INTEGRATED

INFORMATION MANAGEMENT MODEL

FOR TEXTILES

# By

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*To*,

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CERTIFICATE

This is to certify that the thesis entitled **“Integrated Information Management Model for Textiles”** being submitted by **Chandrashekhar Chiplunkar** to the Indian Institute of Technology Delhi, for the award of degree of Doctor of Philosophy is a record of bonafide research work carried out by him. Chandrashekhar Chiplunkar has worked under our joint guidance and supervision and fulfilled the requirements for submission of thesis, which has reached to the requisite standard.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

As of today, the majority of the Indian textile units are not making use of integrated information systems to boost the business performance. This thesis takes a look at the possible reasons for the inadequate use of the integrated information systems. One of the major reasons for the under usage of such systems is potential of such systems in assisting the boosting of the business performance is yet to be fully understood.

Through this thesis an attempt is made to analyze the competitiveness of the Indian textile industry to propose a suitable model for the organization of the industry. An instrument is provided to analyze the business performance and a general information management model is proposed, based on easy-to-understand designing methodology suitable for both information systems analysis and business analysis. Finally data model based on event model is suggested for Codeless Database Management System (CDBMS) to support the development of the proposed integrated information management model.

In order to emphasize the need for having an integrated information management system, a structured questionnaire was developed to elicit the present state of the functioning of a business unit. A case study was conducted, in which the questionnaire along with the proposed event diagrams for the integrated information management solution were presented to the users of a reputed textile unit and the response was recorded. All the possible improvements, which can be achieved with the use of integrated information management solution, were highlighted to drive the point that the integrated information systems are very useful in improving the business performance of the textile unit.

The research also looks into the present international textile scenario and analyzes the Indian textile industry for its weaknesses and strengths to suggest the possible measures to improve its competitive ability. An IT (Information Technology) enabled model for Indian textile industry is presented for coordination of the fragmented Indian textile industry.

A need of presenting a designing methodology, which would be simple enough for participation of the users and yet effective enough from the analysis and designing from point of view of the information system as well as the business systems simultaneously, is addressed. An event related designing approach is proposed with the introduction of new tools for analysis and designing of information and business systems. Based on the suggested methodology, a complete set of event diagrams for the integrated information management model is presented along with the interaction diagrams and associated information elements to constitute the high level design specification for the integrated information system. A framework for application of planning system, which forms the core of an integrated solution, to textile composite mill is also discussed in detail.

A framework for developing a supporting development platform to convert the design specifications into a running system without any further coding, termed as Codeless Database Management System (CDBMS) is presented along with the data model. All the essential components and added advantages of CDBMS are discussed at length.

In summary, the thesis presents the following deliverables:

* Measures for improving the competitiveness of the Indian textile industry
* True potential of the integrated information management solution in making the organization competitive with respect to a textile unit
* A framework for application of production planing and control system to a composite textile mill
* Gaps in the existing designing methodologies
* EROS (Event Related Open Systems) designing methodology with event diagrams, interaction diagrams and event notations.
* High level design specifications for the integrated information management solution
* Essentials of CDBMS (Codeless Database Management System) with the proposed data model.

Key Words: Textiles, Information Systems, Integrated Information Management Model, Enterprise Resource Planning, System Analysis and Design, Database Management Systems.

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LIST OF ABBREVIATIONS AND SYMBOLS USED

|  |  |
| --- | --- |
| **4GL** | Fourth Generation Languages |
| **AM** | Auxiliary Material |
| **ARMA** | Agent Relation Morphism Analysis |
| **Asstt.** | Assistant |
| **AT** | Activity Diagram |
| **ATC** | Agreement on Textiles and Clothing |
| **BA** | Business Analysis |
| **B-A** | Before or After |
| **BOM** | Bill Of Material |
| **BPR** | Business Process Reengineering. |
| **CAD** | Computer Aided Design |
| **CAM** | Computer Aided Manufacturing |
| **CDBMS** | Codeless Database Management System |
| **CEO** | Chief Executive Officer |
| **CIF** | Cost Insurance and Freight |
| **CIM** | Computer Integrated Manufacturing |
| **CM** | Conceptual Modeling |
| **CPU** | Central Processing Unit |
| **CRM** | Customer Relationship Management |
| **CRP** | Capacity Requirement Planning |
| **DBA** | Database Administrator |
| **DBMS** | Database Management System |
| **DCL** | Data Creation Language |
| **DDL** | Data Definition Language |
| **DFD** | Data Flow Diagram |
| **DML** | Data Manipulation Language |
| **DMT** | Di-Methyl Terepthalet |
| **DP** | Data Processing |
| **DQL** | Dynamic Query Language |
| **DSS** | Decision Support System |
| **DW** | Data Warehouse |
| **E Commerce** | Electronic Commerce |
| **ED** | Event Diagram |
| **EDFD** | Event and Data Flow Diagram |
| **EDI** | Electronic Data Interchange |
| **EIS** | Executive Information System |
| **E-R** | Entity Relationship |
| **ERD** | Entity Relationship Diagram |
| **EROS** | Event Related Open Systems |
| **ERP** | Enterprise Resource Planning |
| **FAP** | Finance: Accounts Payable |
| **FAR** | Finance: Accounts Receivable |
| **FET** | Function Entity Type Table |
| **FFA** | Finance: Financial Accounting |
| **FRS** | Finance: Financial Resources |
| **FRT** | Function Refinement Tree |
| **GM** | General Manager |
| **HAL** | Human Resources (Manpower): Allocation |
| **HPR** | Human Resources (Manpower): Personnel |
| **HRC** | Human Resources (Manpower):: Recruitment |
| **HRM** | Human Resource Management |
| **HRMS** | Human Resource Management System |
| **HTR** | Human resources (Manpower):: Training |
| **ID** | Interaction Diagram |
| **Id** | Identification |
| **IIMMT** | Integrated Information Management Model for Textiles |
| **IO** | Input Output |
| IOIS | Inter Organizational Information Systems |
| **IR** | Industrial Relations |
| IS | Information Systems |
| **ISO** | International Standards Organization |
| **IT** | Information Technology |
| **KM** | Knowledge management |
| **KWH** | Kilo Watt Hours |
| **LAN** | Local Area Network |
| **Ltd.** | Limited |
| **M** | Mandatory |
| **Max** | Maximum |
| **MEG** | Mono Ethylene Glycol |
| **MFA** | Multi Fiber Agreement |
| **Min** | Minimum |
| **MIS** | Management Information Systems |
| **MIV** | Materials: Inventory |
| **MoD** | Ministry of Defense |
| **MPR** | Materials: Purchase |
| **MPS** | Master Production Schedule |
| **MRP** | Material Requirement Planning |
| **MRP – II** | Manufacturing Resource Planning |
| **MSM** | Materials: Supplier Management |
| **NA** | Not Applicable |
| **NCC** | National Computing Center |
| **NITRA** | North Indian Textile Research Organization |
| **NV** | Not Available |
| **O** | Optional |
| **OE** | Open End |
| **OLTP** | On Line Transaction Processing |
| **OOAD** | Objected Oriented Analysis and Design |
| **PBM** | Production: Bill of Material |
| **PCP** | Production: Capacity Planning |
| **PDM** | Product Data Management |
| **PGD** | Post Graduate Diploma |
| **PL** | Power Loom |
| **PM** | Project management |
| **PMP** | Production: Material Planning |
| **PO** | Purchase Order |
| **POP** | Production: Operations |
| **POS** | Point-Of -Sales |
| **PPA** | Production: Production Accounting |
| **PSA** | Professional Service Application |
| **PSD** | Process Structure Diagram |
| **QA** | Quality Assurance |
| **QBR** | Quality control: Business Event Records |
| **QC** | Quality Control |
| **QPM** | Quality control: Plant Maintenance |
| **QSP** | Quality control: Statistical Quality Control / Statistical Process Control |
| **QTS** | Quality control: Trouble shooting |
| **R&D** | Research and Development |
| **RDBMS** | Relational Database Management System |
| **RM** | Raw Material |
| **RMG** | Ready Made Garments |
| **RMI** | Remote Method Invocation |
| **ROI** | Return On Investment |
| **Rs** | Indian Rupees |
| **SAD** | Sales: Advertising |
| **SAP** | Software Application Product |
| **SAS** | Sales: After Service |
| **SCM** | Supply Chain Management |
| **SCM** | Sales: Customer Management (In Event Diagrams) |
| **SITRA** | South Indian Textile Research Association |
| **SMK** | Sales: Marketing |
| **SSM** | Sales: Sales Monitoring |
| **SN** | System Network |
| **SO** | Sales Order |
| **SPC** | Statistical Process Control |
| **SPD** | Sales: Product Development |
| **SQC** | Statistical Quality Control |
| **SQL** | Structured Query Language |
| **SSAD** | Structured System Analysis and Design |
| **STD** | State Transition Diagram |
| **SWOT** | Strength, Weaknesses, Opportunities and Threats |
| **TCM** | Tools for Conceptual Modeling |
| **TQM** | Total Quality Management |
| **TUT** | Transaction Use Table |
| **WAN** | Wide Area Network |
| **WTO** | World Trade Organization |

Chapter 1

INTRODUCTION

**1.1 Motivation**

In this information-centric age, which is driven by fierce competition, it is expected that the quality of decision making would improve, if the proper information system is in order. The present research work on **'Integrated Information Management Model for Textiles'** is aimed at equipping the management with appropriate information for making sound decisions, thereby improving the quality of decision making. Information is an asset for any organization. Decisions based on the use of the latest and current information, arriving from internal and external environment, are always profitable. For example, an old production plan based on the planning assumptions made at the start of the year may need change, if the market scenario differs significantly from the earlier projections. In such cases, if current information is not available to the management, production plan based on old projections would continue resulting in piling of non-saleable inventory of finished goods and ultimately resulting in loss. In the fast changing world, quick information flow up and down the organizational hierarchy is essential to remain competitive in the marketplace.

Although many commercial integrated systems are available to assist the management in collecting the necessary information, the present research is taken up for the reasons listed below.

* Commercial integrated systems available in the market (such as SAP, BaaN, J D Edwards etc.) are very costly.
* These systems do not seem to be very successful in the textile industry mainly because of cost considerations and their inability to take into account the complexities of the textile processes.
* These systems seem to be complex to understand. It takes a long time to customize and implement them, as level of customization required is very high.
* Many of them do not support management theories and lack modularity.
* It is very difficult to modify such systems at later stage.
* There is also a problem of lack of skilled manpower to maintain such systems.

Owing to these deficiencies, the number of Indian textile business houses implementing such systems is very less. An exploratory survey of various organizations clearly shows that organizations, which make use of such systems, are far ahead of their competitors in terms of capacity utilization, cost control and market share.

Motivated by the above factors, the proposed research study is an attempt to develop a general model, which when developed into a commercial system can provide Indian textile industry with the necessary information at the necessary time so as to remain competitive in the international markets.

This research work also proposes a new modeling technique for systems analysis and design. It takes an event-based approach for the analysis of information system or business analysis. A common method for both is suggested. It further introduces a framework for developing a codeless database system, which can cut down the development and customization efforts drastically, customization being the major problem for textiles.

**1.2 Overview of the contemporary system designing methodologies**

Information system designing techniques are broadly classified in two major categories. The first one is Structured System Analysis and Design (SSAD) and the other being Object Oriented Analysis and Design (OOAD). The following sub sections describe SSAD and OOAD in brief.

**1.2.1 Structured system analysis and design**

SSAD makes use of the following techniques for information system analysis:

* Context Diagram : It gives the system scope and interfaces with the system
* Levelled Data Flow Diagrams: Gives processes, inputs and outputs. It also supplies the details of source and destination of data. Each process and data flow must be given number and name to identify them separately. It is necessary to ensure that data flow diagrams are balanced at every level. **Process Model** consists of context diagram and data flow diagrams.
* Event List: Listing sequence of activities involved in carrying out business operations as they take place.
* Structure Chart: It gives modules in the system and organisation of modules.
* Data Model: It gives interrelationships between various data structures or tables or files and their attributes. "Entity Relationship (E-R) diagrams" are used to show relationships between various data structures.
* Real Time Process Model or State Transition Diagram (Sequence of interaction): It is similar to the event list, which describes the sequence of events as different transitions of the original event. For example the sequence, requisition state to enquiry state to purchase order proposal state to purchase order state, shows the transitions of the original state.
* Data Dictionary: It contains data elements, data structures, data flows and data stores.
* Specification Technique: It includes flow charts, decision trees, decision tables and structured English.

