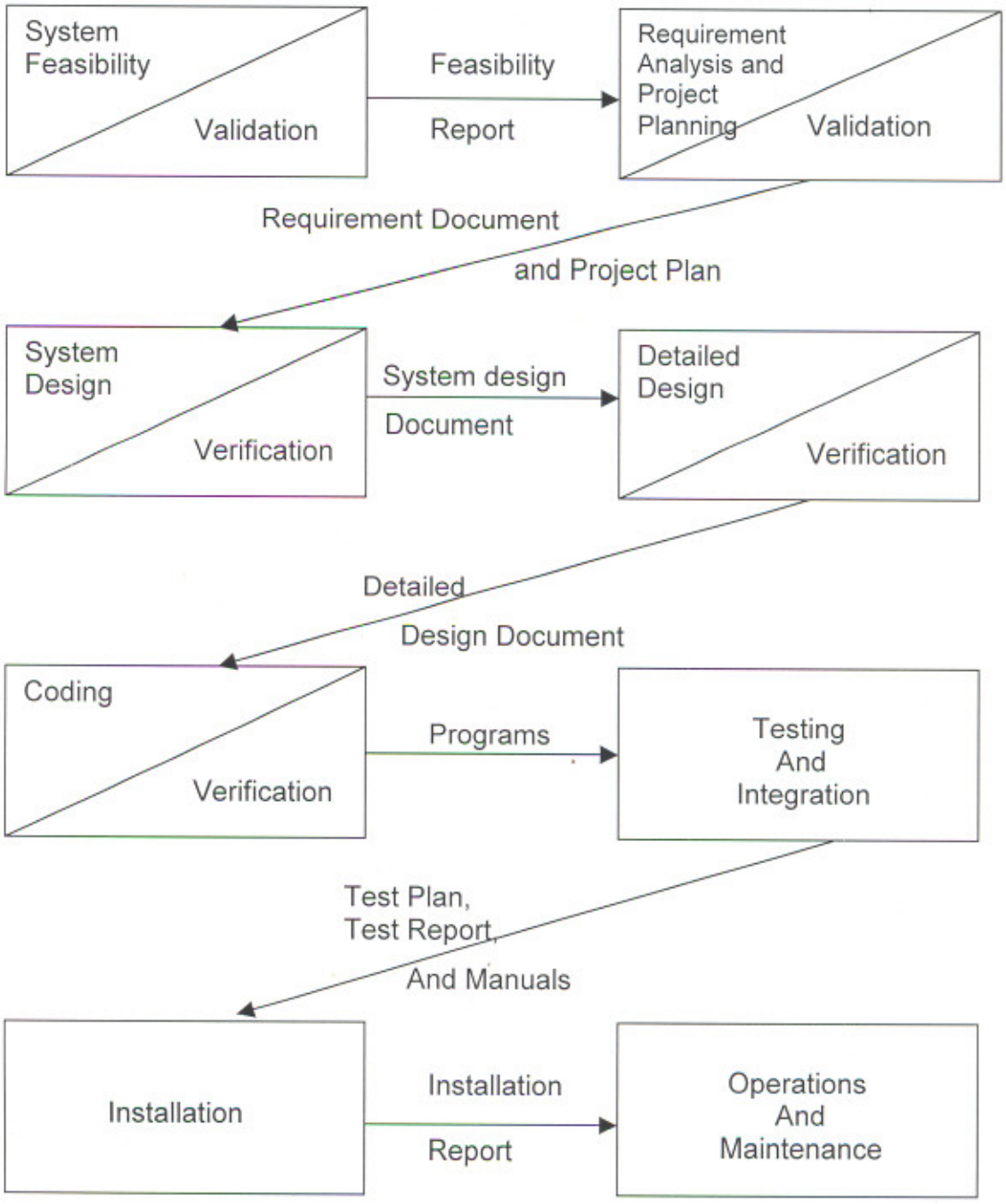


Figure 2.1 The waterfall model

2.2.2 Limitations of Waterfall Model

1. This model assumes that the requirements of a system can be frozen before the design begins. It is suitable for systems designed to automate an existing manual system. For the new systems it is difficult to determine the requirements of the user,

2. A large project might take a few years to complete. If the hardware is selected early due to freezing of requirements, then due to speed of hardware technology changing, it is likely that the final software will use a hardware technology on the verge of becoming obsolete.

3. This model suggests that the requirements be completely specified before the rest of the development can proceed. So it becomes very difficult in situations where it is desirable to first develop a part of the system completely and then later enhance the system in phases.

4. The document driven process that requires formal documents at end of each phase makes the process documentation heavy and is not suitable for many applications.

2.3 ITERATIVE ENHANCEMENT

The main idea of Iterative Enhancement model is that the software should be developed in increments, each increment should add some functional capability to system until the full system is implemented. At each step extensions and design modifications can be made. The major advantage of this approach is that it can result in better testing because testing of each new step is easier than testing the entire application. [8]

In the beginning of this model a simple initial implementation is done for a subset of the overall problem. This subset is one that contains some of the key aspects of the problem that are easy to understand and implement and forms a useful and usable system. A project control list is created that contains, in order, all the tasks that must be performed to obtain the final implementations. This project

control list also gives an idea of how far the project is at any given step from the final system. The iterative enhancement model is shown in figure 2.2 given below

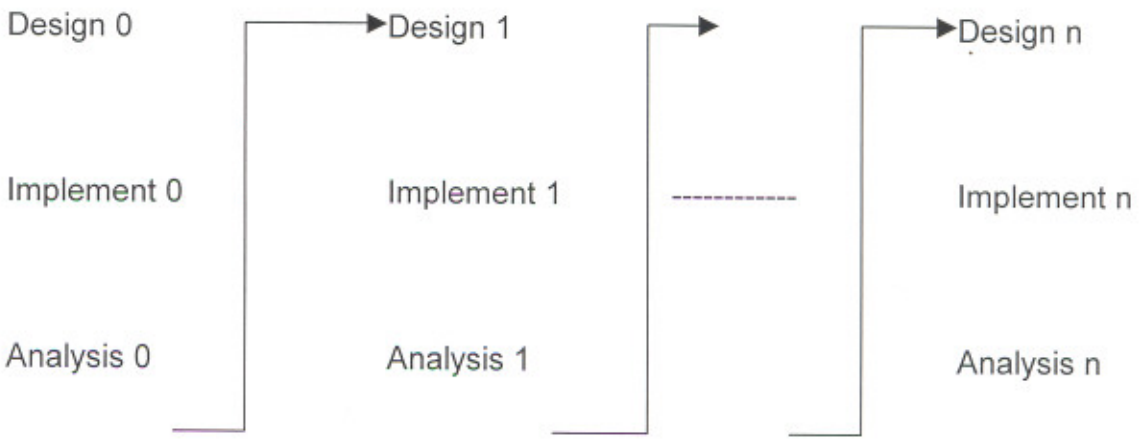


Figure 2.2 The Iterative Enhancement Model

Each step consists of removing the next task from the list, designing the implementation for the selected task, coding and testing the implementation, performing an analysis of the partial system obtained after this step, and updating the list as a result of the analysis. These three phases are called the design phase, implementation phase and analysis phase. The process is iterated until the project control list is empty, at which time the final implementation of the system will be available.

The project control list guides the iteration steps and keeps track of all tasks that must be done. Based on the analysis, one of the tasks in the list can include redesign of defective components or redesign of the entire system. However, redesign of the system will generally occur only in the initial steps. In the later steps, the design would have stabilized and there is less chance of redesign. Each entry in the list is a task that should be performed in one step of the iterative enhancement process and should be simple enough to be completely understood.

Most effective use of this model is for product development, in which the developers themselves provide the specifications and therefore have a lot of control on what specifications go in the system and what stay out. In fact, most products undergo this type of development process. First, a version is released that contains some capability. Based on feedback from users about this version, a list of additional desirable features and capabilities is generated to produce next enhanced version.

Major problems that arise in a customized software development is, where the client has to essentially provide and approve the specifications, it is not always clear how this process can be applied. Another practical problem with this type of development project comes in generating the business contract. How will the cost of additional features be determined and negotiated, particularly because the client organization is likely to be tied to the original vendor who developed the first version.

Overall, in these type of projects, this process model can be useful if the core of the application to be developed is well understood and the increments can be easily defined and negotiated.

2.4 THE SPIRAL MODEL

Boehm has been proposed this model. The activities in this model can be organized like a spiral that has many cycles. The radial dimension represents the cumulative cost incurred in accomplishing the steps done so far, and the angular dimension represents the progress made in completing each cycle of the spiral. Each cycle in the spiral begins with the identification of objectives for that cycle, the different alternatives that are possible for achieving the objectives, and the constraints that exist. This is the first quadrant of the cycle. The next step in the cycle is to evaluate these different alternatives based on the objectives and constraints. The focus of evaluation in this step is based on the risk perception for the project. Risks reflect the chances that some of the objectives of the

project may not be met. The next step is to develop strategies that resolve the uncertainties and risks. This step may involve activities such as benchmarking, simulation, and prototyping. Next, the software development, keeping in mind the risks. Finally the next stage is planned. The development step depends on the remaining tasks. [8]

The risk driven nature of the spiral model allows it to accommodate any mixture of a specification-oriented, prototype-oriented, simulation-oriented or some other type of approach. This model also incorporates some of management and planning activities. This model is shown in fig. 2.3.

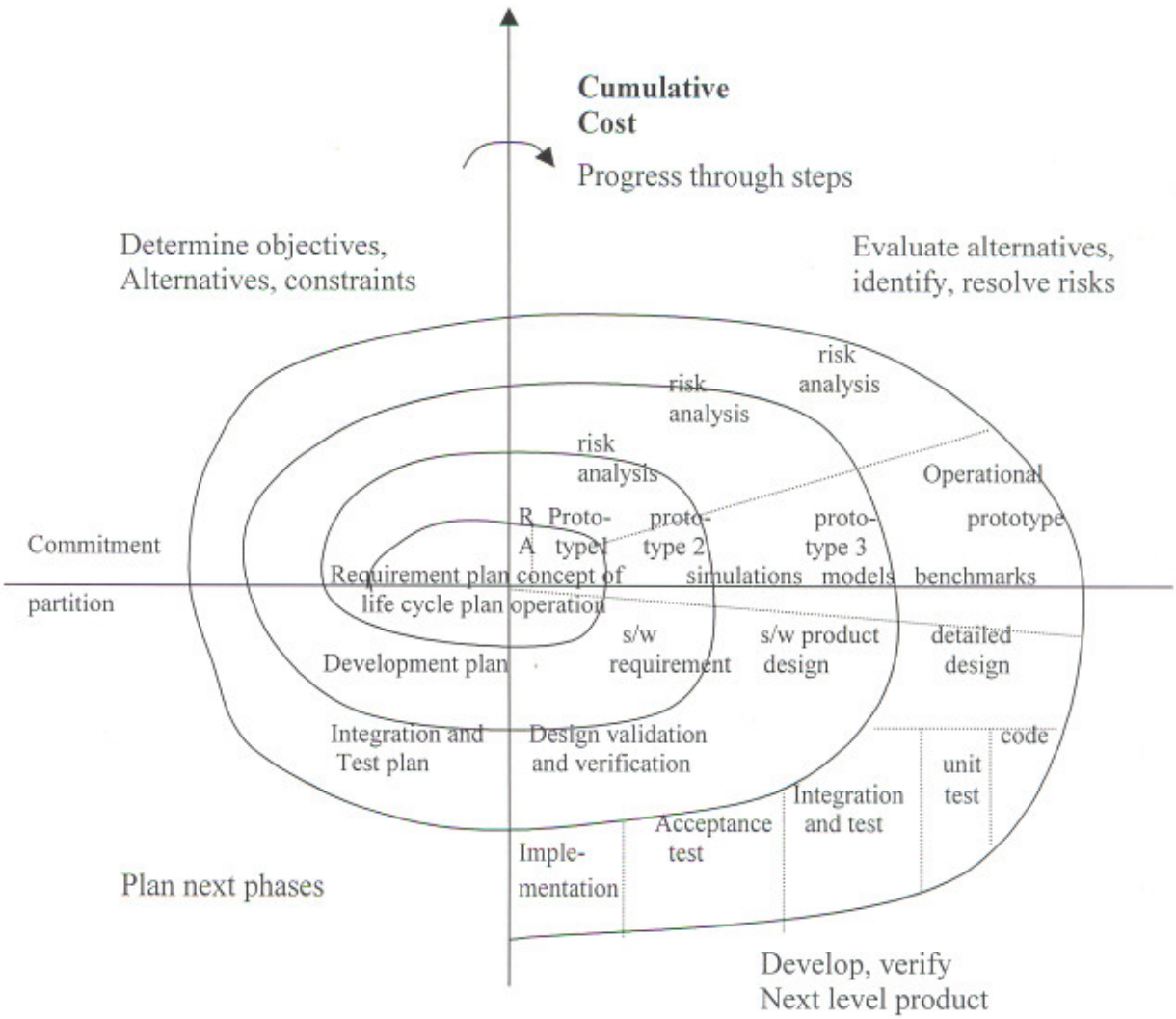


Figure 2.3 THE SPIRAL MODEL

2.5 PROTOTYPING APPROACH

The prototyping methodology is based on the simple proposition that people can express what they like or do not like about an existing application system more easily than they can express what they think they would like in an imagined, future system. The basic idea here is that instead of freezing the requirements before any design or coding can proceed, a throwaway prototype is built to help understand the requirements. Development of the prototype obviously undergoes design, coding and testing, but each of these phases is not done very formally. Prototyping is used when requirements are difficult to specify in advance or when requirements may change significantly during development. [4]

Users and the system designers play significant role in developing prototype. Basically four steps are involved in Prototyping Process Model for an application system development, which are briefly discussed as follow:

1. Identify the user's basic information requirements: At the first stage the user give basic needs in terms of output from system. The designer's responsibility is to establish the user requirements and to give the estimate about cost of developing the system.

2. Develop the initial prototype system: This step allows the designer to build a interactive application system that meets the user's basic stated information requirements. The system designer has the responsibility for building the system using very high level development languages or other development tools.

3. Use of the prototype system to refine the user's requirements: The objective of this step is to allow the user to gain hands-on experience with the system in order to understand his or her information needs and whether the system does or does not meet those needs. User will find problems with the first version and he or she decides when changes are necessary and also controls the overall development time.

4. Revise and enhance the prototype system: As per changes required by the user in early version, the designer makes requested changes. Speed in modifying the system and returning it to the user is emphasized.

Prototyping Process Model is shown in figure 2.4, which indicates that steps 3 and 4 are iterative in nature. The number of iterations may vary considerably. Modifications are made in system if user determines that the prototype is not useful and the working prototype is discarded. Other reason may be that initially the user is satisfied with the system and it becomes "operational prototype". It may be modified at a later stage, but at this point it is considerable usable and may be distributed to other users.

The prototyping model has several significant advantages in development of applications having high uncertainty as to requirements:

- It has ability to try out ideas without high cost.
- It helps in lowering overall development costs.
- It has a ability to get functioning system for users very quickly.
- It divides the labor in effective way between the user and MIS professional.
- Reduces application development time to achieve a functioning system.
- Effective utilization of human resources.

Multiple users may be involved in prototype development when the application is to complex as to require input from several specialists. Alternatively if an application requires complex technical or analytical skills, it may be necessary to have more than one designer. As user becomes more familiar with the tools used to develop system and gain experience with the use of prototypes, it will become more common for the user to also function as the system designer.

A major difficulty with prototyping is management of the development process because of frequent changes.

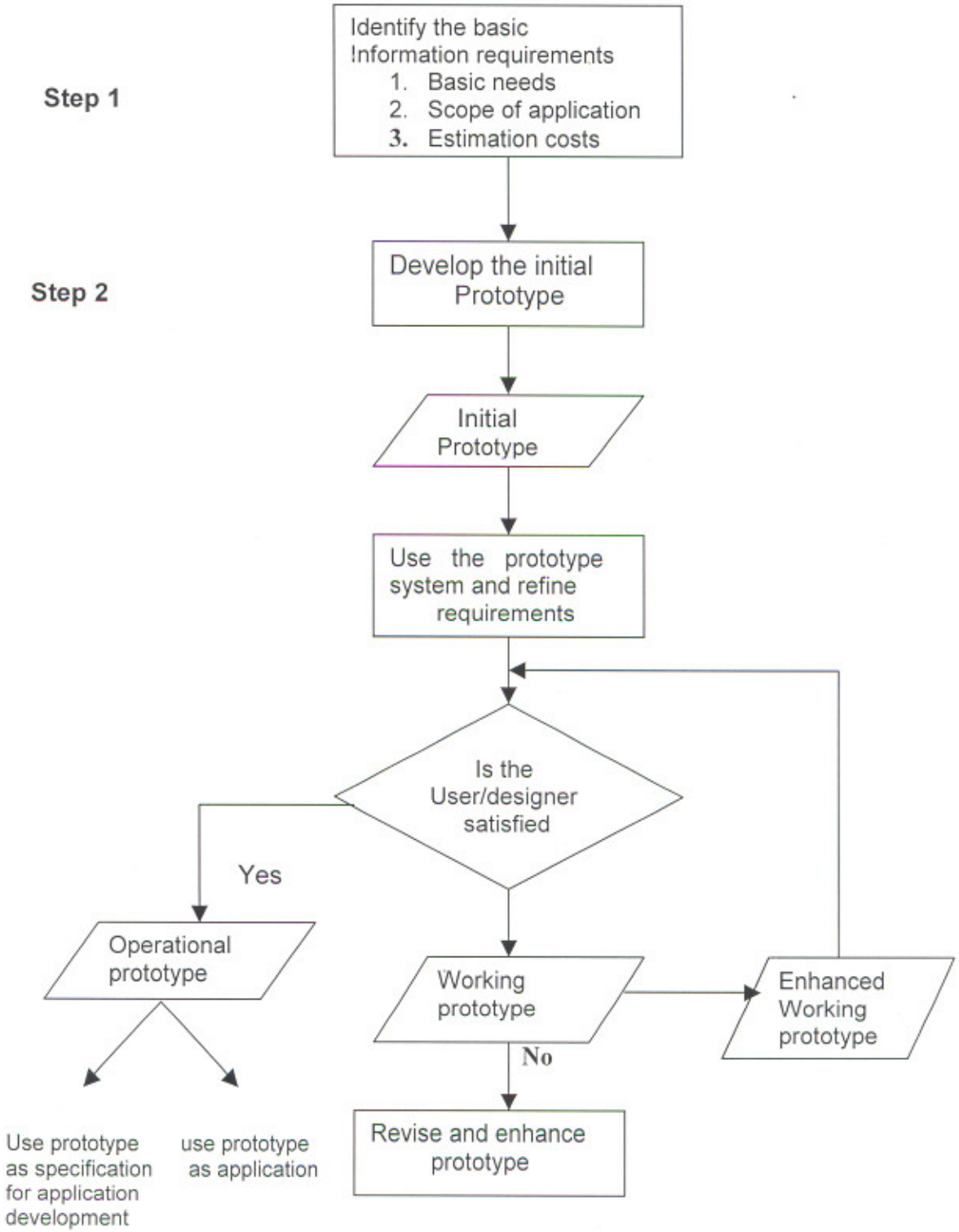


Figure 2.4 PROTOTYPING MODEL

2.6 SYSTEM DEVELOPMENT LIFE CYCLE MODEL

The basic idea of the system development life cycle is that there is a well-defined process by which an application is conceived, developed and implemented. The life cycle gives structure to a creative process. In system development life cycle model each stage of development is well defined and has straightforward requirements for feedback, sign-off and deliverables. The phases in the system development life cycle provide a basis for management and control because they define segments of the flow of work which can be identified for managerial purposes and specify the documents to be produced in each phase. [4]

The information system development life cycle for an application consists of three major stages:

1. Definition
2. Development
3. Installation and operation

The first stage is the process, which defines the information requirements for a feasible cost-effective system. The requirements are then translated into a physical system of forms, procedures, programs etc., by system design, computer programming and procedure development. The three stages of definition, development, installation and operation can be further divided into smaller steps or phases, which are described as below and shown in fig. 2.5.

2.6.1 DEFINITION Stage has following phases:

- Proposal definition
- Feasibility assessment
- Information requirement analysis
- Conceptual design.

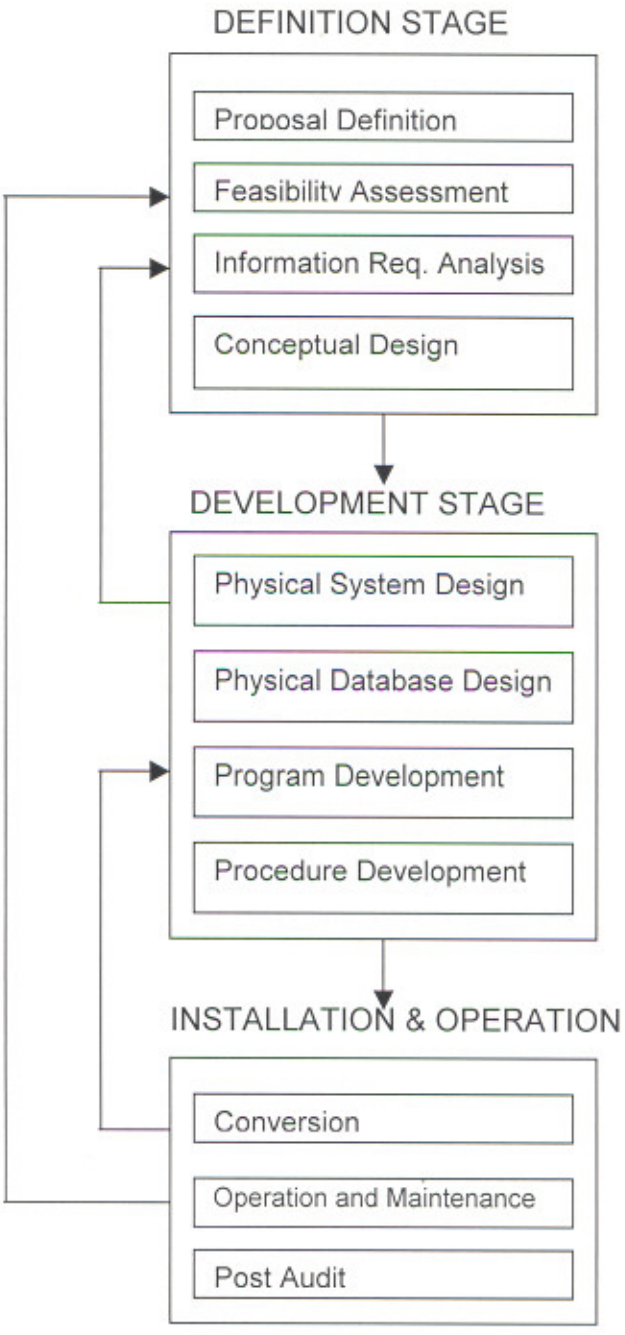


Figure 2.5 LIFE CYCLE APPROACH TO SYSTEM DEVELOPMENT

2.6.2 DEVELOPMENT Stage include following phases:

- Physical system design
- Physical database design
- Program development
- Procedure development

2.6.3 INSTALLATION AND OPERATION Stage has following phases:

- Conversion
- Operation and maintenance
- Post audit.