**1.2.2 Object oriented analysis and design**

Object oriented design and development technique makes use of four major concepts, which are listed below (Coad and Yourdon, 1991):

* Abstraction: The principle of ignoring those aspects of a subject that are not relevant to the current purpose in order to concentrate more fully on those that are.
* Procedural Abstraction: It is often characterised by function sub-function abstraction. Procedural abstraction is not the primary part of abstraction for OOAD.
* Data Abstraction: Defining attributes and services that exclusively manipulates those attributes.
* Encapsulation: Data abstraction is one form on encapsulation. Binding of data elements and procedures related to any entity in a single piece. "Class" is the term used to denote such encapsulation. A class can have many "Objects", which make use of data elements and procedures or methods contained in it. Encapsulation serves the purpose of information hiding so that as little part is exposed as required to the programmer.
* Inheritance: Inheritance is a property by which one class inherits data elements and methods of other class. Class, which provides such access to other class, is called as "Super Class" and class, which makes use of data elements and methods of other class, is called as "Derived Class" or "Sub Class".
* Polymorphism: It is same as one name many functions. For example, one function name "Area" can be made capable of calculating areas of different figures like triangle, square, circle etc.

**1.3 Overview of the contemporary computerized planning systems**

Computer based production planning systems are also known as Manufacturing Resource Planning Systems or MRP-II systems. The need for “II” suffix arises as MRP refers to Material Requirement Planning, which is a subsystem of MRP-II system. Lanvater and Gray (1987)gave a good account of MRP-II systems.Typically,the objectives of an MRP-II system are:

1. To accurately simulate realities of manufacturing

environment.

1. To assist planning and scheduling function.

MPS

Sales plan

MRP

Feed back loops

**1**

**2**

**3**

**4**

**5**

**6**

**7**

CRP

Feedback

Business plan

Production plan

**inventory**

**BOM &**

**operations**



**MPS**

**MRP& CRP**

## Figure 1.2 MRP-II system cycle

Figure 1.1 Planning route

To achieve these objectives MRP-II systems are divided into the following major areas (Lanvater and Gray, 1987).

1. Business Plan.
2. Business Mission
3. Products
4. Markets
5. Profits
6. Financial Resources

b) Sales and Production Plan

1. Planned Rate of Sales
2. Planned Rate of Production

c) Master Production Schedule

1. Planned Production for specific

products or end items

d) Material Requirement Planning

1. Purchase and production forecast

e) Capacity Requirement Planning

1. Machine loads and labour requirement.

f) Production feedback

* Actual production record of the goods produced.

As an illustration a MRP-II may have the following sub systems (Lanvater and Gray, 1987):

* Sales and operations planning
* Demand management
* Master production scheduling
* Materials requirements planning
* Bill of material
* Inventory transactions
* Scheduled receipts
* Shop floor control
* Capacity requirement planning
* Input output control (Production feedback)
* Purchasing
* Distribution resource planning
* Tooling
* Financial planning interface
* Simulation
* Performance measurement

Performance measurement takes into account the following factors:

* What is the present production level as compared to the theoretical production at 100% efficiency?
* Is there any scope to improve the running efficiency? To answer this question, a thorough analysis of planning process, machine problems, process parameters, raw material quality, working practices and coordination of production rates of machines in the production line is necessary.
* How to reduce defects in the final product? It can be achieved by pointing out the reasons for the specific defect and therefore, suggesting the remedial measures.
* How do the figures of waste and cost compare with other organizations, which are in the similar business? It can be found out by analysis of consumption of the various raw materials and analysis of the labor force deployment.

**1.4 Need for an integrated system**

Integrated information system is justified on the following grounds:

* Activities of the various departments in an organization are interconnected. For example, marketing personals would be interested in knowing the stock status of the finished goods and production plan to reply customer's query. Marketing personals would also be interested in knowing the past payment history from the finance department. Similarly production department would be interested in knowing latest order status to plan or modify their production schedule. Purchase and stocks departments would be interested in knowing the expected requirement of the raw material in future to keep the optimum stock levels and to plan their purchases. An integrated system helps in coordinating such information flow through out the organization. It helps to cut down the product cycle time and facilitates quick deliveries to the customers.
* Integrated system works with the principle of single point data entry, thus avoiding confusion as same information is conveyed to all without any distortion.
* Integrated system avoids delays in information communication so that the activities of all the departments can be synchronized to improve the overall profitability of an organization by increasing its productivity and reduction in costs at different stages. It also helps in maintaining reduced inventory levels as any delay means keeping additional stock for those many days.
* Finance department can keep track of expenses incurred by various departments and thus, integrated system helps in budgetary control.
* Problems or changes at any place are conveyed across the organization speedily, so that the overall planning function can deliver effective plans based on the latest information. It imparts flexibility to a manufacturing process by virtue of the changes in the production plan according to the demand in the market. This coupled with the efficient management of inventory improves the overall profitability of the company.

**1.5 Specific needs of the textile sector**

The textile process industry, spinning department in particular, differs from manufacturing and chemical process industry in the following aspects:

* Only one material, which is subjected to opening, cleaning, thinning (drafting or attenuation) and twisting flows from the beginning to the end.
* The same material can be reprocessed through the same process or the earlier process without any disassembling.
* It is very difficult to construct a normal bill of material, like other manufacturing industries, for every stage of production. There is no concept of assembly or disassembly.
* There is a possibility of the same material being used for the different end products for which it is not meant with some changes in the process parameters, which means, the end product can be made from the inputs that are not predefined. A variety of sequences are possible to arrive at end product although specific product and process parameters are standardized for a particular end product.
* Thus, it is necessary that the bill of resources should be flexible enough to take into account these variations.
* Some processes like sizing, which are from the weaving department, put some added material on the product to improve its strength or appearance.

It is quite evident that to sustain the international competition, textile industry in India will have to optimize manufacturing and administrative processes to deliver quality goods at reduced costs and with shorter lead times. There is also a need to develop and apply concepts of business model to the Indian textile industry.

**1.6 Objectives of the present study**

# The broad objectives of the present research are:

* Analyze the competitiveness of the Indian textile industry
* Highlight the specific needs of the textile sector.
* Propose a suitable model for the Indian textile industry
* Provide an instrument to analyze the business performance.
* Discuss the role of information technology in improving the competitiveness
* Develop a framework for business analysis and work out a general information management model, which can be applied to the textile industry.
* Propose a designing methodology suitable for both information systems analysis and business analysis.
* Suggest a suitable Database Management System to support the development of the proposed model.

**1.7 Research methodology**

Figure 1.3 shows the major steps taken in conducting the current research. Literature review was conducted to study different implications of information system with respect to the business environment. Analysis of the Indian textile industry was done from the available data and a suitable IT (Information Technology) enabled model that takes into account both the centralised and the decentralised sectors, was proposed for the Indian textile industry. Measures to improve competitiveness of the Indian textile industry were also suggested. The research also involved a case study to establish the need of the integrated information management solution in managing the business. An extensive questionnaire was prepared to bring out the current status of an organization. The questionnaire was administered to a reputed composite textile mill. The response was analyzed and the benefits of using the integrated solution were highlighted. Event diagrams of the proposed integrated information management solution were shown to different respondents and their

Stress

The need of

Integrated

Information

System

**Literature**

**Review**

**Survey of**

**Textile**

**Units**

**Carry out SWOT**

**analysis of**

**Indian**

**Textile Industry**

Business

Perspectives

Information

Systems

Textile

Scenario

Summarize

Gaps

Make

Questionnaire

Administer

Questionnaire

Conduct

Interviews

Analyse

Response

Study

the available

Literature

List Strengths

Weaknesses

Opportunities

Threats

Make

Force field

Diagram

Suggest

Corrective

Measures

Propose

IT enabled

Model for

Indian

Textile

Industry

Discuss

Benefits of

Using IT

**Propose IS Model**

**and**

**Discuss**

**PPC application**

Suggest

Development

Methodology

Furnish

Event

Diagrams

Furnish

Information

Elements

Suggest

Development

Platform

High light

Advantages

of proposed

methodology

&

proposed

development

platform

Discuss

Business

Analysis

with the help

of proposed

methodology

Discuss

application of

PPC to

composite

mill

## Figure 1.3 Research methodology

feedback was obtained to know the suitability of event diagrams to represent the respective functions. EROS (Event Related Open Systems) methodology for analysis and design of information system was proposed and advantages of using EROS were highlighted. EROS introduced event diagram and interaction diagram as tools for business modelling and modelling of information system. A concept of codeless database management system (Easy Program) was also introduced along with the data model and advantages of using such DBMS (Database Management System) were highlighted.

**1.8 Thesis outline**

This thesis is organised into 9 chapters. Chapter 2 reviews the literature on information systems, on management related issues and the literature related to the Indian textile industry. Chapter 3 gives the analysis of strengths, weaknesses, opportunities and threats for the Indian textile industry with suggested measures to improve the competitiveness of the industry. Chapter 4 brings out the need for an integrated information management solution from a case study of a textile unit. Chapter 5 deals with the designing methodology for the development of an Integrated Information Management Model and gives a framework for analysis of business processes and information systems. Chapter 6 gives the event diagrams or information flows and interaction diagrams for the proposed Integrated Information Management solution, and discusses a framework for the application of the production planning systems to composite textile mill. Chapter 7 discusses a supporting development platform - the codeless database management system with the data model - for the proposed Information Management Solution. Chapter 8 is devoted to the summary, conclusions and the limitations of the present work. Finally, Chapter 9 highlights the future scope for the research in this area.

**Chapter 2**

##### LITERATURE REVIEW

**2.1 Introduction**

Literature review was conducted with the following objectives:

* Analyse the Indian textile industry in order to propose a suitable model to enhance its competitiveness.
* Find out the level of usage of Information Technology (IT) in the Indian textile industry in relation to the information management systems.
* Take into account the various issues related to the information systems and business management to check the validity of suggested designing methodology, suggested development platform and therefore, the proposed integrated information management model in addressing these issues.
* Highlight the gaps in the current business analysis and information system designing methodologies to bring out the usefulness of the suggested designing methodology in bridging these gaps.

Figure 2.1 shows the classification of the literature review. The literature review is divided into three main categories to view IT from systems perspective, business perspective and to discuss the Indian textile scenario related to utilization of IT for business management.

*Italic typeface shows the comments made by the researcher in connection with the literature presented*.

**2.2 System Perspective**

**2.2.1 Strategic drivers for the information management solution**

Korhonen et al.(1998) reported the key requirements for the information management solution as strategic direction and focus, integration, information coverage and availability, flexibility and adaptability, information quality (relevance, timeliness, continuous flow, validity, accuracy, intelligibility, accessibility and visibility), decision making support and simplicity. They have mentioned the strategic questions and drivers for information management solution in today’s context, which are given below:

* How to improve customer satisfaction through the following measures?

Product availability

Delivery accuracy

Responsiveness and flexibility

Offer of value adding services

Improvement in effective feedback and learning

* How to increase profitable sales revenue?
* How to improve efficiency of operations through eliminating unnecessary activities, reducing inventory and improving utilisation of assets?
* How to improve and support understanding of logical links and causalities in the supply chain?
* How to manage performance in real time, process based mode instead of traditional functional performance management?
* How to improve relevance, quality, timeliness and visibility of information?

***Not only quality of information but quality of product should also be included in the strategic drivers for modern information management solution. In addition, employee satisfaction needs to be given due consideration while designing information management solution.***

Literature

# Review

Textile Scenario

Systems

Perspective

Business

Perspective

Present State

Need for IT

International

Front

RMG

Sector

Drivers

Classification

Planning

Model

ERP systems

Performance

improvements

Supply chain

management

BPR

PSA

Theory

Attributes

Fig 2.1 An overview of the literature review

**Galliers (2000) has given the components of the information systems strategy, which is the result of the business environment and business strategy as follows: Technology strategy, information services strategy, change management and implementation strategy (IS related human resources issues), assessment and review. Generally, strategy tries to answer five basic questions: Why, What, Who, When and How.**

**2.2.2 Classification of the business information systems**

Holsapple and Whinston (1996) have classified business information systems into the following categories:

* Data Processing Systems
* Management Information Systems
* Decision Support Systems
* Executive Information Systems

Brief description of these categories is provided below:

**Data Processing Systems (DP)** (Holsapple and Whinston, 1996)

* dominated business computing field in 1950s and 1960s
* purpose is to automate large volumes of transaction handling
* store records of what has happened (descriptive knowledge)
* process incoming transactions to keep records current (record keeping ability)

**Management Information Systems (MIS)** (Holsapple and Whinston, 1996)

* dominated business computing field in 1970s and into 1980s
* purpose is to provide managers with periodic reports that recap predetermined aspects of an organization’s past operations, giving them snapshots of what has been happening
* store records of what has happened (descriptive knowledge)
* process incoming transactions to keep records current (record keeping ability)
* produce reports (standard, recurring)
* get support from MIS departments to build/operate these systems
* **decision support is limited by**
* predefined reports
* periodic reports
* descriptive knowledge only
* relevant information in MIS reports incomplete, hard to dig out, unfocused, difficult to grasp, in need of processing, unavailable when needed

Encyclopædia Britannica (1999) gives the following description of management information systems. Administrative functions in formal organizations have as their objective the husbanding and optimization of corporate resources--namely, employees and their activities, inventories of materials and equipment, facilities, and finances. Administrative information systems support this objective. [Management Information Systems](/bcom/eb/article/idxref/0/0,5716,315265,00.html) (MIS), focus primarily on resource administration and provide top management with reports of aggregate data. Executive information systems may be viewed as an evolution of administrative information systems in the direction of strategic tracking, modeling, and decision-making. Typically, administrative information systems consist of a number of modules, each supporting a particular function. The modules share a common database whose contents may, however, be distributed over a number of machines and locations.