At completion of each phase, formal approval sign-offs are required from the users as well as from the manager of project development. Each phase also results in formal documentation. The information system development life cycle can follow an iterative assurance strategy.

2.6.1 The Life Cycle Definition Stage is further divided into four phases:

a) PROPOSAL DEFINITION: A simple procedure may be used for proposal of an application. Proposals may be for entirely new applications or for modification to existing applications. The proposal should not be complex but in short one or two page document should provide sufficient justification to support a decision to proceed with a feasibility analysis. Proposal definition document should include following list of items:

- Identification of those proposing the project and interested in it.
- The organization benefit or need for the application.
- Organizational support for budget, sponsor, management support etc.
- Schedule consideration, i.e. time required and availability of user personnel etc.

b) FEASSIBILITY ASSESSMENT: An application proposed in proposal definition phase normally goes through a feasibility study before it is approved for development. If a proposal is submitted outside of the plan, the feasibility study includes whether it is consistent with the existing plan and whether it should override the priorities of other applications already planned. Five types of feasibility are done in the study.

- ***Technical Feasibility:*** It tells whether the proposed application be implemented with existing technology. Analysis of the project risk includes what type of new technology is available in the market relative to the company's current technical sophistication.
- ***Economic Feasibility:*** The aim of economic feasibility study is, that will the newly developed system provide benefits greater than the costs. The feasibility study presents intangible as well as tangible benefits in a formal way. A relatively detailed report of the cost of development and operations of the various alternatives is also presented.
- ***Motivational Feasibility:*** It involves the probability that the organization is motivated to support the development and implementation of the new application.
- ***Schedule Feasibility:*** The probability that the organization can complete the development process in time allowed for development. Adding development resources does not always reduce the development time.
- ***Operational Feasibility:*** After the installation of new system, will it fulfill needs; this analysis may involve subjective assessment of the political and managerial environment in which the system will be implemented.

The feasibility report is reviewed by the management of information systems and by the requesting department. Once the feasibility study has been accepted and an alternative is approved, information requirement analysis can begin.

c) INFORMATION REQUIREMENT ANALYSIS: In order to effectively obtain a complete and correct set of requirements, it is necessary to use a method or

methods that take into account the extent to which requirements are already known versus their needing to be searched out or discovered. The result of information requirement analysis phase of the application development life cycle is a report detailing the requirements for the application. The requirements consist of items such as following:

- Reports that include data items
- Queries
- Conceptual schema for database
- Functional requirements
- User interface requirements

d) CONCEPTUAL DESIGN: The conceptual design phase establishes a more complete user-oriented design for the application. The conceptual design emphasizes the application as seen by those who will operate or use the outputs of the system. The conceptual design establishes the inputs and outputs, functions to be performed by the application, and application audits and controls. Typical contents of conceptual design report are the following:

- User oriented application description.
- Inputs for the application with the general description.
- Outputs produced by the application.
- Functions to be performed by the application system.
- General flow of processing with relationships of major programs, files, inputs and outputs.
- Outlines of operating manuals, user manuals and training material needed for the application.
- Audit and control processes and procedures for ensuring appropriate quality in the use and operation of the application.

2.6.2 THE LIFE CYCLE DEVELOPMENT STAGE

The development stage of the system development life cycle consists of four phases, which are explained one by one as follow:

a) PHYSICAL SYSTEM DESIGN: The physical system design phase consists of activities to prepare the detailed technical design of the application system. The physical system design is based on the information requirements and conceptual design. It provides the basis for physical database design, program development, and procedure development. The results of the physical system design phase are specifications and designs for the following:

- System design showing flow of work, programs and user functions.
- Hardware specifications for the application.
- Control design-showing controls to be implemented at various points in the flow of processing.
- Data communications requirements and specifications.
- Security and backup provisions.
- The overall structure of programs
- An application test or quality assurance plans for the remaining part of development.

System analysts and other technical personnel completed this phase. The work of the physical system design phase is to take the fairly high level, users requirements of the conceptual design phase and produce a specific technical design.

In physical system design phase simplicity can be achieved by subdividing the application system into small, relatively self-contained modules. System modules can be programs or procedures, which are subparts of the main program. System complexity is reduced because each module can be developed, coded and tested independently. Modifications can be done easily because a change

can be made to a system module with minimal efforts. Some of the other design techniques are briefly described below:

- ***TOP-DOWN Design:*** The system/program is defined by a general statement of its purpose and then broken down into smaller and smaller parts. The design is depicted as a hierarchy chart with general control modules at the top and detailed modules at the bottom. The resulting program is also hierarchically structured.
- ***STRUCTURED Design:*** In this technique each module of a program is defined by the specific function it performs. Emphasis is on minimizing the integration between modules, each module is highly cohesive, meaning all the statements within it are functionally related. Structure charts show module definition and transformation of data is represented by data flow diagrams.
- ***SYSTEM ANALYSIS AND DESIGN TECHNIQUE (SADT):*** This technique is a proprietary system utilizing a graphical modeling languages to describe, in a top-down fashion, the functions of the system and the data utilized.
- ***HIERARCHY-INPUT-PROCESS-OUTPUT (HIPO):*** It is a documentation technique, which can also be used to communicate system specifications to project participants throughout the design process.

Each of these techniques has a unique feature for defining and communicating system specifications. They can be used in communicating the design specifications to users, although they are not necessarily easy to understand for a person untrained in the technique.

b) PHYSICAL DATABASE DESIGN: The approach to physical database design for an application depends on the existing database and the approach followed for database requirements. There are three major approaches to meet the data requirement for an application:

- Create a new database. This is suitable when no database is used or a database is dedicated to the application. New data may be required to design database for the application.

- Using and modifying an existing database. This method is suitable if an evolutionary strategy for data development is followed. It may require special functions to be evoked by the database administrator for reconstructing the existing database as well as adding necessary data.
- Access an existing database by means of a user schema. This method is suitable if a complete conceptual model of the enterprise was used as the basis for physical database design. New data may need to be added to the database, but the connection between the logical description of the data needed by the application and the physical database is easily made through the database management software.

c) PROGRAM DEVELOPMENT: The goal of the program development phase is to code and test programs required for the application. Testing of each module is performed on test data by complete variations in input data in the user environment. Problems arising during the programming phase are typically a result of lack of complete specifications provided during conceptual or physical design, which often results in extensive reprogramming efforts when specifications are changed. A number of programming techniques are used to reduce complexity for e.g. modularity, structured programming, application generators and tailoring of application packages.

The concept of modularity is of subdividing a program into small well-defined modules. Modularity helps in reducing program complexity and in enhancing reliability. Each module can be coded and tested independently before being integrated and tested with other modules.

In case of Structured Programming, a small set of basic coding structures is used for all program code, which results in programs that are straightforward in flow of logic. The three primary coding structures used in structured programming are given below in fig 2.6:

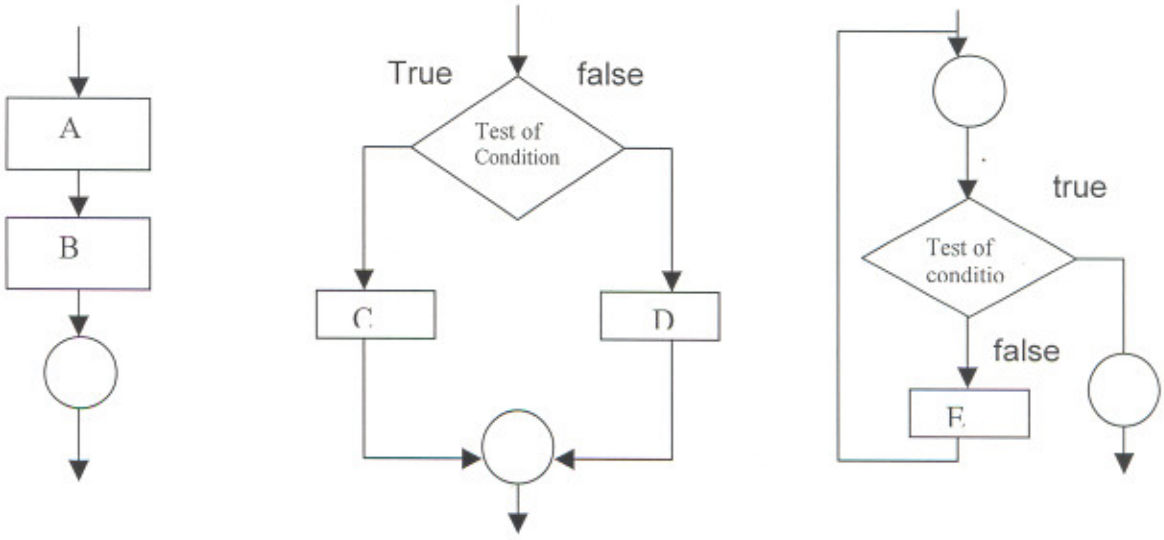


Fig 2.6(a) Simple sequence **2.6(b) Selection** **2.6(c) Repetition**

Another approach to application development is to purchase generalized software packages and modify them to meet the unique needs of organization. There are two different methods to use the generalized application software packages:

- Have organization adapt to the package: The application software procedures are fixed and the operating procedures of the organization are modified to conform to the software. This approach may be desirable for an organization with applications where there are no significant requirements.
- Adapt package to organizational needs: In this approach software developers provide general packages to the clients, which can be easily modified. The increasing cost of software development relative to packages makes it cost effective to purchase a package and spend some amount to modify it.

Tailoring of application packages. It can be done by software developers by themselves i.e. modifications in general packages can be done by vendors. The tailoring alternative is suitable for situations in which the essential features are found in a package, but the client desires unique features.

When the choice is made to purchase a software package rather than to develop in-house, it is still important to have complete, accurate system design specifications.

d) PROCEDURE DEVELOPMENT: Procedure development include manuals, instruction sheets help screens etc. procedures should be developed for all personnel who are associated with the system. This normally includes the following:

- ***Primary users:*** This step includes instructions for interpreting a report and to select different options for a report. If the user executes system directly, it includes detailed instructions for accessing the system.
- ***Secondary users:*** This step includes detailed set of instructions for entering each type of input.
- ***Computer operating personnel:*** There are generally maintenance procedures to be performed by computer operators. Procedures include instructions for quality assurance, backups and maintaining program documentation etc.
- **Training procedures:** Sometimes a separate training manual or sets of training screens are developed for the implementation stage.

System analysts generally with help of users develop the procedures. Because by working together they can be able to produce a procedure, which is technically correct and understandable manual.

2.6.3 THE LIFE CYCLE INSTALLATION AND OPERATION STAGE: The third stage of the information system development cycle has three phases i.e. conversion, operation and maintenance and post audit which are briefly explained below:

a) Conversion: Shifting or conversion to new system begins after all programs and procedures have been prepared and tested properly. There are three major activities prepared for actual conversion these are given as below:

Acceptance testing: it is done with completed application and comparing it to user specifications. The testing includes user inputs, operating and control procedures and outputs.

File building: it is the collection and conversion to machine-readable form of all new data required by the application. File building can be a long and tedious process and careful strategy is required. The required data is collected, coded and entered into the database. Responsible human resources and sufficient time should be provided to remove inaccuracies and inconsistencies to make the data complete.

***Users training*:** proper user training is an important factor in overcoming user resistance to new systems.

So conversion from old system to new system takes place after acceptance testing, file building and user training are complete. It can be done by several ways. The most careful method is to run the old and new systems in parallel results of new system are compared with the existing system for accuracy and reliability. If the results of new system are satisfactory then adopt it and drop the old system. The major drawback of this method is that it is expensive because both employs and machines have to work double time. Alternative method is that the new system should be tested under simulated conditions of full volume before dropping the old system. This is a risky method for e.g. for payroll system, a very little delay can be tolerated. It is recommendable that conversion should take place gradually, one portion of the system at a time.

b) OPERATION AND MAINTENANCE: After the conversion phase the system appears to be operating without any difficulty, it is turned over to the information processing production function. Any subsequent changes in the application are

handled as maintenance. Maintenance of an application can be classified as repairs or enhancements. Repairs are needed when incomplete or incorrect coding renders the application defective. Enhancements are additions or improvements.

c) POST AUDIT: An audit team with representatives from users, development, maintenance, operations perform internal audit, for the operations, use, cost and benefits of the new system. Post audit include specific recommendations for dropping, repairing or enhancing and application.