**Decision Support Systems (DSS)** (Holsapple and Whinston, 1996)

* includes descriptive and possibly other types of knowledge
* has ability to acquire/maintain these types
* has ability to present knowledge on ad hoc basis in customized ways (as well as in standard reports)
* has ability to select any desired subset of stored knowledge for presentation or derivation during problem recognition/solving
* can interact directly with decision maker who has flexibility in choice/sequencing of knowledge management activities

Encyclopædia Britannica (1999) gives the following description of decision support system. Data classification, modeling, and simulation capabilities are characteristic of a [Decision Support System](/bcom/eb/article/idxref/0/0,5716,315263,00.html) (DSS), a composite of computer techniques for supporting executive decision making in relatively unstructured problem situations. Decision-support software falls into one of two categories: decision-aid programs, in which the decision maker assigns weighted values to every factor in the decision, and decision-modeling programs, in which the user explores different strategies to arrive at the desired outcome.

**Executive Information Systems (EIS)** (Holsapple and Whinston, 1996)

* specifically designed for ad hoc information needs of the top executives
* filter, summarize, track critical information
* has extensive access about environment
* allows top-down information access
* customized to executive
* give graphical presentations
* require little training

Encyclopædia Britannica (1999) gives the following description of Executive Information System. The objective of these systems is to gather, analyze, and integrate internal (corporate) and external (public) data into dynamic profiles of key corporate indicators. Depending on the nature of the organization's business, such indicators may relate to the status of high-priority programs, health of the economy, inventory and cash levels, performance of financial markets, relevant efforts of competitors, utilization of manpower, legislative events, and so forth. The indicators are displayed as text, tables, graphics, or time series, and optional access is provided to more detailed data. The data emanate not only from within the organization's production and administrative departments but also from external information sources, such as public databases. Present-day efforts, drawing on research in neural computers and networks, are to enhance executive information systems with adaptive and self-organizing abilities by means of learning from the executives' changing information needs and uses.

*However, MIS, DSS and EIS appear as distinct islands of information rather than integrated solution.*

It is preferable to have a modular system. Modularity is a general systems concept. It is the degree to which a system’s components can be separated and recombined (Schilling, 2000). The systems are said to have high degree of modularity when their components can be disaggregated and recombined into new configurations with little loss of functionality (Langlois 1992, Sanchez 1995). The degree to which a system achieves a greater functionality, by its components being specific to one another can be termed as synergistic specificity and the combination of components achieve synergy through the specificity of individual components to a particular configuration. For such systems, any change in one component requires extensive compensating changes in other components of the system or else the functionality is lost (Sanchez and Mahoney, 1996). *Information systems should be modular at the same time should have less synergistic specificity.*

**2.2.3 Planning system model**

A model presented by Collin and Devenna (1990) for MRP-II system consists of the following steps:

* Business Planning (Market planning and Finance planning).
* Production Planning.
* Master Production Schedule.
* Material Requirement Planning with inputs from inventory and bill of material.
* Capacity Planning.
* Planned order releases.

Tasiopaulous and Mekras (1999) proposed a model for the evaluation of production planning and control systems, which included the following modules:

* Manufacturing Data Management
* Forecasting
* Master Production Scheduling
* Capacity Planning
* Material Requirement Planning
* Shop Floor Control
* Inventory
* Purchase
* Costing
* Distribution Resource Planning

*Drawback of above models is that they do not detail out the procedure for arriving at information solution.* Gondgayu (1999) proposed a model for rule based production systems. *But such models are not very popular due to problem in the formation of exact rules.*

**2.2.4 Review of Enterprise Resource Planning (ERP) systems available in the market**

ERP systems are the information management systems which address the information needs of the entire enterprise and provide integrated information solution for various functions like finance, production, suppliers, inventory, sales, manpower etc. of an organization.

There are many ERP systems in the market like Oracle, SAP, BaaN, QAD, Ramco, J. D. Edward, People Soft etc. Wadhwa and Rao (1998) have reported features of two widely used commercial ERP systems (Baan and SAP) as given in table 2.1 and table 2.2

*All these systems suffer from the same disadvantages as stated in introduction. Another important point is system analysis methodology is not the same as business analysis methodology. This makes it difficult to integrate ongoing business improvement process with information system development*

Table 2.1 Baan components

|  |
| --- |
| ***Manufacturing*** Multi-site MRP, product configuration, project control and critical path analysis, job shop production and supply chain control for multi-site manufacturing. |
| ***Distribution and Transportation*** Sales and purchases, order processing, margin monitoring, contract administration, route optimization, transport order management, transport public ware housing and packaging. It is integrated with EDI (Electronic Data Interchange) module for rapid communications with clients and sub contractors. |
| ***Finance*** General ledger, fixed assets, account payables, account receivables |
| ***Service*** Installation control, contract control, service order control and invoicing. |
| ***Project*** Management of large projects through all stages from estimating tenders to delivery and through out the guarantee period. |
| ***Process*** Developed for process industry including co-product, by-product management |
| ***Tools*** Powerful 4GL application development environment |
| ***Orgware*** Customizable process model, which are linked to applications to speed up implementation end user training. |

Saxena and Sahay (2000) stated that most of the Indian companies have fragmented (rather than integrated) information management systems which may not enable them to deliver superior value to their customer. Davis and O’Sullivan (1998) stressed the need for electronic data interchange for more accurate records, lower data entry costs, reduced inventory, reduced mail cost, quicker turnaround on inventory, better customer satisfaction and increased business opportunities.

Table 2.2 SAP R/3 components

|  |
| --- |
| ***Financial Accounting*** General ledger, accounts receivables and payables, fixed assets |
| ***Financial Control*** Costing, overheads, cost control, profitability analysis |
| *Investment management*Corporation-wide budgeting, appropriation requests, investment measures, automatic settlement to fixed assets, depreciation forecasts |
| ***Treasury*** Cash management, treasury management, market risk management, funds management |
| ***Production planning and control*** Production planning, production control, project system, project information system |
| ***Materials management*** Purchasing, warehouse management, inventory management, invoice verification, inventory control, quality management, plant management, service management. |
| ***Human resource management***Personneladministration to create corporate wide HR database, recruitment management, Travel management, Benefits administration, Salary administration |

Pryce and Saaiman (1999) gave following disadvantages of islands of automation:

* Invalid data in the face of an ever changing business environment
* Unsynchronised data creation and maintenance
* Missing, lost or incompatible data
* Difficulty in accessing and controlling data
* Bad systems bread more systems

Sinha (2000) put six most wanted ERP implementation factors as reduced implementation time frame, low cost for the entire exercise, after implementation support and training, reengineering, simplicity and ease of installation and use.

Vowler (2000) stated that ERP, the NCC IT Management guidelines point out, is essentially inward-looking. Customer relationship management, supply chain management and the Internet are not - they reach out to customers and suppliers and do so over new channels. In-house ERP is - and must be - extensible beyond the boundaries of the organisation, both to suppliers and customers. The guidelines point out the kind of ERP that can tackle this will need to be different from the monolithic, wall-to-wall, multi-year implementations that corporate IT has been hammering in for the last decade - they are too slow, too expensive and too inflexible for the new external-facing focus. The only way to break the deadlock, as per the guidelines, is for ERP to liquefy into smaller, fleeter parts. Components must become the name of the game. "Componentisation... [offers] cost advantages, ease of deployment, improved manageability, effective scalability and... vendor independence," say the guidelines. Components - a chunk of functional (object-based) code wrapped up in usability-focused layers such as communications, data validation, event handling and relationship management services - can communicate with each other via message passing (ideally using standards common to all ERP packages). This means that they can establish an inter-company exchange mechanism irrespective of what package is installed. According to the guidelines, "Each component exposes its methods so that other components or applications can exchange information with it, and this architecture is intended to make it relatively easy to extend the scope and scale of the ERP solution, taking in any part of the enterprise or of any other enterprise whose own components support the same message-passing techniques and standards."

"The component approach is ideally suited to the deployment of ERP within organisations committed to trading partnerships or intending to rationalise the supply chains," the guidelines argue. "It also simplifies the processes by which complementary software, such as data warehouses and customer relationship management systems, can be integrated within ERP." Because the component approach is modular, risk is minimised and systems can be built organically at the most appropriate pace and with the benefit of a growing body of experience.

And, the guidelines conclude: "What users increasingly want from ERP systems is support for e-commerce, lower cost, flexibility, ease of use and ease of maintenance and development. All of these are offered by componentisation."

**Supplier component plans**

According to the NCC report, ERP suppliers are driving towards component strategies but each one is starting from a different base line and each one has adopted a different approach to componentisation. SAP, the market leader has opened up its core R/3 system, but is concentrating its effort on producing new component modules. Baan has taken a more radical approach in an attempt to steal a march on its competitors and is committed to reengineering all its offerings as true components. *This brings out the point that both SAP and Baan are targeting to make their solutions flexible to allow for customized products and at present their solutions are not flexible enough for rapid deployment to cover diversified requirements.*

Phillips (2001) takes the review of the current scenario, "Over the last 12 months many companies have struggled with Customer Relationship Management (CRM) because of difficulties with systems integration, the challenge of managing all the component elements of a CRM system and problems measuring return on investment [ROI]. Fewer than 10% of companies investing in CRM have a means of measuring ROI. It was surprising that that the biggest enterprise resource planning (ERP) and CRM vendors had not exploited this type of software further. Business Objects recently reached an agreement with SAP to integrate its Infoview product with the Web-enabled ERP package, MySap.com. “ *It shows that ERP system SAP in itself is not addressing the need of business analysis.*

A survey of IT users (National Computer Centre, 1999) lists ERP systems as a major disappointment of the past decade. The survey says, “ERP implementations have been a major development for many in the past year, and many more will be tackling them in the near future. However, this was one of the areas where a significant number of respondents reported a failure to meet expectations or considerable problems with implementation. It was noticeable that many of those describing disappointing IT developments were citing the implementation process (sometimes implicating end-users or more often the suppliers) rather than the underlying technology itself.”

Linthicum (1998) states the following factors which hinder the successful implementation of integrated solutions:

* **Lack of proper preparation**

Preparing for a package installation and integration project means first understanding the user requirements and business issues in great detail. For instance, how many end users will use the system on a daily basis? What are the hardware and software requirements for the package? What about sharing information and processes with other external systems? How long will it take for users to learn the new software? It’s also a good plan to document these requirements, feeding them back to the user to assure there is no miscommunication. *If designing methodology can be used to analyse business processes along with information system, it would serve a useful purpose in extracting user requirements. Implementation of new business processes should precede the implementation of information system. Thus, lack of preparation could be avoided.*

1. **No clear vision of the business drivers**

Another project killer is the lack of a clear vision of the business drivers. The package has to solve some problem that will make money for the company somehow. *To arrive at business drivers, investigation stage must be supported with a suitable diagnostic tool.*

1. **No application architecture**

A common issue is that most organizations don’t accept the package as it is bundled. Instead, they make modifications to the business service and interface layers of the packaged application, which is not unlike a reengineering and application development activity. Requirements must be gathered, interfaces designed, and business processes redefined. A *set of easy to understand and easy to apply tools would be a great help in this regard.*

1. **Lack of understanding of the human elements**

Lack of understanding of the human elements is a critical mistake because, ultimately, they are the people responsible for accepting the system into production. The ultimate users should be included in the design of the interface, definition of business services, and the common definition of what denotes "good performance”. Moreover, a training plan should be in place to get all potential users up to speed with the new application as well as a change-management plan to bring the system into everyone’s workplace in an orderly manner. As technicians, we tend to focus on the technology and not the biology. Do so, and the project may not meet the requirements of the end user, and that is the ultimate measure of success. *The ultimate users can be involved in analysis and design process, if they can comprehend what designing tool has to convey. Further, the tool should be simple enough so that users can represent their understanding of the system in the form suitable for analyst from the point of view of information system analysis and design.*

* **Neglecting a rigorous testing process**

It is a mistake to neglect the rigorous testing process that assures that the newly installed system is meeting performance, interface, and business expectations. There really are no tricks of the trade here other than creating a test bed for the package and putting it through its paces. There are three levels of package testing: performance, process, and interface. Performance testing is a direct examination of the throughput of the packaged application. Process testing is a quick look at the system’s accuracy and its ability to live up to the business requirements. Interface testing is a quick look at how well the interface works with the human beings who have to use it. It involves working directly with the end users during the entire installation process, gathering requirements, and assuring the user that the requirements are met in the final product. *If the development platform provides for evolutionary prototyping capabilities combined with system designing, it would allow to test the system at all stages without any additional efforts.*

Davenport (2000) stated that based on his observations, there are three commonly used ways of installing ERP.

i) **The Big bang strategy**

In this, the most ambitious and difficult of the approaches to ERP implementation, companies cast off all their legacy systems at once and implement a single ERP system across the entire company. Though this method dominated early ERP implementations, few companies dare to attempt it anymore because it calls for the entire company to mobilize and change at once. Getting everyone to cooperate and accept a new software system at the same time is a tremendous effort, largely because the new system will not have any advocates. No one within the company has any experience using it, so no one is sure whether it will work. Also, ERP inevitably involves compromises. Many departments have computer systems that have been honed to match the ways they work. In most cases, ERP offers neither the range of functionality, nor the comfort of familiarity that a custom legacy system can offer. In many cases, the speed of the new system may suffer because it is serving the entire company rather than a single department. ERP implementation requires a direct mandate from the Chief Executive Officer (CEO).

ii) **Franchising strategy**

This approach suits large or diversed companies that do not share many common processes across business units. Independent ERP systems are installed in each unit, while linking common processes, such as financial book keeping, across the enterprise. This has emerged as the most common way of implementing ERP. In most cases, the business units each have their own "instances" of ERP—that is, a separate system and database. The systems link together only to share the information necessary for the corporation to get a big picture of the performance across all the business units (business unit revenues, for example), or for processes that don't vary much from business unit to business unit (perhaps HR benefits). Usually, these implementations begin with a demonstration or "pilot" installation in a particularly open-minded and patient business unit where the core business of the corporation will not be disrupted if something goes wrong. Once the project team gets the system up and running and works out all the bugs, the team begins selling other units on ERP, using the first implementation as a kind of in-house customer reference.

iii) **Slam-dunk strategy**

ERP dictates the process design in this method, where the focus is on just a few key processes, such as those contained in an ERP system's financials module. The slam-dunk is generally for smaller companies expecting to grow into ERP. The goal here is to get ERP up and running quickly and to ditch the fancy reengineering in favor of the ERP system's "canned" processes. Few companies that have approached ERP this way can claim much payback from the new system. Most use it as an infrastructure to support more diligent installation efforts down the road. Yet many discover that a slammed in ERP system is little better than a legacy system, because it doesn't force employees to change any of their old habits. In fact, doing the hard work of process reengineering after the system is in, can be more challenging than if there had been no system at all, because at that point, few people in the company would have felt much benefit.

Schneider (1999) stated, “Consultants believe that evolutionary change in business from ERP will not occur until organizations begin to reorganize their businesses around processes, which means pitching the old organization chart and starting anew”. Gupta (1999) made following recommendations for successful coordination of IT and manufacturing staff: Call for early participation, cross functionlization, commitment to training and change in attitude. Reel (1999) stated signs of project failure as given by Field (1997), which included improper understanding of users’ needs and user resistance. *Suggested designing methodology tries to address both these issues.* Bhaskar (2000) wrote, “In order to better manage information flows in companies, many application-level frameworks address workflow. By compiling workflow rules into a set of triggers in a database system, and attaching them with the stored data, information flows could be integrated with data. This would lend workflow processes the high level of security, reliability, integrity, and concurrency offered by databases. *CDBMS suggested through this thesis, tries to address this need.*

**2.2.5 Professional Service Application (PSA)**

Ward (2000) stated, “PSA looks set to do for the services sector what enterprise resource planning did for manufacturing and distribution. Put in simple terms, PSA is the name given to a group of software applications designed to enable service-based organisations to better manage all their internal skills and resources. By providing an infrastructure within which a business can streamline every element of the service chain, PSA applications can enable a company to more efficiently manage its core processes, thereby improving productivity and the availability of its staff. Through automation of the service chain, companies can take control of everything from time reporting and expense capture, to billing, resource planning and project management, while becoming better informed about the status of staff, customers, projects and resources. With the savings and cost benefits going straight to the bottom line, PSA can deliver a significant return on investment, often within the space of a year.

PSA is geared towards the professional services and consulting sectors, which includes IT services companies, management consultants, engineering and legal services, and internal IT departments. Although suppliers are targeting all the professional service organisations, it is largely the IT-related companies, which are the early adopters of the technology.

The potential for an application, which improves the productivity and availability of existing staff, is huge, especially in the IT sector where skilled professionals are in such short supply.”

*It shows that integrated solution is equally important for service industries as well.*

**2.2.6 Desired features of a good theory**

Wacker (1998) reported the key features of good theory. Some of these features were generalizability, internal consistency and abstraction. Generalizability allows more areas to be added to make it a better theory. Internal consistency means theory has identified all relationships and offers adequate explanations. Abstraction level means it is better to integrate many relationships and variables into a larger theory.

*All these aspects are important while designing integrated information management solution.*

**2.3 Business perspective**

**2.3.1 Performance improvement**

Flynn et al. (1999) suggested measures for improving company performance. Table 2.3 lists some of the measures and how they can be attempted to resolve through integrated information management solution.

Table 2.3 Measures for improving organisation performance.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Measures** | ***Can be Addressed Through*** |
| Cost | Reduce inventory | *Planning & Inventory control* |
| Increase capacity utilisation | *Planning, Maintenance, Training* |
| Reduce production costs | Planning & Inventory control |
| Increase labour productivity | *Training & Personnel* |
| Quality | Provide high performance products | *Quality Control, Training* |
| Offer consistent, reliable quality | *Trouble shooting* |
| Delivery | Provide fast deliveries | *Planning* |
| Meet delivery promises | *Planning* |
| Reduce production lead-time. | *Planning, Supplier Management* |
| Flexibility | Make rapid design changes | *Product Development* |
| Adjust capacity quickly | *Planning* |
| Make rapid volume changes | *Planning* |
| Offer a large number of product features | *Product Development* |
| Offer a large degree of product variety | *Product Development* |
| Adjust product-mix. | *Market Planning* |

*Customer relationship management should also be given the due consideration.*

IT infrastructure capabilities underpin the competitive positioning of business initiatives such as cycle time reduction, implementing realigned cross-functional processes, utilizing cross-selling opportunities and capturing the channel to the customer (Braodbent and Weill, 1997). Mohanty and Deshmukh (1998-b) gave some strategies for waste minimisation. Some of the points are listed below. Italics typeface in brackets shows how these issues can be tackled through integrated information management solution.

* Wastage due to excess finished goods inventory. (*Production Planning).*
* Waste due to rejection. (*Quality Control).*
* Wastage due to non-value-adding activities: Unnecessary movement, delays and deployment of manpower. (*Integration of activities, Business Events Analysis)*.
* Wastage due to excess of raw material inventory and work-in-process. (*Production Planning).*
* Waste in raw material. (*Quality Control).*
* Capital waste: From uptime. (*Down time analysis).*
* Waste in yield: Productivity, use of latest technology. (*Product Development, Business Events Records).*
* Waste in energy: Energy conservation, proper utilisation of energy avoid losses due to poorly maintained machinery, use of latest technology. (*Plant Maintenance).*
* Waste in manpower: Persons without specific job descriptions, uneven workload distribution. (*Labour utilisation report).*
* Waste in information: Unnecessary record keeping. (*Data pickup at source).*
* Waste in machinery: Losses due to set up times, lack of proper preventive

Maintenance program. (*Down time analysis)*.

System changes are closely associated with process redesign. It is impractical to focus the organization on customers with lifetime value or most profitable segment or presume to offer seamless services with a hodgepodge of mismatched legacy systems (Day, 1999). Few criteria of people management, which were reported by Sampson and Terizovski (1999), included organization-wide training and development process, top down and bottom up communication process, quality consciousness, health and safety practices for employees and employee flexibility. *These attributes can be taken care of in* *manpower and quality control* sections of integrated solution. Jayawardhane (1995) studied the effect of work values, which included security, relationship with superiors, environment, participation in management, achievement, intellectual simulation, creativity, prestige, variety, colleagues, recognition, independence and money. Findings showed that autonomous work teams placed higher values on security, relationship with superiors, participation in management and achievement. They also considered intellectual simulation, creativity, prestige, variety, colleagues and recognition as important. They placed the lowest value on money. The normal workgroups attached higher value to money, security, relationship with superiors and environment. Mangalraj (1999) has found out from a case study that Human Resource Development system in the form of human resource planning, training, performance appraisal, promotion etc. would be quite useful for the growth of organization. *HRM (Human Resource Management) or manpower section of integrated solution could offer a great help in tackling employee related issues. In order to know the psychology of a work group, IT would be useful to collect and analyze data on various personal attributes to arrive at correct human resource development strategy. With such attributes readily available for making decisions, management can utilize the work force in the best possible way.*

Tracey et al. (1999) reported the following parameters for arriving at competitive capabilities: Price offered, quality of products, product line breadth, order fill rate, order cycle time, order shipment information and frequency of delivery. *These areas can be taken care through planning, product development, marketing, sales monitoring and customer management of the integrated system.*

It is imperative that the quality implememtation strategies, tactics and measurements are correctly aligned with strategies in areas of finance, operations, procurement, logistics and marketing, new product development and sales (Kannan et al., 1999). *That is, an integrated approach is essential.* Angeles (1999) argued that IT could be used to meet seven dimensions which customers use to judge a firm’s service as identified by Parashuraman et al. (1985, 1990). These dimensions are listed below:

* Reliability: Consistency of performance and dependability
* Responsiveness: Willingness and readiness of employees to provide service and timeliness of service
* Competence: Possessions of skills and knowledge required to perform the service
* Access: Approchability and ease of contact
* Communication: Keeping customers informed in a language they can understand and listening to them
* Understanding and knowing the customers: Making the effort to understand the needs of customers
* Credibility: Trustworthiness, believability, honesty and having best interest of customers at heart

Joyner et al. (2000) listed four constructs linked to organizational learning as given by Huber (1991) as follows:

* Knowledge acquisition: The process by which information is obtained
* Information distribution: The process by which information from different sources is shared
* Information Interpretation: The process by which distributed information is given one or more commonly understood interpretation
* Organizational memory: The means by which the knowledge of an organization is stored for future information

*One can notice that IT can be effectively deployed to help organizational learning process, as information systems are being utilised for information gathering, information analysis, information distribution and information storage.*

Grover (1999) contended that it would be possible for suppliers to use IT to collect and process information on buyers and infer the reservation price. Supplier then could customize their products according to the feedback and charge prices accordingly to extract the consumer surplus. Kasturi (1996) pointed out that organizational survival would depend on the response that organization offered to its customers. Mahadevan(1996) put essentials of high competitiveness as zero defects, zero breakdowns, zero inventory, zero waiting time. *Use of integrated information system would be useful to move in this direction.*

2.3.2 Supply chain management (SCM)

**Supply chain management is concerned with flow of products and information between supply chain member organizations (Handfield and Nicholas, 1999). At the limit, it encompasses all those organizations (i.e. suppliers, customers, producers and service providers) that link together to acquire, purchase, convert/manufacture, assemble and distribute goods and services from suppliers to end user. All these flows are bidirectional (Harrington, 1995). Bakos (1991) defined Inter Organizational Information Systems (IOIS) as systems based on information technology that crossed organizational boundaries. Balsmier and Voisin (1991) stated that at the ultimate level of integration, all member links in the supply chain would be continuously supplied with information in real time. Barret (1986) described IOIS as an integrated data-processing, data-communication system utilized by two or more separate organizations. The development of IOIS for the supply chain management has three distinct advantages: cost reductions, productivity improvements and product/market strategy. Distorted information from one end of a supply chain to other can lead to tremendous inefficiencies: excessive inventory investment, poor customer service, lost revenues, mis-guided capacity plans, ineffective transportation, and missed production schedules (Lee et al., 1997). Clearly, the main point of leverage for improving cycle-time performance across the supply chain is ‘informating’. (Wetherbe, 1995).**

**Davis (1993) suggested the following framework for supply chain management:**

* Developing a simple, generic framework to describe the supply chains that organisation has
* Accurate modelling of the propagation of uncertainty up and down the supply chain
* Creating a modelling approach to support strategic decision-makers and not simply provide yet another tool for solving day to day problems.

**Handfield et al. (2000) made some important observations regarding supplier development. They are as follows: As manufacturing firms outsource more parts and services to focus on their own core competencies, they increasingly expect their suppliers to deliver innovative and quality products on time and at a competitive cost. When a supplier is incapable of meeting these needs, a buyer has three alternatives:**

* Bring the outsourced item in house and produce it internally.
* Change to more capable supplier.
* Help improving existing supplier’s capabilities.

For low value-added, non-strategic commodities, the cost of changing to new supplier is low and switching may be the best option. At the other extreme, when an under performing supplier provides an innovative product, the buyer may wish to protect this potential advantage and bring the work in-house by acquiring the supplier. For all other cases, the best option would be supplier development. Supplier development is any activity that a buyer undertakes to improve a supplier’s performance and capabilities.

The following process map for supplier development was suggested by Handfield et al. (2000).

* Identify critical commodities: In order to identify critical commodities and therefore suppliers, they have suggested a scheme for classification of the commodities as shown in the table 2.4.