2.7 CONCLUSION

In this chapter the existing development process models namely waterfall model, the spiral model, iterative model, prototyping approach and system development life cycle approach for developing an information system have been studied. Each of these models has its own merits and demerits for specific type of organization. In this chapter all these process models have been critically evaluated. On the basis of the analysis, it is observed that SDLC approach is the most suitable approach to be adopted in DCW Patiala. The study carried out in this chapter, helps the designer to develop an effective MIS for an organization.

CHAPTER 3
SYSTEM ANALYSIS

3.1 INTRODUCTION

This chapter describes the detailed functioning and requirements of materials department in the organization and find out the deficiencies of the existing system. To remove such deficiencies, last section of the chapter proposed an alternative computer based conceptual model. The proposed model explains, in brief, the inputs, outputs and functions to be performed by the new information system.

3.2 INTRODUCTION TO MATERIALS DEPARTMENT

DCW Materials department deals with sales and distribution of manufactured and rebuilt Diesel Loco Spares, Components and assemblies to various Zonal Railways. Stores Department purchase includes raw material purchase for its production requirement and items required for running & maintenance of machinery & plant, other assets and medicines for hospital.

The zonal Railway Organization of materials department is at three levels.

1. HEADQUARTER LEVEL: At this level controller of stores is responsible for coordinating various activities of materials department.

2. DIVISIONAL LEVEL: Senior divisional controller of stores coordinates with controller of stores to meet the material requirements of his division. He has been delegated some purchase powers to locally purchase items required for the division.

3. DEPOT LEVEL: Normally materials departments are locally attached to the major workshops for supply of raw material.

3.3 MATERIALS ORGANIZATION

The organization of Materials Department of DCW comprises of the following

a) Purchase/Administrative officers at Patiala.
b) Stores Depot/ Receipt & dispatch section of Patiala.
c) Camp office at New Delhi to deal with clearance of Air consignments, sale of tenders and cash purchase etc.

3.4 EXISTING SYSTEM OF MATERIALS DEPARTMENT

Materials department of DCW performs the following functions:

1. Purchase of materials.
2. Receipt of materials.
3. Storage and issue of materials.
4. Disposal of surplus and scrap material.

3.4.1 PURCHASE ORGANIZATION:

The entire purchase activity is organized into "Unit Purchase Cells" entrusted with procurement of raw materials and other items of stores. During 1998-99 orders worth Rs. 107.15 crores were placed through various agencies, 6440 stock items were dealt and 3812 purchase orders were placed during the year.
The demand of the materials is estimated based upon the previous consumptions. At present the demand is estimated based upon the average of past three years consumption.

Thus the future consumption is forecasted on the basis of:

a) Past 3 years consumption after giving due considerations for stock out periods.
b) Trend of past consumption.
c) Information about increase/decrease of activities, condemnation of a particular type of rolling stock, phasing out of old rolling stock, machinery, plant, acquisition of new stock etc.

3.4.1.1 RECOUPMENT:

The Materials are recouped based upon the annual estimate system. In this system, the date for the recoupment of the items is fixed as per predefined time table to be followed. The period for which the items are recouped is fixed (1 year) is called the 'contract period". The lead time is equivalent to the interval between the dates fixed for the recoupment and the beginning of the contract period.

For the purpose of convenience different contract periods are fixed for different group of items so that some groups are recouped in Jan, some in Feb and so on. This system is advantageous, because it is possible to combine the demands of different depots and similar item to make bulk purchases.

Gross requirement of lead time (GRLT) =

Lead time (in months) x Anticipated consumption (monthly) + Buffer stock + pending demand (if any)

Net requirement = Gross Requirement – (Stock + Dues)

A supplementary estimate sheet may be submitted if it is found that total stocks are not sufficient to last.

3.4.1 PURCHASE PROCEDURE:

Method of purchase in this organization is generally the tender system. For purchasing, contracts are signed with suppliers by way of tenders and suppliers submit their offer for supplying the material. Various activities performed during purchase are briefly given below:

1. First the depot/store sends a recoupment sheet to the purchase department based upon the requirement of a particular item.
2. The purchase section floats the tender. After signing contract with the suppliers, the purchase section sends a purchase order to the supplier.
3. The supplier has to deliver the consignment within contract period. The supplies may be total or in steps/parts.
4. For high value items inventory is kept lower than the low value items.

3.4.2 MATERIAL RECEIVING PROCEDURE:

The inspection section first inspects the material supplied and after receiving the satisfactory inspection report, the material is accepted and receipt notes are issued by the store. Entry of received material is made in the stock register.

3.4.3 ISSUE / DISTRIBUTION OF MATERIAL:

The store issue materials to the workshop and other departments depending upon their requirements and the inventory position of a particular item. The store maintains a ledger for keeping up-to date information of the inventory position. It also keeps a record of the monthly issues, balance, of a particular item and on issuing updates the stock. It also keeps the information about the consumer, maximum and minimum values that are to be kept in the store.

3.4.4 DISPOSAL OF SURPLUS AND SCRAP MATERIAL:

The concerned department for the disposal of some item raises request. Disposable items are those, whose servicing or maintenance charges are more than their book value. According to the orders of store officer, new item is issued in place of item to be disposed and disposable item is taken back to the stores. Then with approval of high authorities, depending on type of material to be disposed-off the advertisement is given in Newspapers. Advertisement is given for the items whose return value is considerably good, otherwise items are sold in public auction.