Table 2.4 Classification of commodities

|  |  |  |
| --- | --- | --- |
| Commodity type | Purchase Volume. | Supplier type |
| Low opportunity low risk | Low | Non-critical |
| (Adequate availability, Std specs, substitution possible) | High | Leverage |
| High opportunity high risk High entry barriers, Critical geographic or political situation, substitute very difficult | Low | Bottleneck |
| Substitution very difficult, | High | Critical |

* Identify critical suppliers: By Pareto analysis
* Form cross-functional teams
* Meet with supplier top management
* Identify key projects
* Define details of agreement
* Monitor status and modify strategies

*Integrated information system can be designed to assist SCM function. One should not only take into account uncertainties like SCM but should also focus on other factors like human resources, quality improvement, knowledge management and technology to offer continual improvement in the business. There is a need for common platform to manage the project and to visualize combined effect of different business forces on the company’s performance.*

Chandra (2000) argued that SCM should consider supply chain cost analysis, supply chain inventory analysis and supply chain time analysis. *Every event in the proposed model can be analyzed for the above characteristics.* Narasimhan and Das (1999) argued that the well-managed SCM would improve the modification flexibility, volume flexibility and delivery flexibility. Lulmmus and Vokurka (1999) stressed the need of capturing moments of information from consumers, suppliers, retailers, carriers, manufacturers and distributors to make SCM more effective. Demand managers must have information on point-of-sales (POS) activity, demand forecasts, growth projections, manufacturing plans, inventory balances and product movement throughout the supply chain. These moments of information become the basis for making decisions, which allow maximum responsiveness to the customer demand. *Integrated system can capture moments of information from all the sources and present a collective view to the management for making decisions.*

2.3.3 Business process reengineering (BPR) and role of IT

**BPR involves critical analysis and redesigning of the business processes to increase the profitability of a business house by quantum jumps.**

**Benjamin and Levinson (1993) reported the following principles of IT Enabled change:**

* Develop a systematic process for change
* Manage equilibrium and mutual adaptation of organization, technology and business process
* Determine whether there is enough energy for change
* Analyze the size of the change effort
* Analyze and manage stakeholder commitment
* Major change requires a champion – know what one does
* Prototype organization response
* Build change reviews into management process

Figure 2.2 shows organizational components of equilibrium as shown by Benjamin and Levinson (1993).

Organization/ Culture

Business Processes

### Fig 2.2: Balancing of the organizational components

***Further division of these forces is necessary for careful analysis of the business through BPR exercise. Business processes are many and must be modeled properly so that they could be analyzed and redesigned. Some conceptual modeling tool would be useful in this context. Such tool should facilitate analysis of business process as well as analysis information system. There is also a need for supporting information system, which would work out quick numerical analysis of cost and benefit of different process sequences***

**BPR benefits and BPR project phases**

Mohanty and Deshmukh (1998-a) listed the various benefits realized by implementing BPR projects as given below:

* Improved Financial performance
* Enhanced customer satisfaction
* Cost reduction
* Improved quality of products and services
* Improved delivery performance
* Improved productivity
* Improved flexibility or responsiveness
* Reduction in process time
* Enhanced rate of innovation
* Improved employee participation
* Increased competitiveness
* Sharp process focus
* Organization restructuring

The following table gives BPR implementation frame work as given by Mohanty and Deshmukh (1998-a).

Table 2.5 BPR implementation frame-work

|  |
| --- |
| Diagnostic Phase: Critical appraisal of system, Identification of problems, Structuring of problems |
| Process design phase: Process selection, Process description |
| Evaluation phase: Process qualification and quantification (Modeling and Analysis) |
| Implementation phase: Team formulation, Action plans development and pilot run |
| Appraisal phase: Benefits realization, evaluation |

A suggestion was made that after appraisal phase, feedback should be given to the process design phase.

*However, this kind of structure does not include the concept of ongoing changes in the business environment or the dynamic business environment.* *After appraisal phase, one must go back to diagnostic phase to see whether there is any change in the business forces, which affect profitability of the business unit. Moreover, to have such system, which would respond to the constantly changing business atmosphere, proper emphasis on project management along with a common platform to analyse the combined effect of different business forces is essential.*

**BPR Methodologies**

Bond (1999) made the following observations: “Although systems analysis for designing information systems shares much in common with business process mapping, there are some critical differences. System analysis methodology produces a logical model, which omits all extraneous details in somewhat similar spirit to BPR. The approach is based on two views: entity relationship for data modelling and data flow diagrams for representing functions.” A third view using an event driven process network, which served as a macro representation complementing other two views, was advocated. (Refer to Appendix 2 on 'Tools for conceptual modelling' for the description of various conceptual modelling techniques).

*Proposing such view in addition to data flow diagrams makes the technique too cumbersome. More over, it would not result in compact diagrams. Author had not presented any diagram for any of the business process based on the suggested methodology.*

Chan and Land (1999) stated that IT projects, whether as large as company-wide reengineering or as small as single department, should always look towards IT-proposed systems which would attempt to provide cross function integration. Integrated solutions could dramatically increase the speed of information delivery, streamline activity and decrease redundant data entry.

This section (2.3.3), here onwards, summarises commentary of Valiris and Glykas (1999) on BPR methodologies. Valiris and Glykas (1999) stated, “A plethora of BPR methodologies have appeared in literature. BPR methodologies can be classified into two main categories depending on the perspective they take in BPR. The first one is management accounting perspective and the other is the information system perspective (Morris and Bradon 1993, Petrozzo and Stepper 1994, Short and Ventaktraman 1992, Butler-Cox 1991, Lewis 1993, Morrow and Hazzel 1992, Smith 1993). Lately, a few methodologies have started to apply organisational theoretic principles to BPR. In the management accounting perspective, the analyst attempts to reorganise business processes and uses IT as an enabler in the effort. In the IS development perspective IS developers need to understand and possibly reorganise business processes so that the introduction of IT has the highest possible impact on them. Management accounting methodologies view organisation from process perspective.” The process perspective involves the following factors- (Harrington, 1991):

* Flow: The methods for transforming inputs into outputs
* Effectiveness: How well customer expectations are met
* Efficiency: How well resources are used to produce the output
* Cycle time: Time taken for transformation from input to final output
* Economy: The expense of the entire process

IS (Information Systems) influenced methodologies arose from the fact that IS development had started realising the need for understanding the wider organizational environment within which IS was going to operate (Curtis, 1989). One of the central argument was, “The evolution of information systems is, to a large extent, due to changes of the organisational environment and therefore, substantial improvements can be made in development and evolution of the system, if the business knowledge is explicitly captured and presented (Loucopoulos et al., 1991)”. Olle (1998) also argued that during the analysis stage of the IS life cycle, an examination of existing state of affairs in a given business area of the enterprise should be undertaken. It might call for analysis of what was done in the enterprise and, furthermore, of what needed to be done, given the support of more advanced information systems (Lundberg 1982, McGaughey and Gibson 1993). IS methodologies add another structural perspective or data perspective to process perspective. The process elements are usually modelled using data flow diagram and data elements are usually modelled on entity relationship diagram (Chen, 1976). IS methodologies which support both the process and the data perspective are called structured methodologies. (Gane and Sarson 1977, Jones 1980, Avison and Fitzgerald 1988). Valiris and Glykas (2000) further stated, “A third behavioural perspective is also required and most of the IS methodologies include these three perspectives (data, process and network). Lately object oriented designing techniques are also used to address these three perspectives. In comparison with accounting methodologies, IS methodologies provide richer models by incorporating two additional perspectives. However, IS methodologies which try to model all three perspectives face problem of integration.The most significant problem comes from the fact that different modelling techniques built for different point of times for different purposes are amalgamated. The stress here is on modeling with an aim to understand the organisational environment. Issues like cost, cycle time reduction, steam lining and continuous improvement are not taken into account. “

“Organisational based methodologies add more elements to business modeling like people, their accountabilities and their roles. Sowa and Zachman (1992) identified the need for expressing accountabilities. These methodologies are emerging due to the identification that IS do not provide any model of the organisational setting based on organisation theory and, as a result, fail to understand the relation between organisational actors and business processes. Many enterprises have started to apply process management principle to business processes. BPR methodologies based on the manufacturing and the software development paradigms have proven to be more and more incomplete. Scherr (1993) incorporated a focus on people and their accountabilities to resolve this problem.“

“Organizational theory based methodologies actually represent a model of some business situation but lack sufficient level of abstraction to represent the business of IS design and implementation issues. Employees and their roles, for example appear as data entities in entity relationship diagram. People's actions and interactions appear as processes and data flows respectively in data flow diagram.”

Valiris and Glykas (1999) claimed that the aforementioned methodologies were developed for other purposes and were later re-labeled to fall under the BPR umbrella. Most of these re-labeled methodologies appeared to have many limitations and there were only a few exemptions where methodologies were developed solely for BPR (Davenport, 1993; Harrington, 1991; Hammer, 1993; Morris and Brandon, 1993; Petrozzo and Stepper, 1994; Ould, 1992). However, even these methodologies were non-systematic and their emphasis was more on hands-on experience and case studies.

* + 1. **Limitations of existing BPR methodologies**

The limitations of existing BPR methodologies can be summarised as follows (Valiris and Glykas, 1999):

* IS methodologies which try to model all the three perspectives face the problem of integration. The most significant problem comes from the fact that different modelling techniques built at different point of times for different purposes are amalgamated.
* The stress in IS methodologies is on modeling with an aim to understand the organisational environment. Issues like cost, cycle time reduction, streamlining and continuous improvement are not taken into account.
* IS do not provide a model of the organisational setting based on organisation theory and, as a result, fail to understand the relation between organisational actors and business processes.
* There is a lack of systematic approach that can lead a process re-designer through a series of steps for the achievement of process redesign. Most of the existing methodologies are based either on real life experience with little attention on the modelling and analysis of the business environment or vice versa.
* There is a big division in the BPR literature between methodologies that concentrate either on process improvement or process innovation. The main difference is on the way organisational change is understood. In the first case, change is performed in an incremental fashion whereas in the latter in a radical way. However, in many cases a combination of the two approaches has yielded the most impressive results.
* There is a need for an integrated holistic and individualistic view of the organisation Most methodologies concentrate on organisational processes without paying much attention to the roles and responsibilities of the employees that carry out the activities that compose these processes.
* Most methodologies are oriented towards specialists rather than being oriented to be used by organisational managers and people, who want to carry out BPR in their organisation.
* Most methodologies use a more black and white approach. For example, in some methodologies cost is the central issue whereas in others generic management and the use of IT are the main objectives.
* Most methodologies fail to recognise the importance of a diagnostic stage at the beginning of the redesign process. During this stage the BPR scope, mode and objectives are determined.
* There is inadequate support for storage and access of gathered information during and after the redesign process, especially for non-participants in the redesign exercise.
* Business modelling is performed using either inadequate descriptive notations from management accounting or through poor use of graphical notations that were created for software development which do not take into account organisational issues.
* Most of business analysis performed is based on subjective rather than objective analytical methods.
* There is a lack of integrated tool sets that allow modelling and analysis of the business environment. Most of the existing tools for modelling come from the area of software development and usually concentrate on conceptual business modelling. At present there is a lack of business analysis tools that are integrated with the IS designing ones.
* There is no formal underpinning to ensure consistency across models. When graphical notations are used in business modelling and business redesign there is no means of verifying the logical consistency of the resulting models. This creates a feeling of insecurity to the business process re-designer that his work might be undermined by the company's cynics.
* BPR is a new discipline that is in need of case studies that provide justification of the benefits it can provide to the organisation. BPR should be applied in different organisational contexts in different cultures and in different organisation sizes. Most of the existing methodologies are applied in western countries where the business environment is more suitable to the BPR philosophy.

Valiris and Glykas (1999) suggested Agent Relation Morphism Analysis (ARMA) to take holistic view of organisation. In ARMA, the modelling of business environment is achieved with the use of three perspectives: the structural, behavioural and process. Models, which they advocated to analyse the business, are based on object oriented technology. *They haven't explained modeling of business using suggested tools nor explanation is available for how the proposed model (ARMA) is going to bridge the gaps mentioned above.*

**2.4 Indian textile scenario**

**2.4.1 Introduction**

Literature review for Textile scenario takes an overview of the current state of computerisation in Indian textile industry, current international and export scenario, and discusses need for IT.

**2.4.2 Present state of computerisation in the Indian textile industry**

Shrivatava et al. (NITRA, 2000) described the present state of computerization in Textile industry. Not a single mill in the survey reported successful implementation of ERP system and many mills were far away from computerizing all the functions across the organization. The problems of existing ERP systems have already been listed earlier. From the survey of Textile Industry on application of information systems, the following conclusions were drawn:

* Most of the mills are yet to computerize various activities or departments.
* Most of the mills have computerized Personnel (Human Resource Development) and accounts.
* Many of the mills are proposing to computerize marketing and quality control. And majority of units requires outside help for computerization.