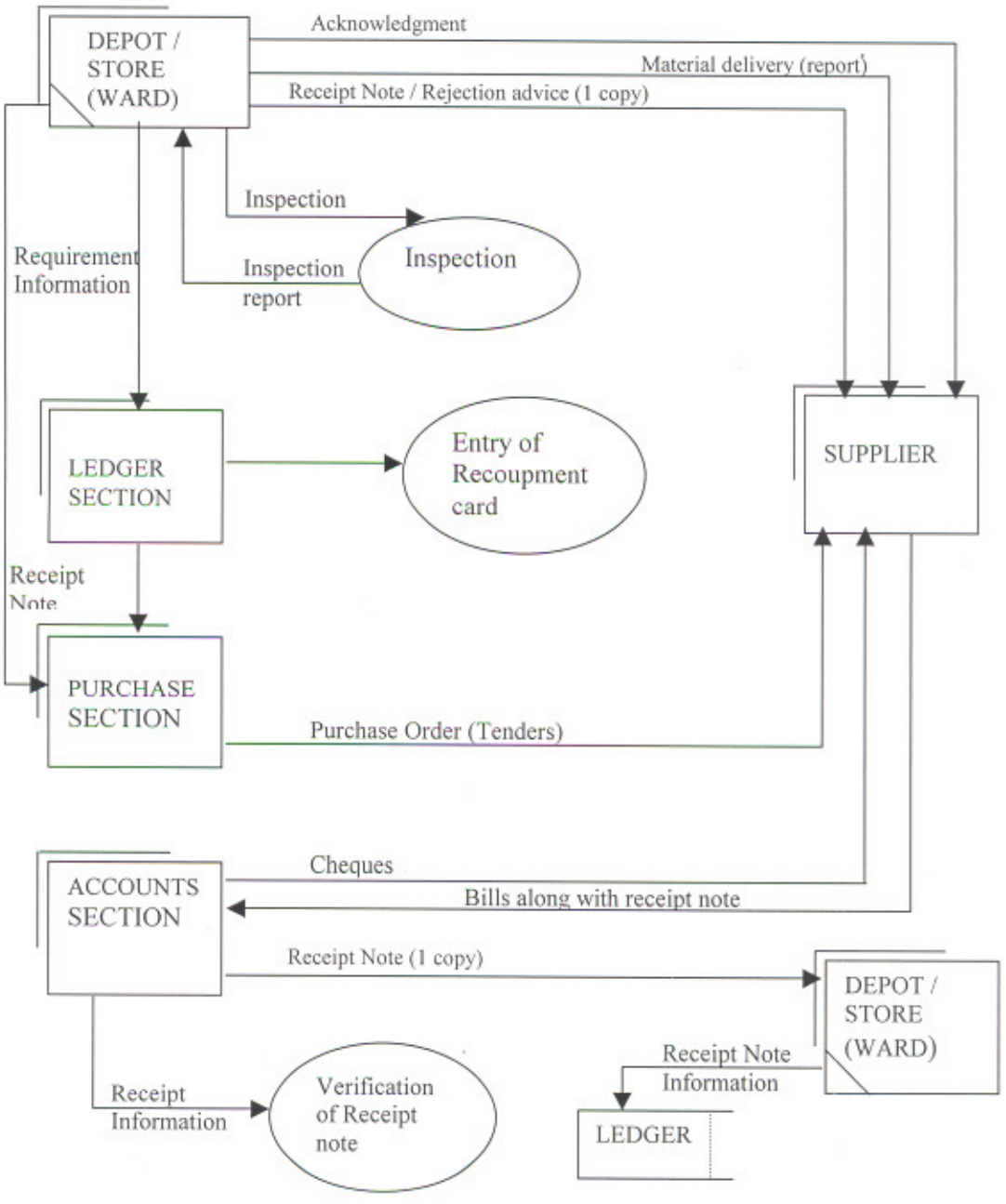


Fig 3.1 Data Flow Diagram Material Procurement

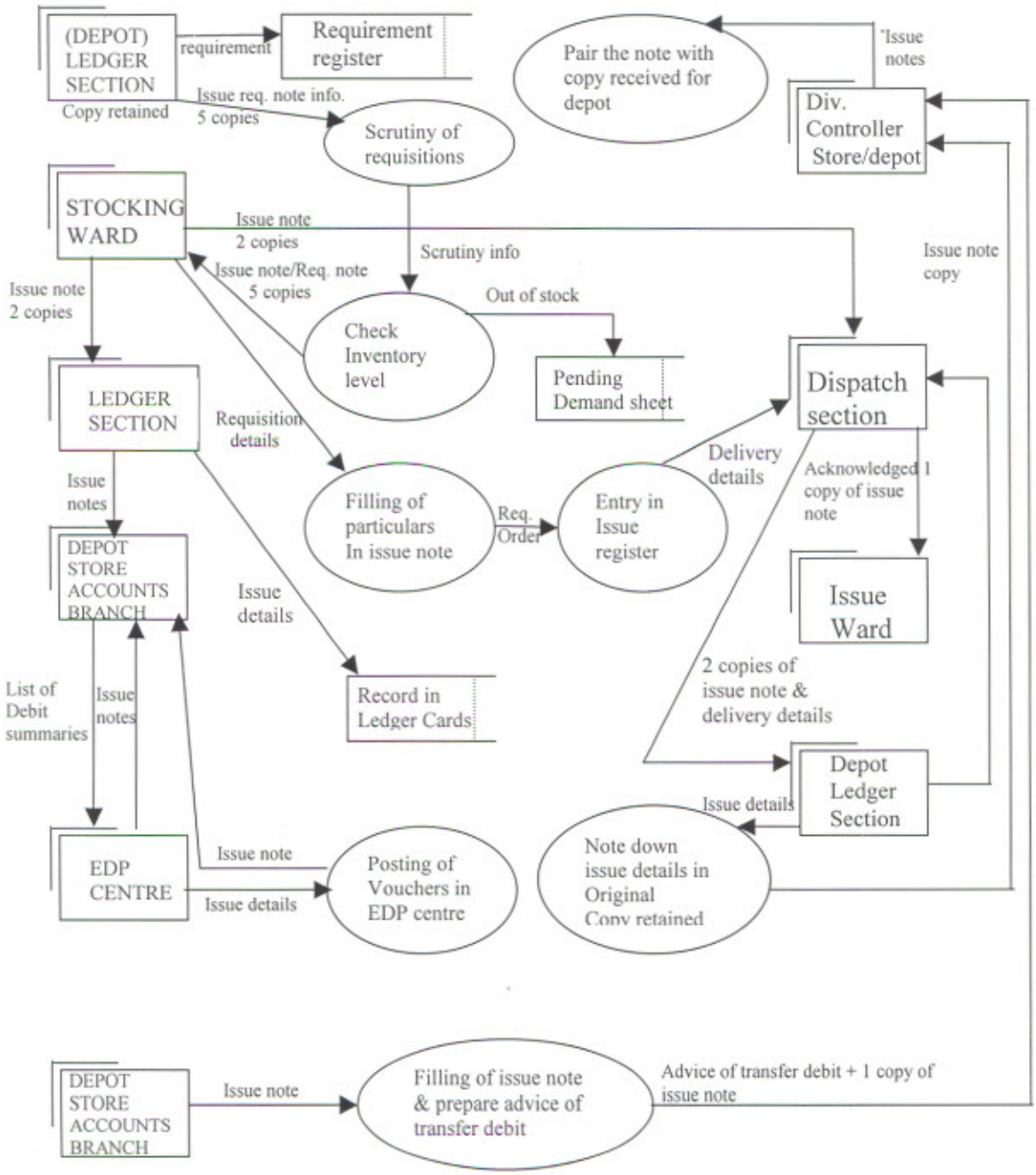


Fig 3.2 Data Flow Diagram Issues And Distribution

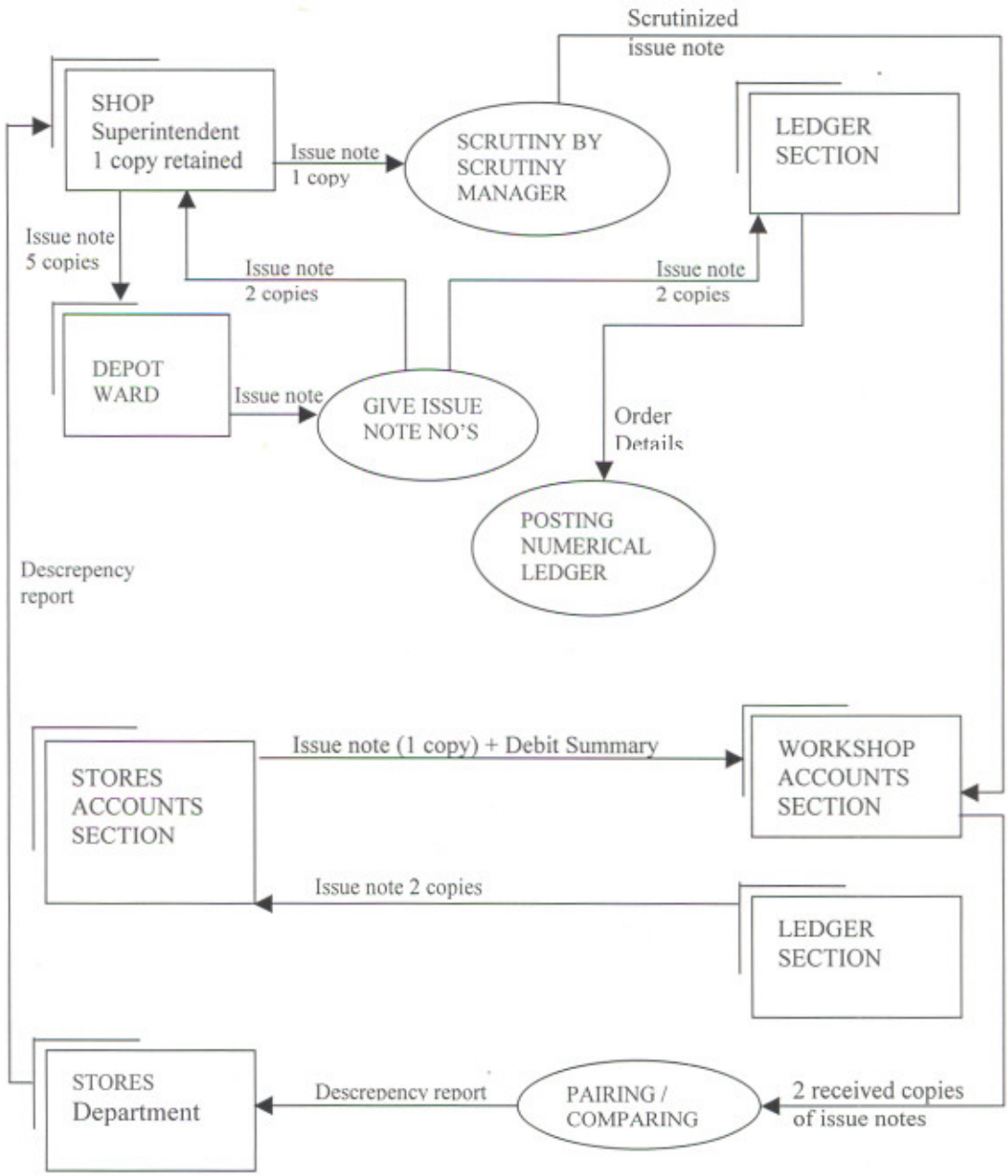


Fig 3.3 Data Flow Diagram Issues For Workshops

3.5 PROBLEMS IN THE EXISTING SYSTEM

1. No regular monitoring of stock takes place and as a result the stock position falls to nil. (Out of stock position)
2. A large number of items are left in the balance stock at the end of the period, which should be minimized. (Dead stocks are created)
3. No economic order purchases are made and as a result money is blocked in the inventory unnecessarily.
4. The information flow between the stores and other departments concerned as well as the suppliers are too slow and not up-to date.
5. The store transactions are manual. Only purchase order is computerized.

3.6 SOURCES OF GETTING INFORMATION AT DCW

1. Stores Officer
2. Stores/Depot Incharge
3. Office Superintendent
4. Senior Office Assistants
5. Public Relation Officer

INFORMATION COLLECTED FROM :

1. Store Officer:

a) Structure of the stores department
b) Overview of the inventory system and its functioning
c) Forecasting techniques
d) Inventory management system
e) Deficiencies of the present system
f) Various decisions taken and their implementation
g) Budgets allocated to stores department
h) Mode of functioning (whether manual or electronic)
i) Future expansion and improvisation plans.

2. Stores / Depot Incharge:

a) Item classification

b) Mode of transportation and storage methods

c) Various entries made in the depot ledgers

d) Maximum and minimum inventory levels maintained

e) Various documents maintained, received and issued by the depot.

3. Office Superintendent:

a) The sources of data and the information flow.

b) Records and documents maintained by the office.

c) Various sections/departments to and from which the information flows.

d) Duplication of data and the workload.

4. Senior Office Assistant:

a) List of items and their cost.

b) Views regarding the computerization of the department.

c) Formats of various documents and reports.

5. Public Relation Officer:

a) History of the organization.

b) Department Hierarchy.

c) Financial repot and the achievements of the organization.

d) Functions and other details of various departments.

3.7 PROBLEM DEFINITION

Presently the materials department has a manual information system. The manual system is a slow and lengthy system and it has a number of drawbacks.

1. There is a lot of duplicity.
2. It requires a lot of space as the number of personnel involved in the process is large enough.
3. The system is quite time consuming due to the slow flow of information from one person to other.
4. It is not very easy to access the data, as data is stored in a large number

of ledgers and registers.

5. The department is not integrated due to the lack of smooth information flow between the management and subordinates.
6. The inventory management is not very efficient due to the fact that the more sophisticated and modern inventory techniques are not used by department.

3.8 OBJECTIVES OF SYSTEM

The objective that we are trying to achieve and the results that we want to see are as follows:

1. The flow of the information should be timely, accurate and up-to date so that it can really help the management in taking correct decisions for efficient inventory management.

In order to achieve this objective, we must shift from the manual system to the more sophisticated computerized system. We must have a management information system that helps to create an integrated environment for decision - making.

2. We must check the duplicity of data, as it results in the wastage of time.

E.g. a) At the time of the material procurement, a number of copies of the single receipt note, are prepared by the depot for distribution to various sections/departments and the suppliers. This is a quite time consuming process as hundreds of items, are produced by the depot. For each item, a number of copies of the same issue note are prepared. This is also a time consuming process and requires lot of work hours. So we must shift to a computerized system to reduce time wastage.

All the information regarding the receipt of an item should be stored in a file in computer system. We can use floppy disks or magnetic tapes to store the information and then we can easily transfer this information to various sections/departments.

b) Similarly at the time of issuing the material, five or six copies of the issue note are prepared. The information regarding the issue of the

material can be efficiently and easily stored in a computer and then transferred to its destinations.

c) A lot of capital is unnecessarily blocked in the inventory. We must minimize the amount of money blocked in the inventory by applying more efficient inventory control models. The inventory management software packages can be developed and used for efficient inventory management.

d) The forecasts regarding the material procurement is made by the management, based upon the average of past three years consumption. These forecasts may not be very precise as sometimes the stock level of some items comes down to nil due to the fluctuation in the demand of the item. More sophisticated forecasting techniques should be used, by making use of computer based information system. We should try to generate the future demands of items through simulation techniques.

e) The size of the orders placed by the depot should be optimum and economical depending upon the demand of particular item. The material schedule for various projects should be prepared sufficiently in advance so that the stores department can supply the items by purchasing from specific demands.

3.9 PROPOSED CONCEPTUAL DESIGN

Whenever an old system fails or a new set of objectives have to be achieved, we should propose a new system that can effectively replace the old system and cover its limitations. Going through existing materials management system study, it was observed that it involved more of the manual work, time consumption and duplicity. So it was desired that materials management and inventory system should be computerized.

For the computerization of Materials Information system, information related to all the items in the store is maintained. Information implies item's code, description, quantity, minimum level, maximum level, reorder point etc. under this system following documents are computerized:

1. Requisition slip
2. Material receipt slip
3. Issue slip
4. Return slip
5. Inventory System
6. Reports generation
7. Queries

1. Requisition slip: In this module requisition number will be generated automatically and user has to enter department code, item code, quantity required,

2. Material receipt slip: Material receipt number will be generated automatically. The user has to enter item code, receipt date, supplier code, bill number, bill date, quantity ordered, quantity received etc. Total quantity of an item will be updated automatically.

3. Issue slip: Issue slip number is generated automatically. User has to enter issue date, department code, item code, quantity required. Automatic checking of requested quantity in stock is done and after issuing total quantity of an item will get updated automatically.

4. Return slip: Return slip number will be generated automatically. User has to enter department code, item code, quantity returned etc. Total quantity in the stock will be updated automatically.

REPORT GENERATION: In the proposed system reports like item details, supplier details, department, stock, inventory, item issued, item received, item returned etc. can be generated.

Apart from these, the proposed system has enquiry capability to respond information regarding item. The system also includes inbuilt checks to ensure the correctness of the input data at required levels and for security point of view, password facility is provided.

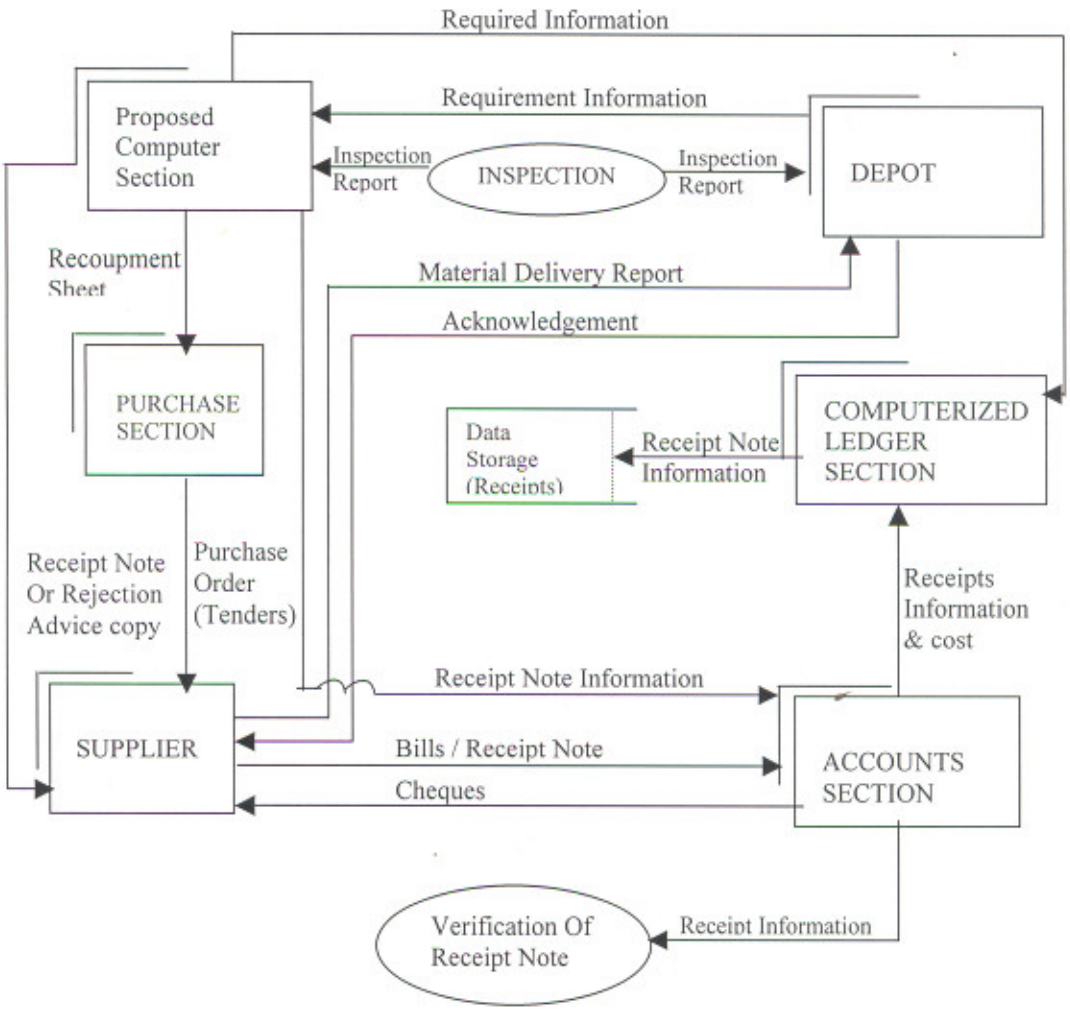


Fig. 3.4 DATA FLOW DIAGRAM (PROPOSED SYSTEM)

Material Procurement

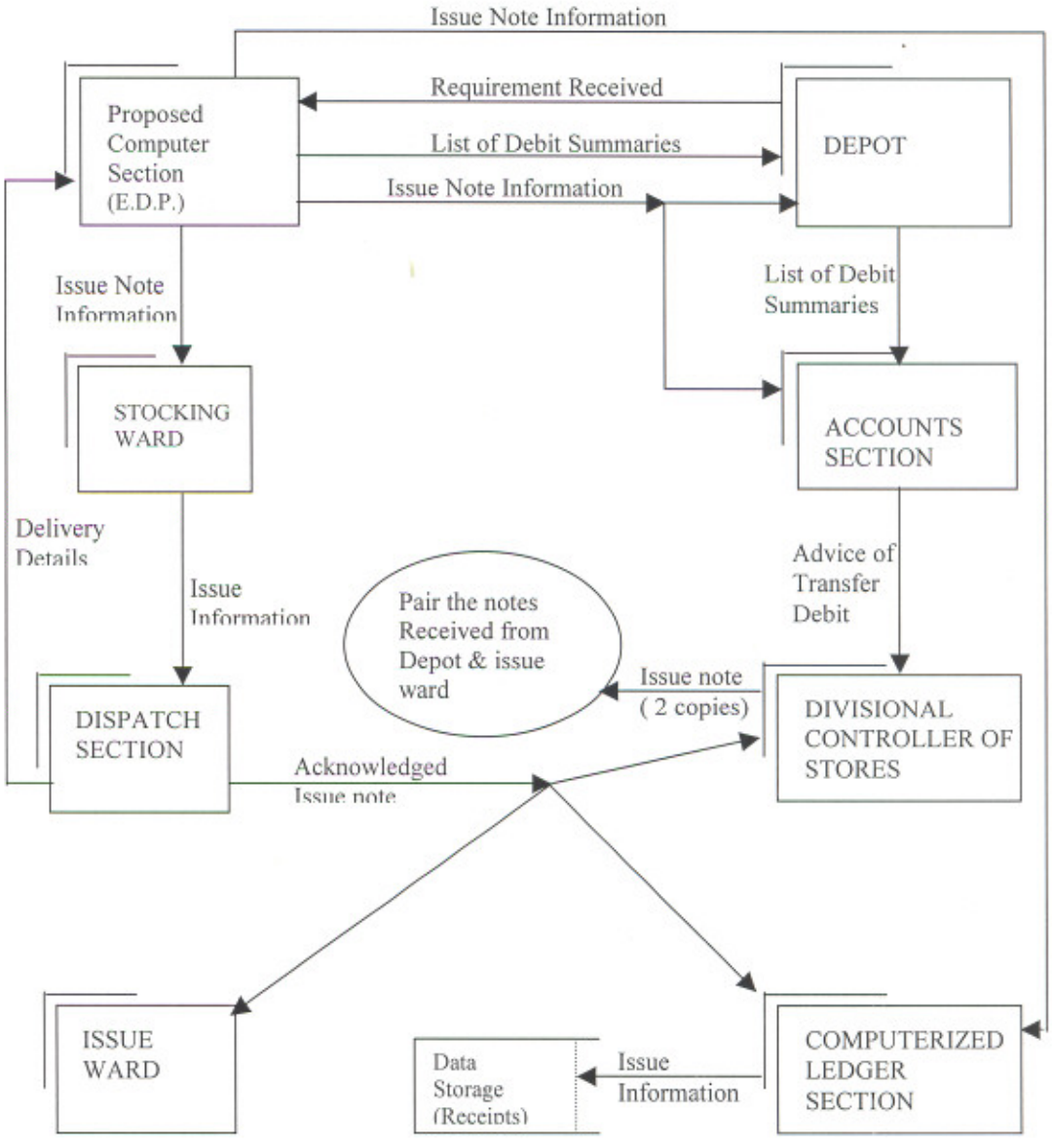


Fig. 3.5 DATA FLOW DIAGRAM (PROPOSED SYSTEM)

Issue and Distribution

3.9.1 ADVANTAGES OF PROPOSED CONCEPTUAL DESIGN

A few advantages that occur out of the proposed system shall be as under:

* Manual work will be reduced to great extent.
* Decision-making becomes more effective and scientific, as up-to-date data and information will be made available.
* Overall efficiency and transparency in working environment will be achieved.
* It will help in simplification and standardization of procedures.
* Record management, storage and retrieval of data will become much simpler.
* Monitoring of various activities at different levels shall be more effective.
* It should be possible to generate exceptional reports.

3.10 CONCLUSION

In this chapter detailed overview of existing information system has been given. Going through the existing system, it was observed that more of the manual work, time consumption and duplicity is involved in materials department of DCW. To remove these limitations, a conceptual design has been proposed and got it approved from the users, which briefly gives the basic outlines, inputs, outputs and functions of the new information system.

CHAPTER 4

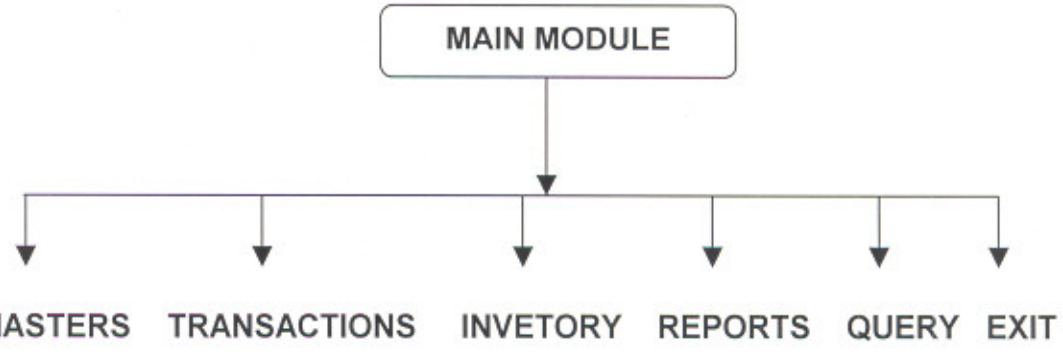
SYSTEM DESIGN

4.1 INTRODUCTION

This chapter consists of the detailed technical design of the information system under study. The various techniques like ABC analysis, calculating economic order quantities are discussed and used in system design to make it more effective. Section two, gives the detailed database design along with complete pseudocode.

4.2 SYSTEM DESIGN

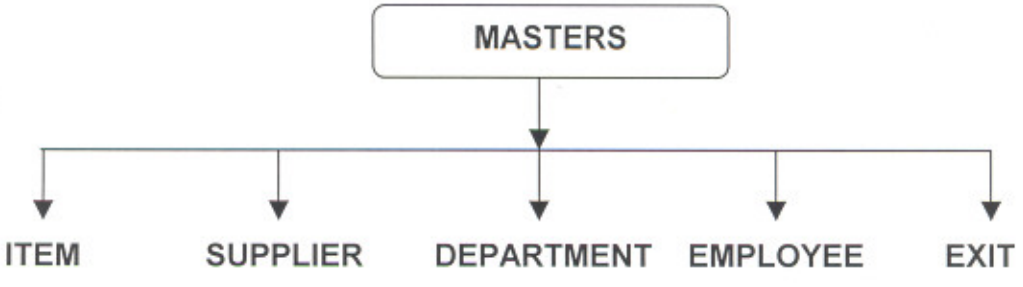
This system is based on database interrelationships, but the user transparency is provided so that he feels as if he is working with an integrated system. System is divided into following modules:



These modules in turn consist of various procedures.

4.2.1 MASTERS

The various options under the master menu will enable us to manipulate all the information regarding Item, Supplier, Employee and Department.



4.2.1.1 Item Master: Information related to the items in store is entered through this option. The details include Item code, Item description, Item type i.e. (Consumable / Non Consumable), ABC Type etc.

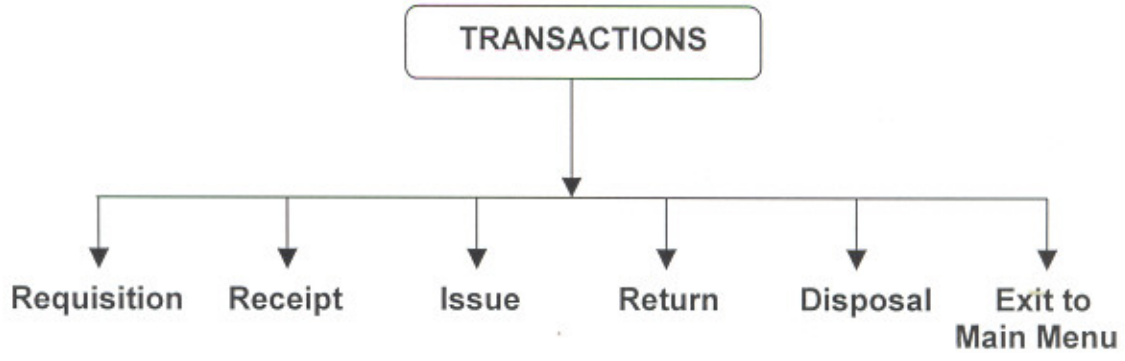
4.2.1.2 Supplier Master: Information of supplier like supplier code, name, address, city, telephone number etc. is maintained through this option.