*The present state of computerization clearly points to the lack of attaching importance to information management solution. This project focuses on advantages of deployment of such integrated management solution, makes the whole life cycle simpler and proposes methodology, which can elicit user participation in all phases of system development life cycle.*

**2.4.3 Need for an information management solution**

Shanmugnandam et al. (SITRA, 2000) stated, “In order to be competitive and to achieve customer focus and quality excellence, mills must have information system that covers all the functions across the organisation from raw material through quality control to customer feedback and market analysis. In parallel with Technology up-gradation, the spinning industry should also change its traditional marketing methods as business will be more and more customer driven and customer relationships will assume paramount importance. This would require closer links with consumers, obtaining their feedback and acting on it, custom production in smaller lots to cater to niche markets, setting up market research cells and so on. The domestic buyers will also be equally demanding as global buyers and meriting equally important attention. Efforts should be made to manufacturing of cost competitive quality products with prompt deliveries.”

“Towards achieving such focus and excellence, information technology can be a very useful tool and the industry should tap the full potential of IT usage across all the functions starting right from raw material selection through quality control to customer feed back and market analysis. Groups of mills can own a common web site to promote their products. Mills should also go for ISO 9000 certification.“

India’s world share in international textile trade in terms of export volume is about 3.1% and to increase this share following steps are necessary (Malik, 2000):

* Reduce cost and maintain quality
* Shorten lead times
* Expand the product range especially in apparel
* Have economics of scale with flexible operation
* Have tie-ups with retail chains, overseas and plan own or joint marketing arrangements overseas.

Malik (2000) further argued that these steps would enable stocks at the point of delivery as required, since none of the retailers would want to keep stocks in warehouse and needed quick replacement of stocks through Electronic Data Interchange. *To cater to these needs, integrated information management solution would prove useful.*

Jayaraman (1990) stated that in order to be successful and competitive and achieve excellence in manufacturing, the textile/apparel industry must successfully use the most advanced concepts and methods, including computer-integrated manufacturing (CIM).

**2.4.4 International front**

Ghosh (2000) argued, “The end of quota system and the end of dual market system (separate market for exports as distinguished from domestic market) will make the competition more and more keen in free trade regime and use of information technology will dominate the textile industry. India has a definite advantage as it has a very strong Textile base and the potential of becoming a strong global player in information technology. The use CAD/CAM facilities (for manufacturing of garments) for design and product development is wide spread. The use of Internet, electronic data interchange, e-commerce and e-business will increase the competitiveness. Already predictions of billions and trillions of dollars of business through e-business are made, *which may not turn out to be true in most likely hood however*. It is also predicted that company not using Internet in next 4 to 5 years will not survive there after. Information management tools, like ERP and integrated supply chain management software, are useful for improving competitiveness.”

“There is also an interesting development, which is very relevant in this context. Researchers are in process of developing Intelligent Fabrics. Incorporated features so far include swim wear having integrated audio-visual player, shirt with its own mobile phone, jackets that warms up wearer, T shirt with global positioning to track movements, etc. These products are wire free, soft to touch and can be operated by a small battery. In fact efforts are made to use heat of body to generate electricity to replace battery. Electronic clothing would be as important to the fashion industry as designer clothes.”

Director, Textile Division, World Trade Organization, Campeas (1999) poined out, “It is a necessity for the participants in the textiles and clothing trade to reflect on the current situation and to anticipate what might lie ahead. For many, a key factor in the present situation is the extensive network of quota restrictions, which has governed the trading activities of many developing countries for the past three decades. Faced with increasing pressures from expanding activity of developing countries, the textile and clothing industries in industrialized countries have carried out major adjustment programs in order to increase their competitiveness both in domestic markets and in world trade. Future trade scenario will be different in view of dismantling of the extensive bilateral system of quota arrangements over a ten-year transition period (2005).”

*The result is textile industry will be highly competitive. Firms will have to take all the measures listed earlier to improve company performance. An integrated information management solution will be extremely useful in this context.*

**2.4.5 Indian textile scenario**

Ghosh (2000) furnished following statistics on Indian textile industry, “The Textile sector in the Indian economy occupies a place only next to agriculture. It contributes nearly 14% of the annual value addition of industrial production and more than 30% of total exports. It provides direct employment to nearly 35 million people. Taking into account the cotton and other related services, the total employment is in the region of 100 million. India accounts for 1.8 million tons of jute production, which is more than 50% of world’s production. It is the second largest producer of silk after China. India is the fifth largest producer of man-made fibers like PSF (Polyester Staple Fiber) and the third largest producer of cellulosic fibers. In the production base, India has the second largest installed spindle capacity after China. India accounts for 64% of total looms installed the world over out of which only 10,000 account for modern shuttle less looms. India controls nearly 20% of global trade in cotton yarn and it is the second largest producer of cloth after China. India has good entrepreneurial skills as well. There is existing and upcoming market of technical textiles which accounts for global market of $54 billion per year. In most of the developed countries, technical textiles already account for 25 to 30% of total textile production. India’s share is almost negligible.”

Shanmuganandan et al. (2000) have summarized challenges, opportunities and threats to spinning mills. “Challenges are modernization requirement to get better quality yarn and to achieve high productivity, total requirement of spindles, funds for modernization, making use of IT for marketing and fast response capabilities. They have observed that idle spindles are about 15% and idle rotors are about 10%. *It is quite alarming situation.* The profitability of spinning mills is very low about 3% of sales. By 2002, India will need modernization of 16 million spindles and 3.6 million new spindles to reach the targeted production. Total funds required are slightly more than Rs.13,500 Crores. Threats perceived are inter-mill differences in productivity, cost and profitability, cotton cost, conversion costs and infrastructure deficiencies. The inter-mill differences cause inherent instability of the industry as a whole. The reasons for these differences are disparity in modernization, operational inefficiencies, high costs, ineffective management and considerable differences in value addition. Cotton accounts for about 60% of yarn cost. Keeping in view the profitability margin increase in cotton cost can do a lot of damage to competitive ability of spinning industry. Recently there has been a surge in cotton prices and it has been found that these costs are 6 to 8% higher than the expected to be under the normal trading conditions. In conversion costs, power is a major contributor and is increasing by about 12% a year along with wages cost which is increasing by about 10% a year. Prevailing power costs are very high about 10 US cents per KWH compared to global average of 6 US cents per KWH. Labour costs are also high by about 30 to 60% compared to other yarn exporting countries. Infrastructure deficiencies include fewer ports, less frequent shipping, delays in ports and inland transport. Opportunities include constant increase in yarn demand in export market and in domestic market, adequate availability of cotton even after allowing for about 10% export of raw cotton.”

Malik (2000) included the following additional factors in weaknesses – Low emphasis on product development and design capacities and low sensitivity on proper controls on manufacturing processes. He also suggested the following measures to remain competitive in the market: “Reduce cost and maintain quality, shorten lead times, economies of scale with flexible operations, tie-ups with retail chains overseas and joint marketing arrangements.”

Joseph (1999) furnished SWOT analysis and strategies for readymade garment sector-

* Strengths: Strong cotton production base, storehouse of manpower, exquisite designs, low production costs, low capital and intensive employment industry, excellent government support.
* Weaknesses: Quota misuse, production is basically for summer and spring collection, small sector problems- inconsistency in quality and lack of economies, infrastructure problems, old technology, lack of backward linkages.
* Opportunities: Removal of Multi Fiber Agreement (MFA) will open up more markets, direct export of garments can be increased as foreign departmental stores are allowed to set up their own private bonded ware houses in the country
* Threats: Re-export of exported Indian garments, Anti-dumping duties on Indian goods, export subsidies extended by competitors like China to their manufacturers, MFA phase out resulting in considerable price pressure on Indian garment exporters, trading blocks, India’s lack of presence in wear and winter garments restricts market expansion.
* Strategies: Quality standardization on international lines, upgradation of product technology, promoting eco-friendly and natural fibers, reduction in import duties on machines and other accessories, establishing brands in international markets, market tie ups, improving the delivery schedule and reducing delays.

*The above analysis does not detail out the reasoning nor it tries to find out relationships between strengths, weaknesses, opportunities and threats.*

Palande et al. (2000) summarized problems of Ready Made Garment (RMG) sector:

1. Advent of foreign brands and their capturing market of high market segment with more profit margins.
2. No known brand at international level.
3. Quality problems.
4. Distance from the export markets.
5. No local brands for women clothes.
6. Fast fashion changes.

**2.5 Observations on the literature**

To summarize, following gaps have been found in the present IS (Information Systems) and BPR (Business Process Reengineering) methodologies:

* *There is a need for a common platform to manage the project and to visualize the combined effect of different business forces on the company’s performance.*
* *The main drawback of MRP-II models available in the literature is that these models do not detail out the procedure for arriving at information solution.*
* *Further division of the business forces (organisation, technology and business processes) is necessary for careful analysis of the business.*
* *After the appraisal phase, one must go back to the diagnostic phase to see whether there is any change in the business forces, which affect the profitability of a business unit. Moreover, to have such a system, which would respond to constantly changing business atmosphere or dynamic business environment, proper emphasis on project management is essential.*
* *A methodology should provide a well-integrated view of all the business perspectives namely process perspective, data or structural perspective and behavioural perspective.*
* *A methodology should address the various issues like cost, cycle time reduction, streamlining and continuous improvement. The data elements considered should provide for arriving at suitable analysis base for addressing the above issues.*
* *Integrated model should focus on the roles and responsibilities and take into account the various management theories like Supply Chain Management, Customer Relationship Management, Human Resource Management, Total Quality Management and should provide for a common analysis and design tool for all.*
* *Integrated model should take into account the various industrial practices in detail. It should be supported with excellent tools for modelling and analysis of the business environment. The approach for analysis must be extremely systematic and simple one, which could involve hierarchical breaking down the business to reach to smallest unit of the event, which would further be analysed for the various aspects.*
* *Designing methodology should provide for the analysis and design of existing processes along with the analysis of the market changes and technological changes to decide the necessary course of action, which in-turn, provides a base for process and product innovation. Such innovations then can be absorbed in the existing business depending on their viability.*
* *Designing methodology should support both the views – holistic and individualistic. It should consider the individual limits as well as the combined limits of the business environment. It should also provide for recording of roles and responsibilities of actors so that the delegation of authorities can be made without any internal conflicts.*
* *Tool used for business process analysis and design should be useful from all angles: simplicity of construction and understanding, exhaustive coverage of procedures, quantum of information display, ease of modification and user participation.*
* *A model must give importance to all issues related to the business management and should not adopt black and white approach.*
* *Designing methodology should be supported with an exhaustive questionnaire to diagnose the business and to arrive at the scope for improvement in sales, customer relation, supplier base, cycle time, machine uptime, cost savings and employee satisfaction.*
* *Software should be made available to first store the gathered information during the exercise and to retrieve it later.*
* *Business model should make use of easy to understand graphical notation and should be supplemented with information related to different perspectives. For example, it should allow for recording of information related to event analysis, data analysis, operation analysis and resource analysis in easy to understand graphical interface.*
* *Designing methodology should provide for recording of all information in a manner, which can be handled by the information system. It implies that subjective information is broken down into small elements, which can be associated with individual events as an object or as an attribute of an object.*
* *The same set of tools should be made available for system analysis and business analysis.*
* *Designing methodology should take a logical approach right from the beginning and the consistency in all the perspectives must be maintained.*
* *Sample case study should be conducted to highlight scope for the business improvements in a textile organization and to judge the applicability of suggested methodology to achieve the visualised improvements.*
* *It is extremely difficult to apply concepts of object orientation to business analysis. The proposed event driven approach is much simpler to analyse the business than the object oriented one and everyone can contribute to the exercise of BPR, since it is easy to understand at all levels.*
* *With DFD (Data Flow Diagram), the whole module cannot be viewed at a glance and structured charts are required in addition to data flow diagrams to know organization of the system. It is a difficult task to analyse the business in terms of objects and relationships. The event driven approach is much simpler compared to object orientation.*
* *Logical flaws in the system cannot be detected at higher level of abstraction, as DFD does not deal with logical sequence of events as they occur.*
* *It is not known whether process is mandatory or optional. Processes cannot be defined as mandatory and optional, such defining helps in deciding nature of references to these processes through other processes.*
* *DFD is a tool for system analysis and not for business analysis.*
* *In DFD, It is not known which processes are to be complete before executing any process.*
* *Very few processes can be listed on a single page.*
* *DFD cannot be used to explain system to users; it is designers’ tool.*
* *DFD is not suitable for field based program development because process data flow does not specify the field at which the operation is taking place.*

**2.6 Summary**

Textile business requirements can be summarised as follows:

1. Continuous data collection from markets
2. Better customer relationship management
3. Building of brand image in India and abroad supported by quality fabric
4. Shorter lead times
5. Reduce cost and maintain quality
6. Expand the product range especially in apparel
7. Have economics of scale with flexible operation
8. Plan own or joint marketing arrangements overseas

It has been observed that a number of shortcomings exist in the current information system designing methodologies and therefore, in information systems. Shortcomings have also been observed in business analysis methodologies. An effort will be made through this thesis to minimise the shortcomings of the present methodologies by introduction of new designing methodology after analysing Indian textile industry for its competitiveness and highlighting need of integrated solution through a detailed case study.

An analysis of the Indian textile industry is presented in the next chapter.