4.2.1.3 Department/Workshop Master: Information of department/workshop like department code, department name, head of department is entered through this option.

4.2.1.4 Employee Master: Information of employees like employee code, name, designation, address, city, telephone number etc. is maintained through this option.

4.2.2 TRANSACTIONS

Under this option, various transactions screens are included. Add, View, Delete and Exit facilities are provided at each level. Validation checks are also provided at each level of user entry.



4.2.2.1 Requisition slip: In this module requisition number will be generated automatically and user has to enter department code, item code, quantity required.

4.2.2.2 Material receipt slip: Material receipt number will be generated automatically. The user has to enter item code, receipt date, supplier code, bill

number, bill date, quantity ordered, quantity received etc. Total quantity of an item will be updated automatically.

4.2.2.3 Issue slip: Issue slip number will be generated automatically. User has to enter issue date, department code, item code, quantity required. Automatic checking of requested quantity in stock is done and after issuing total quantity of an item will get updated automatically.

4.2.2.4 Return slip: Return slip number will be generated automatically. User has to enter department code, item code, quantity returned etc. Total quantity in the stock will be updated automatically.

4.2.3 INVENTORY

This module keeps up-to date information about the stock, stock in hand, stock outstanding, maximum level, minimum level and reorder point etc. This module also compute the order size by applying suitable inventory models for different type of items and thus suggest the decision maker that how much to order.

On the basis of value, the items stored in the depot have been broadly divided into three categories:

1) ***A-Category items:*** are those items, which are extremely difficult to procure and cover about 70-85% of the total cost. The inventory of these items should be closely monitored such that no surplus A-category items are kept in the stock as they block a lot of money. In fact only 5 to 10% of the total inventory constitute 'A' category items.
2) ***B-Category items:*** are those items, which are difficult to procure but are available in the market. In fact 10 to 20% of total items are 'B' category items and they represent 10 to 20% store value.
3) ***C-Category items:*** are those items, which are easy to procure. In fact 70 to 85% of total inventory constitute 'C' category items.

Apart from this classification the items can further be classified on the basis of movement of stores or rate of consumption, into three more categories:

1) Slow moving items having very low consumption.
2) Fast moving items having a high consumption.

3) Not moving items having negligible consumption.

Proper maintenance of stock items of each type of material is the main function of the stores department. Maintenance of large quantity of stock heads leads to huge investment in materials, large space coverage and danger of deterioration in the quality and obsolescence of materials. On the other hand, less stock may result in frequent purchases, higher costs and loss in production etc. Procurement of proper quantity of materials is greatly facilitated by keeping in view certain considerations:

a) Time involved in procurement or placing the order.

b) Quantity and type of materials required.

c) Availability of floor space.

d) The minimum quantity of material, which can be advantageously purchased.

e) Annual consumption of material etc.

Keeping in view the above-mentioned considerations, different types of stock levels are fixed viz., (I) Minimum Level, (II) Re-order level and Maximum Level.

(I) Minimum Level

A minimum stock level is that level of an item of material, below which the actual stock should not normally be allowed to fall. The main objective of fixing the minimum level of materials is to ensure that the required quantity of each item is available in stores all times. The minimum stock level can be determined by applying the following formula:

Minimum Stock Level=Re-order level – (Normal consumption x Normal delivery time)

(II) Re-order Level

The re-order level is that level of inventory at which purchase order should be placed. The re-order stock level can be determined by applying any one of the following formulae:

i. Re-order Level = Maximum consumption x Maximum delivery time.

ii. Re-order Level = Maximum stock x Average consumption during normal delivery time.

(III) Maximum Level

Maximum Level is the upper limit of the stock above which the stock should not be allowed to exceed under normal circumstances without the prior sanction of the management. The main objective for fixing up the maximum stock level is to avoid undue investment of capital leading to loss of interest, obsolescence of materials etc. The maximum stock level can be determined by applying any one of the following formulae:

Maximum Stock Level = Re-order level + Re-order quantity – (Minimum consumption x Minimum time required for delivery).

Maximum Stock Level = Re-order level – Consumption during the time required to get Supplies at minimum rate + Economic order size.

ECONOMIC ORDER QUANTITY OR ECONOMIC ORDER SIZE

This concept relates to the quantity of materials to be purchased by purchasing department. Economic order quantity is that size of order which gives maximum economy in purchasing any item of material. In order to determine the economic order quantity, an analysis of the various costs associated with the ordering quantity is made.

a) Cost of ordering or acquisition: the demands received are scrutinized and for purchasing them, enquiries are issued, tenders are received and evaluated, orders are progressed, materials are received and inspected. All these costs together constitute what is called the cost of ordering.

b) Inventory carrying costs: the very fact that items are required to be kept in stock means additional expenditure to the organization. These are called the inventory carrying costs. The different elements of the costs involved in holding inventory may be as follows:

- Interest on capital/opportunity cost

  This may be roughly 20% per annum.
- Cost of storage/handling

  This may be roughly 3 to 5% of inventory holding.
- Insurance cost

  This may be roughly 1 to 2 %.

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- Interest on capital/opportunity cost

  This may be roughly 20% per annum.

- Cost of storage/handling

  This may be roughly 3 to 5% of inventory holding.

- Insurance cost

  This may be roughly 1 to 2 %.

- Obsolescence and depreciation

  This may be roughly 2 to 5% of inventory holding

The Economic Order Quantity is ascertained by the following formula:

$$EOQ = \sqrt{\frac{2CO}{I}}$$

Where,

'EOQ' stands for Economic Order Quantity.

'C' stands for annual consumption of material in terms of units.

'O' stands for cost of placing one order including the cost of receiving it.

'I' stands for interest payment or carrying cost per unit per annum.

4.2.4 REPORTS

Following reports shall be generated through the system:

1. List of all records in the following master databases.
   - Item
   - Supplier
   - Department
   - Employee
2. Details of items issued to department.
3. Details of items received till date.
4. Details of disposed items.
5. Inventory details etc.

4.2.5 QUERIES

This module has the enquiry capability to respond to information regarding items.

4.3 DATABASE DESIGN

4.3.1 FILE NAME : *ITEM*

KEY : ITEM_CODE

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	ITEM_CODE	Numeric	8	0	Item Code
2.	ITEM_NAME	Character	15		Item Name
3.	PLNO	Numeric	8	0	PL Number
4.	TYPE	Character	1		Item Type A/B/C

4.3.2 FILE NAME : SUPPLIER

KEY : S_CODE

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	S_CODE	Character	4		Supplier Code
2.	S_NAME	Character	15		Supplier Name
3.	S_ADD	Character	20		Supplier Address
4.	S_CITY	Character	15		Supplier City
5.	PIN_CODE	Numeric	6		Pin Code
6.	S_PHONE	Numeric	8		Phone Number

4.3.3 FILE NAME : DEPTT

KEY : DEPT_CODE

DESCRIPTION : Department file contains information related to particular Department/workshop.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	DEPT_CODE	Character	4		Department code
2.	DEPT_NAME	Character	15		Name of department
3.	HOD	Character	20		Head of department

4.3.4 FILE NAME : EMPLOYEE

KEY : EMP_CODE

DESCRIPTION : This file contains information related to employees of DCW.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	EMP_CODE	Character	4		Employee Code
2.	EMP_NAME	Character	15		Employee Name
3.	EMP_ADD	Character	20		Employee Address
4.	EMP_CITY	Character	15		Employee City
5.	EMP_PHONE	Numeric	8		Phone Number
6.	DEPT_CODE	Numeric	6		Dept. Code
7.	EMP_DESIG	Character	10		Designation

4.3.5 FILE NAME : REQUEST

KEY : REQ_NO + ITEM_CODE

DESCRIPTION : REQUISITION file contains information of requisition slip.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	REQ_NO	Numeric	6		Requisition slip number
2.	REQ_DATE	Date	8		Requisition date
3.	ITEM_CODE	Numeric	8		Item code
4.	QTY_REQ	Numeric	4		Quantity required
5.	DEPT_CODE	Character	4		Requesting Department

4.3.6 FILE NAME : ISSUE

KEY : ISSUE_NO + ITEM_CODE

DESCRIPTION : ISSUE file contains information of requisition slip.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	ISSUE_NO	Numeric	6		Issue slip number
2.	ISSUE_DT	Date	8		Issue date
3.	ITEM_CODE	Numeric	8		Item code
4.	QTY_REQ	Numeric	4		Quantity requested
5.	QTY_ISSUE	Numeric	4		Quantity issued
6.	DEPT_CODE	Character	4		Requesting Department
7.	ISSUE_BY	Character	4		Employee Code
8.	ISSUE_TO	Character	4		Employee Code

4.3.7 FILE NAME : RETURN

KEY : RET_NO + ITEM_CODE

DESCRIPTION : Return file contains information related to returned item.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	RET_NO	Numeric	6		Return slip number
2.	RET_DT	Date	8		Return date
3.	ITEM_CODE	Numeric	8		Item code
4.	QTY_RET	Numeric	4		Quantity returned
5.	DEPT_CODE	Character	4		Returning Department
6.	RET_BY	Character	4		Employee Code
7.	RET_TO	Character	4		Employee Code

4.3.8 FILE NAME : DISPOSAL

KEY : SANC_NO + ITEM_CODE

DESCRIPTION : DISPOSAL file contains information of disposed item.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	SANC_NO	Numeric	6		Sanction number
2.	DISP_DT	Date	8		Disposed date
3.	ITEM_CODE	Numeric	8		Item code
4.	QTY_DISP	Numeric	4		Quantity disposed
5.	AMT_REC	Numeric	8	2	Amount received

4.3.9 FILE NAME : RECEIPT

KEY : REC_NO + ITEM_CODE

DESCRIPTION : RECEIPT file contains information of the material received.