Chapter 3

SWOT ANALYSIS OF INDIAN TEXTILE INDUSTRY

**3.1 Introduction**

Today’s changing world requires continuous assessment of the direction in which the business is heading. The correct speculation of future trends and developments definitely leads to the better decision making and it is essential for survival of the Indian textile industry, which is one of the important sources of foreign exchange and employment.

Indian textile industry has not come off age as of today. Many mills are still working on the age-old machinery. Information technology is not exploited to its full potential. With the end of multi fiber agreement, India is placed at receiving end. Economies like China are engaged in mass production of goods with low costs while economies from western countries have psychologically gripped the upper middle class and the rich populace of India. Although having captured better world share in yarn exports, India is very much behind the competitors in woven cloth and garments. A thorough analysis of international scenario vis-a-vis Indian textile industry is essential at this juncture. This chapter takes a general view of textile industry and discusses possible strategy to deal with the international competition.

**3.2 Some observations on the Indian textile industry**

The relevant information used for analysis is obtained from compendium of textile statistics published by office of the textile commissioner of India.

**3.2.1 Cost comparison with different countries**

Table 3.1 and 3.2 show cost of various components for yarns (Ring, OE), and woven and knitted fabrics made out of them, for different countries.

Table 3.1 Cost break-up of ring yarn and Open End (OE) yarn (US $ / Kg) Source [25]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Product | Cost  element | Country | | | | | | |
| India | Brazil | Indonesia | Italy | Korea | Turkey | USA |
| Ring Yarn  USD  /Kg | Waste | 0.29 | 0.37 | 0.37 | 0.35 | 0.36 | 0.37 | 0.32 |
| Labour | 0.06 | 0.22 | 0.03 | 0.89 | 0.25 | 0.13 | 0.52 |
| Power | 0.33 | 0.19 | 0.19 | 0.27 | 0.18 | 0.23 | 0.17 |
| AM | 0.11 | 0.12 | 0.12 | 0.12 | 0.13 | 0.15 | 0.12 |
| Capital | 1.01 | 1.02 | 1.1 | 0.87 | 0.95 | 1.02 | 0.88 |
| RM | 1.44 | 1.8 | 1.82 | 1.75 | 1.79 | 1.83 | 1.59 |
| Total | 3.24 | 3.72 | 3.63 | 4.25 | 3.66 | 3.73 | 3.6 |
| Waste % | 18.71 | 19.27 | 19.07 | 18.72 | 18.75 | 18.69 | 18.71 |
|  | India | Brazil | Italy | Japan | Korea | Thiland | USA |
| OE Yarn  USD  /Kg | Waste | 0.2 | 0.25 | 0.25 | 0.24 | 0.25 | 0.25 | 0.22 |
| Labour | 0.02 | 0.09 | 0.001 | 0.35 | 0.1 | 0.05 | 0.2 |
| Power | 0.29 | 0.16 | 0.17 | 0.23 | 0.15 | 0.2 | 0.15 |
| AM | 0.13 | 0.14 | 0.13 | 0.14 | 0.15 | 0.17 | 0.14 |
| Capital | 0.91 | 0.82 | 0.98 | 0.74 | 0.78 | 0.95 | 0.71 |
| RM | 1.44 | 1.8 | 1.82 | 1.75 | 1.79 | 1.83 | 1.59 |
| Total | 2.99 | 3.26 | 3.351 | 3.45 | 3.22 | 3.45 | 3.01 |
| Waste % | 12.74 | 12.89 | 12.82 | 12.70 | 12.89 | 12.50 | 12.72 |

Legend: AM: Auxiliary Material RM: Raw Material +: Advantage to India -: Disadvantage to India.

Waste % is calculated on input material.

From the tables 3.1 and 3.2 it can be observed that for all type of textile production, India has clear advantage in

* Conversion factor: Because waste generation is minimum compared to many other countries, India has high yield in converting raw material into the end product. One reason could be that India is catering to the low-end market and therefore, the total waste removed could be lesser as there may not be stringent quality demand. If the trend is observed, India has more sales in non-quota countries than in quota countries. It shows that Indian goods are of acceptable quality at international level. The possibility of waste generation is more, if raw material of inferior quality is used or process of conversion generates more waste inherently. In India, the share of decentralized sector is quite substantial in over all textile production. Less waste generation may be attributed to better utilization of resources

Table 3.2 Cost break-up for Ring, OE and knitted fabric (US $/ Yard) Source: [25] [102]

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | India | Brazil | Indonesia | | Italy | Korea | Turkey | USA |  |
| Fabric of  Ring yarn  USD  /Yard | Waste | 0.05 | 0.064 | 0.064 | | 0.061 | 0.063 | 0.064 | 0.056 | + |
| Labour | 0.032 | 0.125 | 0.016 | | 0.378 | 0.155 | 0.045 | 0.241 | + |
| Power | 0.113 | 0.069 | 0.067 | | 0.107 | 0.065 | 0.075 | 0.063 | - |
| AM | 0.069 | 0.075 | 0.048 | | 0.071 | 0.077 | 0.062 | 0.06 | + |
| Capital | 0.36 | 0.355 | 0.37 | | 0.346 | 0.321 | 0.372 | 0.319 | - |
| RM | 0.251 | 0.314 | 0.318 | | 0.305 | 0.312 | 0.319 | 0.277 | + |
| Total | 0.875 | 1.002 | 0.883 | | 1.268 | 0.993 | 0.937 | 1.016 |  |
| Waste % | 15.63 | 16.45 | 17.49 | | 16.22 | 16.20 | 16.80 | 16.62 |  |
|  |  | India | Brazil | Indonesia | | Italy | Korea | Turkey | USA |  |
| Fabric of  OE Yarn  USD  /Yard | Waste | 0.035 | 0.044 | 0.044 | | 0.042 | 0.043 | 0.044 | 0.038 | + |
| Labour | 0.027 | 0.102 | 0.012 | | 0.283 | 0.129 | 0.031 | 0.185 | + |
| Power | 0.105 | 0.064 | 0.062 | | 0.101 | 0.061 | 0.069 | 0.059 | - |
| AM | 0.072 | 0.079 | 0.051 | | 0.074 | 0.08 | 0.067 | 0.063 | + |
| Capital | 0.343 | 0.32 | 0.349 | | 0.323 | 0.292 | 0.361 | 0.289 | - |
| RM | 0.251 | 0.314 | 0.318 | | 0.305 | 0.312 | 0.319 | 0.277 | + |
| Total | 0.833 | 0.923 | 0.836 | | 1.128 | 0.917 | 0.891 | 0.911 |  |
| Waste % | 10.84 | 11.20 | 11.92 | | 11.08 | 10.97 | 11.40 | 11.18 |  |
|  |  | India | Brazil | Indonesia | | Italy | Korea | Turkey | USA |  |
| Knitted  Fabric  (Ring)  USD  /Yard | Waste | 0.118 | 0.149 | 0.15 | | 0.144 | 0.147 | 0.15 | 0.131 | + |
| Labour | 0.03 | 0.129 | 0.018 | | 0.508 | 0.148 | 0.075 | 0.297 | + |
| Power | 0.164 | 0.095 | 0.094 | | 0.133 | 0.086 | 0.115 | 0.083 | - |
| AM | 0.06 | 0.066 | 0.061 | | 0.064 | 0.067 | 0.078 | 0.065 | + |
| Capital | 0.478 | 0.495 | 0.53 | | 0.421 | 0.455 | 0.484 | 0.429 | - |
| RM | 0.588 | 0.735 | 0.743 | | 0.714 | 0.731 | 0.747 | 0.649 | + |
| Total | 1.438 | 1.669 | 1.596 | | 1.984 | 1.634 | 1.649 | 1.654 |  |
| Waste % | 18.21 | 18.60 | 18.66 | | 18.51 | 18.42 | 18.18 | 18.35 |  |
|  |  | India | Brazil | Indonesia | | Italy | Korea | Turkey | USA |  |
| Knitted  Fabric  OE Yarn  USD  /Yard | Waste | 0.042 | 0.054 | 0.054 | | 0.051 | 0.052 | 0.054 | 0.047 | + |
| Labour | 0.008 | 0.038 | 0.005 | | 0.143 | 0.044 | 0.021 | 0.083 | + |
| Power | 0.076 | 0.043 | 0.044 | | 0.062 | 0.04 | 0.054 | 0.04 | - |
| AM | 0.033 | 0.036 | 0.034 | | 0.035 | 0.037 | 0.043 | 0.036 | + |
| Capital | 0.224 | 0.209 | 0.246 | | 0.186 | 0.198 | 0.235 | 0.182 | - |
| RM | 0.304 | 0.381 | 0.385 | | 0.37 | 0.378 | 0.387 | 0.336 | + |
| Total | 0.687 | 0.761 | 0.768 | | 0.847 | 0.749 | 0.794 | 0.724 |  |
| Waste % | 12.46 | 12.95 | 12.89 | | 12.59 | 12.53 | 12.56 | 12.63 |  |
| Power cost  US cents/KWH | | 10 | 6 | | 6 | 8 | 5 | 7 |  | - |
| Interest rate % | | 18 | 13 | | 17 | 11.5 | 12 | 10 |  | - |

Legend: AM: Auxiliary Material RM: Raw Material +: Advantage to India -: Disadvantage to India.

Waste % is calculated on input material.

because of better supervision with more labor force, as labor cost is low. Additional factor is that power loom and handloom owners are directly affected in terms of monetary income, if waste generation is high. This makes power loom weavers to keep extra vigil on the production process. As one would notice in the further sections, power loom and handloom sectors are the major contributors to the export of fabrics from India. Another reason for the low waste generation is the less use of the non-conventional means (shuttle less looms) which generate more waste in the fabric production. India has the lowest installed capacity of unconventional weaving methods.

* Labour: Labour cost is very low as compared to the other countries except Indonesia. Low labour cost can be attributed to free availability of labour in the market. It also brings out the fact that cost of living is substantially low compared to other competing countries.
* Raw Material: Raw Material cost is low on account of the increased production of different varieties of cotton in the country over past years and low input cost for cotton cultivation.
* Auxiliary Material: Low consumption of auxiliary material follows from low consumption of raw material.
* Over all cost of production: India has lowest cost of production compared to other countries.

The major disadvantages are:

* Power cost is very high as compared to the other countries. The possible mismanagement in public sector could be one of the causes of high power costs. Another reason is free supply of electricity to users. Government estimates of such free electricity run very high. The cost of production is then passed on to the industry. Industry can lose its competitiveness, if the power costs are too high and it would create more problems to the population of India. It is, therefore, better to look into issues like power theft and free supply of electricity to some section of population and to some states. The whole brunt of the power loss is then transferred to the industry. The full analysis of reasons of high cost of power generation, distribution and transmission losses is out of the scope of this thesis.
* High interest rate: It would have a negative impact on investment. From the export statistic of fabrics and made ups, one can notice that the exports are from both the sectors - high capital intensive industry in yarn sector and low capital intensive industry (e.g. power loom) in fabric and made ups. The high interest rate may hold back the industry, especially spinning sector, from modernizing. Low quality yarn production may adversely affect manufacturing of the quality fabric and clothing. Since decentralized power loom and readymade garment industries are not capital intensive, they may not get affected by the high interest rates.

**3.2.2 Raw material production**

Table 3.3 Cotton statistics (98-99 Forecast): Source [25]

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Cotton Yield (Kg/Ha) | India | China | USA | Brazil | Mexico | Pak |  |
| 301 | 910 | 686 | 461 | 990 | 576 |  |
| Production (’000 metric tons) | India | USA | Uzbekistan | China | Turkey | Pak |  |
| 2722 | 2881 | 1002 | 4093 | 806 | 1633 |  |
| Exports (’000 metric tons) | India | USA | Uzbekistan | France | Aus | Argentina | Pak |
| 54 | 980 | 827 | 835 | 631 | 196 | 44 |

Table 3.3 shows the comparison of cotton production and exports from the various countries. Although India has the second largest area under the cultivation for cotton, the productivity of cotton crop is low. World Cotton fiber demand is 40% of total fiber demand including manmade fibers. The increase in the cotton yield together with the improvement in the quality of cotton would help in increasing India’s share in the world cotton trade. There are quality concerns sighted by some research organizations regarding the quality of hybrid cotton. There is ample of scope in improvement in cotton productivity and quality. From table 3.4, it can be seen that India has a clear disadvantage in man made textile raw material. India is the net importer of synthetic fibers and filament yarn. Imports of worth $151 million were recorded in the year 97-98. The statistics of cost break up for different countries are not available. The action for reduction in costs can be initiated only if such statistics are available to pin point the reasons for higher costs of production. Domestic production of manmade fibers at lower costs, particularly that of polyester, which is widely used for clothing, would still boost the competitive pricing of blended and synthetic fabrics and garments.