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	REC_NO	Numeric	6		Receipt number
2.	REC_DT	Date	8		Receiving date
3.	ITEM_CODE	Numeric	8		Item code
4.	QTY_REC	Numeric	4		Quantity received
5.	S_CODE	Character	4		Supplier code
6.	BILL_NO	Numeric	6		Bill number
7.	BILL_DT	Date	8		Bill date

4.3.10 FILE NAME : *INVENTORY*

KEY : ITEM_CODE

STRUCTURE:

S.NO.	Field Name	Type	Width	Dec	Field-Description
1.	ITEM_CODE	Numeric	8		Item code
2.	ORDCOST	Numeric	6	2	Ordering Cost
3.	CARRYCOST	Numeric	6	2	Carrying Cost
4.	LEADTIME	Numeric	4	0	Lead Time
5.	ADEMAND	Numeric	6	0	Annual Demand
6.	UNITPRICE	Numeric	6	2	Price of Item
7.	MAX_LEVEL	Numeric	4		Maximum quantity level
8.	MIN_LEVEL	Numeric	2		Minimum quantity level
9.	RE_ORDER	Numeric	2		Re order level
10.	ST_INHAND	Numeric	4		Stock in hand
11.	ST_OUT	Numeric	3		Stock outstanding
12.	STOCK	Numeric	4		Stock

4.4 PSEUDOCODE:

4.4.1 MAIN MODULE

```
CLEAR SCREEN
SET Environment
Do While Choice is <= 6
        Display on screen the following
                        MAIN MENU
                1. MASTER
                2. TRANSACTIONS
                3. INVENTORY
                4. REPORTS
                5. QUERY
                6. EXIT
 Enter the Choice
  IF Choice is 1
       THEN do Master
 ELSE
     IF Choice is 2
          THEN do Transactions
     ELSE
         IF Choice is 3
             THEN do Inventory
         ELSE
             IF Choice is 4
                  THEN do Reports
             ELSE
                 IF Choice is 5
                      THEN DO Queries
                 ELSE
                     IF Choice is 6
                         EXIT.
```

4.4.1.1 PSEUDOCODE FOR MASTER MODULE

```
CLEAR SCREEN
SET Environment
Do While Choice is <= 5
        Display on screen the following
                        MAIN MENU
                1. ITEM
                2. EMPLOYEE
                3. SUPPLIER
                4. DEPARTMENT
                5. EXIT TO MAIN MENU

 Enter the Choice
  IF Choice is 1
       THEN do Item
 ELSE
     IF Choice is 2
          THEN do Employee
     ELSE
         IF Choice is 3
             THEN do Supplier
         ELSE
             IF Choice is 4
                  THEN do Deptt
             ELSE
                 IF Choice is 5
                         EXIT to Main menu
```

4.4.1.1.1 PSEUDOCODE FOR ITEM MASTER:

```
CLEAR SCREEN
SET Environment
Do While Choice is <= 5
        Display on screen the following
                        MAIN MENU
                1. ADD
                2. VIEW
                3. UPDATE
                4. DELETE
                5.  EXIT
 Enter the Choice
  IF Choice is 1
        THEN do Itemadd
 ELSE
     IF Choice is 2
           THEN do Itemview
     ELSE
         IF Choice is 3
             THEN do Itemmod
         ELSE
             IF Choice is 4
                   THEN do Itemdel
             ELSE
                 IF Choice is 5
                         EXIT.
```

4.4.1.1.1.1 PSEUDOCODE FOR ITEMADD:

USE Database file ITEM
Index the database
Set environment
Declare Memory Variables
Design Screen for data entry
Enter the item code
    IF Item code already exists
        THEN display the message Duplicate not allowed Enter again
    ELSE
     Enter item name, item type PI number.
Store above data values in memory variables.
Append blank record.
Replace Field values of database in use with memory variables.
Close all

4.4.1.1.1.2 PSEUDOCODE FOR ITEMVIEW:

USE Database file ITEM
INDEX the database
Set environment
Declare Memory Variables
Enter the item code you want to view
    IF Item code does not exists
        THEN display the message item does not exist try again
    ELSE
     Store data values corresponding to item code in memory variables.
Display the values of these memory variables at the desired location on screen.
Close all

4.4.1.1.1.3 PSEUDOCODE FOR ITEMMOD:

USE Database file ITEM
INDEX the database
Set environment
Declare Memory Variables
Enter the item code you want to modify
    IF Item code does not exists
        THEN display the message item does not exist try again
    ELSE
     Store data values corresponding to item code in memory variables.
Display the values of these memory variables at the desired location on screen.
Make the changes you want in the record
Replace the old Database record values with updated values.
Close all

4.4.1.1.1.4 PSEUDOCODE FOR ITEMDEL:

USE Database file ITEM
INDEX the database
Set environment
Declare Memory Variables
Enter the item code you want to delete
    IF Item code does not exists
        THEN display the message item does not exist try again
    ELSE
     Store data values corresponding to item code in memory variables.
Display the values of these memory variables at the desired location on screen.
Display message 'Do you want to delete the record'
IF Yes
        THEN Display the message 'Do you want to delete permanently '

IF Yes

THEN delete record permanently

ELSE

Recall the record

ELSE exit.

Close all

4.4.1.2 PSEUDOCODE FOR TRANSACTIONS

CLEAR SCREEN

SET Environment

Do While Choice is <= 6

Display on screen the following

MAIN MENU

1. REQUISITION
2. RECEIPT
3. ISSUE
4. RETURN
5. DISPOSAL
6. EXIT TO MAIN MENU

Enter the Choice

IF Choice is 1

THEN do Request

ELSE

IF Choice is 2

THEN do Receipt

ELSE

IF Choice is 3

THEN do Issue

ELSE

IF Choice is 4

THEN do Return

ELSE

IF Choice is 5

THEN do Disposal

ELSE

IF Choice is 6

EXIT to Main menu

4.4.1.2.1 PSEUDOCODE FOR REQUEST:

USE Database file Request

Index the database request slip number + item code

Set environment

Declare Memory Variables

Design Screen format

Enter the item code for which request is made

IF Item code does not exists

THEN display the message item does not exists update item master try again

ELSE

Generate requisition number automatically.

Enter requisition date, department code, quantity required etc.

Store above data values in memory variables.

Append blank record.

Replace Field values of database in use with memory variables.

Close all

4.4.1.2.2 PSEUDOCODE FOR RECEIPT:

CLEAR SCREEN

SELECT B

USE Database file Receipt

Index the database on Item code

Set environment

Declare Memory Variables

Enter the item code you have received

IF Item code does not exists

THEN display the message item does not exists update item master try again

ELSE

Generate material receipt number automatically

Enter Quantity received

Enter receipt date, supplier code, bill number, bill date etc.

Store above data values in memory variables.

Old Quantity received = Old quantity received + New quantity received

SELECT A

USE Inventory INDEX inventory

UPDATE ON Item code From Receipt

REPLACE Stock in hand WITH Stock in hand + Receipt ->Qty received

REPLACE Stock outstanding WITH Stock outstanding - Receipt ->Qty received

REPLACE Stock WITH Stock in hand + Stock outstanding

SELECT B

Append blank record.

Replace Field values of database in use with memory variables.

CLOSE ALL

4.4.1.2.3 PSEUDOCODE FOR ISSUE:

CLEAR SCREEN

SELECT B

USE Database file ISSUE

Index the database on Item code

Set environment

Declare Memory Variables

Enter the item code you have to issue

IF Item code does not exists

THEN display the message item does not exists update item master try again

ELSE

Enter Quantity required

Check whether Stock in hand >= Quantity required

IF No

THEN Inform quantity is out of stock

ELSE

Enter quantity issued, issue date, issued by, issued to,

Enter department code

Store above data values in memory variables.

SELECT A

USE Inventory INDEX inventory

UPDATE ON Item code From Issue REPLACE Stock in hand WITH Stock in hand – Issue ->Qty Issued

SELECT B

Append blank record.

Replace Field values of database in use with memory variables.

CLOSE ALL

4.4.1.2.4 PSEUDOCODE FOR RETURN:

CLEAR SCREEN

SELECT B

USE Database file Return

Index the database on Item code

Set environment

Declare Memory Variables

Enter the item code you want to return

IF Item code does not exists

THEN display the message item does not exists update item master try again

ELSE

Enter Quantity returned

Enter date of return, return by, return to, department code etc.

Store above data values in memory variables.

SELECT A

USE Inventory INDEX inventory

UPDATE ON Item code From Return REPLACE Stock in hand WITH

Stock in hand + Return ->Qty Returned

SELECT B

APPE BLANK

Append blank record.

Replace Field values of database in use with memory variables.

CLOSE ALL

4.4.1.2.5 PSEUDOCODE FOR DISPOSAL:

USE Database file Disposal

Index the database disposal on sanction number

Set environment

Declare Memory Variables

Design Screen format

Enter the item code you want to dispose off

IF Item code does not exists

THEN display the message item does not exists update item master try again

ELSE

Enter sanction number, disposed date, disposed quantity, price received etc.

Store above data values in memory variables.

Append blank record.

Replace Field values of database in use with memory variables.

Close all

4.4.1.3 PSEUDOCODE FOR INVENTRY MODULE:

USE Database file Inventory

INDEX the database on item code

Set environment

Declare Memory Variables

Enter the item code

IF Item code does not exists

THEN display the message item does not exist try again

ELSE && do following calculations

EOQ = SQRT((2*annual consumption*ordering cost)/carrying cost)

Minimum Stock Level=Re-order level – (Normal consumption x Normal delivery time)

Re-order Level = Maximum consumption x Maximum delivery time.

Re-order Level = Maximum stock x Average consumption during normal delivery time.

Maximum Stock Level = Re-order level + Re-order quantity – (Minimum consumption x Minimum time required for delivery).

Maximum Stock Level = Re-order level – Consumption during the time required to get Supplies at minimum rate + Economic order size.

Replace Field values of database in use with memory variables.

END

4.4.1.4 PSEUDOCODE FOR GENERATING REPORTS:

4.4.1.4.1 PSEUDOCODE FOR ITEM REPORT:

USE Item

SET Environment

Start loop for menu

Present Options

1. By item code
2. By item type

Get user's choice

Choice 1. Ask user for item code

Locate the item with item code

Set printer on

Print data record with that item code

Set printer off

Choice 2. Ask user for item type

Locate the item with item type

Set printer on

Print all data records with that item type

Set printer off

Continue to loop through menu until user does not request to exit.

When done, return to main menu.

4.4.1.4.2 PSEUDOCODE FOR ISSUE REPORT:

USE Issue

SET Environment

Start loop for menu

Present Options

1. By issue slip number
2. By date

Get user's choice

Choice 1. Ask user for issue slip number

Locate the record with given issue slip number

Set printer on

Print data record having that issue slip number

Set printer off

Choice 2. Ask user for starting date

Ask user for ending date

Locate the records between these two dates

Set printer on

Print all data records existing between these dates

Set printer off

Continue to loop through menu until user does not request to exit.

When done, return to main menu.

4.5 CONCLUSION

In this chapter, detailed system design and database design has been developed. The pseudocode for various modules of the designed information system has been written, that would be a blueprint for the programmers.

CHAPTER 5
CONCLUSION

5.1 INTRODUCTION

This chapter concludes the study of efficiently designed Materials Information System, using System Development Life Cycle approach. It gives a view of the proposed Materials Information System for an organization, DCW Patiala. Finally suggestions for further investigations have been included, which may be carried out for further enhancement.

5.2 CONCLUSION

In this era of rapid expansion management information system is the ultimate solution for handling all type of data oriented and decision-making problems. The objective of this study was to provide smooth, accurate and timely flow of information to the managers for decision making and thus, to design an information system, that has low failure rate, consistent, reliable and scaled up to large systems. To meet this objective, various system development process models have been put under study and it was found that system development life cycle model outstands all others in more than one ways. First of all each stage of system development is well defined and has a proper structure. The process documentation is easy to maintain because formal documents at the end of each stage are not large. This facilitates future additions, alterations and enhancements in the developed information system. Secondly each of the various phases is freezed out before it passes on to the next one and thus iterations are not required in the system. Since, the preliminary investigations in the system development are of utmost important and if the managers involved in the organization are with similar background, experience and also well versed with the system, SDLC approach should be the only suitable approach to be adopted for developing an Information System.

The design of the system, including conceptual design, detailed technical design, and database design, which is completed by using various tools like DFDs, DDs, Pseudocode etc., has been discussed with the managers to their utmost satisfaction. The designed information system is expected to address the information requirements of the organization managers and has low failure rate. At the same time it would also remove duplicity and minimize the amount of money blocked in the inventory because of the sophisticated techniques applied to inventory system.

Further, it can be concluded from the study that SDLC approach should be the most suitable approach for large organizations where the users can well define their information requirements.

5.3 SUGGESTIONS FOR FURTHER STUDY

The Information System has a wide spread scope for an organization. However, this Information System has been developed particularly for the Materials Department in the organization. To realize its full potential other information systems of the organization should also be developed by following an integrated approach to system development. Further, the application of the process development models can be explored in other organizations to implement organization specific model.

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