Table 3.4 Domestic and international prices Rs. / ton (97-98), Source [25]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RM | Domestic | CIF Value | Custom % | Excise | CIF+Excise |
| DMT | 28250 | 20770 | 36.13 | 18 | 24508.6 |
| PTA | 26790 | 21110 | 36.13 | 18 | 24909.8 |
| MEG | 31100 | 22840 | 36.13 | 18 | 26951.2 |
| Caprolactum | 69700 | 58780 | 36.13 | 18 | 69360.4 |
| Wood pulp | 23600 | 23620 | 14.4 | 0 | 23620 |
| Acrylonitrile | 36200 | 28090 | 20.42 | 18 | 33146.2 |

Table 3.5 Production of manmade (fibres+filament) (97-98) , Source [25]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| India’s share in the world market | Viscose | Polyster | Acrylic | Nylon |
| % of World production | 21.83 | 8.30 | 2.30 | 2.25 |

**3.2.3 Textile exports:**

Fiber

Yarn

Grey Fabric

Dyed Fabric

Made ups

RMG

Figure 3.1 Value chain for textile industry

Table 3.6 Readymade garment (RMG) share in export in million US$, Source [25]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | 91-92 | 92-93 | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 | Target98-99 |
| RMG | 2525.07 | 3502.47 | 3713.85 | 4453.5 | 4502.9 | 4762.1 | 4910.7 | 5900 |
| Total | 4880.97 | 5626.54 | 6754.35 | 8483.02 | 9133.7 | 9914.11 | 10334.74 | 14275 |
| RMG% | 51.73 | 62.25 | 54.99 | 52.5 | 49.3 | 48.03 | 47.52 | 41.33 |

Table 3.7 Value addition for different textile products, Source [102]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Raw | Yarn | Grey Fabric | Dyed Fabric | RMG |
| Value addition % over raw cotton | 0 | 63 | 195 | 224 | 662 |

One can notice that the RMG share in the export of all textile products is gradually falling over the years although it is almost doubled from 1992 to 1998. RMG sector has the largest value addition in all textile products. Lower export market share of RMG can be attributed to

* Improper coordination in centralized and decentralized sector.
* Lack of building of markets overseas
* Less emphasis on having own outlets abroad
* Less emphasis on niche markets

Table 3.8 Spinning and weaving capacities (1996), Source [25]

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Units | India | China | Brazil | Indonesia | USA | Italy |
| Ring Spindles | Millions | 32.765 | 41 | 7.3 | 7.05 | 4.9 | 1.676 |
| OE rotors | Millions | 0.23 | 0.665 | 0.257 | 0.086 | 0.892 | 0.1034 |
| Shuttle less looms | 1000 | 6.28 | 50 | 33.2 | 27 | 62.45 | 13.28 |
| Shuttle looms | 1000 | 133.76 | 880 | 122.41 | 200 | 9.21 | 1.76 |

Table 3.8 clearly shows the reason why India’s share is less in the readymade garments and cloth market. With about 20% less installed capacity than China in the spinning sector, India is in leading position in the yarn market with 25% of world share. But the issue is yarn market is only a small part of total textile market. Total world market for the textile products is of the order of $350 billion while the total yarn trade is about $7 billion (Saran, 2000). Installed capacity for shuttle-less looms is the lowest as compared to the other countries. Even installed capacity for shuttle looms is very low compared to China. When compared with China, with 15.2 % of shuttle looms and 12.56% of shuttle less looms, India’s exports are 18.95% in clothing and 43.21% in textiles. If the exports attributed to power looms and handlooms is deducted from the total production, still the share of organized sector is about 26.43% of that of China’s. Indonesia has more capacity in shuttle looms. The following table brings out the trend in the export share of different textile product categories. It is not justified to include 3.5 million handlooms for the comparison with looms from other categories like shuttle less looms. Although India has 1.8 million power looms, report on their status as to know their working conditions is not available for the comparison.

Table 3.9 World export share percentage (1996), Source [102]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Clothing (ready made garments) |  |  | Textiles (Yarn, Fabric and made-ups) |
| India | 2.9 |  | India | 3.5 |
| China | 15.3 |  | China | 8.1 |
| Indonesia | 2.2 |  | Germany | 9 |
| Thiland | 2.5 |  | Belgium | 6.1 |
| USA | 4.6 |  | USA | 5.3 |
| UK | 3.2 |  | UK | 3.6 |
| Italy | 9.8 |  | Italy | 8.8 |
| Turkey | 3.9 |  | Pak | 2.5 |
| Taiwan | 2 |  | Taiwan | 5.6 |

One can notice the installed capacity is directly reflected in the export of commodities from India. India is world’s largest exporter of yarn (Shanmuganandam et al., 2000), while in other areas, India’s share in world business is very low (2.9 % in garments, 3.5% in textiles). All the countries, which have large installed base for shuttle less looms and even for that matter shuttle looms, are leading exporters of clothing and textiles. The investment in power looms may pay off as table 3.10 confirms the share of exports from power loom sector. The larger share of exports from power looms sector also brings out the point that quality of the power loom fabric is not so bad as it is being projected. It follows from the fact that India’s share in world trade is more in non-quota countries than in quota countries (Shanmuganandam et. al., 2000). In the synthetic and woolen fabric category power loom is the only contributor to the fabric export from 1993 to 1998. For the year 1998, these figures were 511 and 42 million US $ (Compendium of Textile Statistics, 1998). Unit value realization figures in Rs./sq. meter are 51.15, 34.72 and 16.65 respectively for hand loom, mill and power loom sectors. “According to a recent report prepared by the Prime Minister's Council on Trade and Industry, the cost of producing one meter of cloth by a power loom is 22 Paise, compared to Rs 1.60 in a composite mill. Such a huge cost differential, the result of subsidies, has made composite mills sick, and has taken fabric making away from mills to power looms. Laments Anang Lalbhai, managing director, Arvind Products Ltd: With employment creation being the objective, government policies were biased against composite mills and in favour of power looms. But now that the attention has shifted to competitiveness, the rationale of the old policies is in question (Saran, 2000).” Even after considering all subsidies offered to the power loom sector, one still cannot account for the mill production cost, which is 727 % higher than the power loom production cost. Further analysis is necessary to arrive at reasons for such a big difference. The current analysis

Table 3.10 Share of different sectors in export of fabric and made ups, Source [25]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Break-up of cotton Exports (Made Ups) (Million USD) | | | | | |
|  | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 |
| Mill | 106 | 117 | 147 | 158 | 202 |
| Power loom | 301 | 436 | 487 | 576 | 622 |
| Knitted | 2 | 2 | 3 | 3 | 6 |
| Handloom | 325 | 377 | 372 | 395 | 438 |
| Total | 734 | 932 | 1009 | 1132 | 1268 |
| Break-up of cotton Exports(Made ups) (% Share) | | | | | |
|  | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 |
| Mill | 14.44 | 12.55 | 14.57 | 13.96 | 15.93 |
| Power loom | 41.01 | 46.78 | 48.27 | 50.88 | 49.05 |
| Knitted | 0.27 | 0.21 | 0.30 | 0.27 | 0.47 |
| Handloom | 44.28 | 40.45 | 36.87 | 34.89 | 34.54 |
| Break-up of cotton Exports (fabrics) Million USD | | | | | |
|  | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 |
| Mill | 304 | 384 | 431 | 449 | 441 |
| Powerloom | 298 | 449 | 499 | 573 | 585 |
| Knitted | 71 | 91 | 92 | 98 | 80 |
| Handloom | 90 | 102 | 77 | 66 | 59 |
|  | 763 | 1026 | 1099 | 1186 | 1165 |
| Break-up of cotton Exports (fabric) % Share | | | | | |
|  | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 |
| Mill | 39.84 | 37.43 | 39.22 | 37.86 | 37.85 |
| Power loom | 39.06 | 43.76 | 45.40 | 48.31 | 50.21 |
| Knitted | 9.31 | 8.87 | 8.37 | 8.26 | 6.87 |
| Handloom | 11.80 | 9.94 | 7.01 | 5.56 | 5.06 |

is enough to stress the need that mill sector can concentrate on the production of fabrics, which cannot be produced by using conventional shuttle looms. Power loom industry is more competitive, the argument of scale of economies notwithstanding. Handloom industry is equally important for export market, the sale of handloom fabric is mainly because of its exquisite designs and because they are hand-made products. Prices of power loom cloth in synthetic category have gradually fallen over last ten years while those from mill are on increase. Knitting industry can also be looked into for more investment in both organized and decentralized sectors with their proper coordination. The difference in the prices of mill made cloth and power loom made cloth is also very high and over the years, it has increased by 10% to 16% in different categories.

Table 3.11 Cloth prices in domestic market Rs./Meter (PL = Power Loom) , Source [25]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cotton | | | Synthetic | | | Blended | | |
|  | MILL | PL | % diff | Mill | PL | % diff | Mill | PL | % diff |
| 1991 | 20.44 | 8.24 | 59.69 | 55.04 | 14.98 | 72.78 | 40.75 | 14.81 | 63.66 |
| 1992 | 22.98 | 9.15 | 60.18 | 56.99 | 15.37 | 73.03 | 44.80 | 16.83 | 62.43 |
| 1993 | 27.63 | 9.36 | 66.12 | 73.41 | 15.50 | 78.89 | 45.54 | 16.87 | 62.96 |
| 1994 | 32.03 | 11.56 | 63.91 | 77.56 | 14.18 | 81.72 | 53.57 | 18.12 | 66.18 |
| 1995 | 38.84 | 12.16 | 68.69 | 76.51 | 13.86 | 81.88 | 57.17 | 17.00 | 70.26 |
| 1996 | 41.67 | 12.30 | 70.48 | 81.30 | 14.05 | 82.72 | 60.10 | 17.00 | 71.71 |
| 1997 | 42.71 | 12.67 | 70.33 | 76.81 | 12.81 | 83.32 | 62.16 | 17.00 | 72.65 |
| 1998 | 46.39 | 12.39 | 73.29 | 82.03 | 9.66 | 88.22 | 66.51 | 17.00 | 74.44 |

**3.3 SWOT analysis**

**3.3.1 Introduction**

“SWOT is a simple, easy to understand technique. It can be used in formulating strategies and policies for the administrator. However, it is by no means an end in itself. SWOT analysis can be simply understood as an examination of an organization's internal strengths and weaknesses, and its environments, opportunities, and threats. It is a general tool designed to be used in the preliminary stages of decision-making and as a precursor to strategic planning in various kinds of applications. When correctly applied, it is possible to get an overall picture of present situation of industry in relation to its competitiveness. An understanding of the external factors, (comprised of threats and opportunities), coupled with an internal examination of strengths and weaknesses assists in forming a vision of the future. Such a foresight would translate to initiating competent programs or replacing redundant, irrelevant programs with innovative and relevant ones.” (Radha et al., 2001)

**3.3.2 Indian Textile Industry: Strengths, Weaknesses, Opportunities and Weaknesses**

Table 3.12 summarizes strengths, weaknesses, opportunities and threats perceived for Indian textile industry.

Table 3.12: Strengths, Weaknesses, Opportunities and Threats for the Indian textile industry

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **OPPORTUNITIES** | | | | **THREATS** | | | | |
|  | SWOT **ANALYSIS** | Institutional  Support | IT | Increasing per capita consumption | Open markets | Free trade | Re Export | Anti dump  Duties | Subsidy by other nations | Population Growth |
| **S**  **T**  **R**  **E**  **N**  **G**  **T**  **H**  **S** | Availability of RM |  |  | + | + | + |  |  |  |  |
| Variety of RM |  |  | + | + | + |  |  |  |  |
| Low Cost of cotton |  |  | + | + | + |  |  |  |  |
| Cheap Labor |  |  | + | + | + |  |  |  |  |
| Low production cost |  |  | + | + | + |  |  |  |  |
| Designs |  | + | + | + | + |  |  |  |  |
| Wide variety of processes and technologies | + |  | + | + | + |  |  |  |  |
| Conversion Yield |  |  | + | + | + |  |  |  |  |
| **W**  **E**  **A**  **K**  **N**  **E**  **S**  **S**  **E**  **S** | High power cost |  |  | - | - | - |  |  |  |  |
| Low cotton yield and poor quality | + |  | - | - | - |  |  |  |  |
| High cost of RM for Manmade fibers |  |  | - | - | - |  |  |  |  |
| Deficient network of Small and Organized sectors |  | - | - | - | - |  |  |  |  |
| Old Machines |  | - | - | - | - |  |  |  |  |
| Distance |  | + | - | - | - |  |  |  |  |
| Procedural Delays |  | + | - | - | - |  |  |  |  |
| Less R&D expenses | + | + | - | - | - |  |  |  |  |
| Low productivity | + | + | - | - | - |  |  |  |  |
| Poor ginning | + |  | - | - | - |  |  |  |  |
| Less installed capacity |  |  | - | - | - |  |  |  |  |
| No known brand |  | + | - | - | - |  |  |  |  |

(**+** Favourable configuration **-** Unfavourable configuration )

Main strengths of the Indian textile industry are low cost of production, wide variety of processes and availability of the raw material. Major weaknesses are less installed capacity, inferior quality of raw material, old machinery and procedural delays.

**3.3.3 Explanation of the SWOT Table**

* Availability of cotton in different varieties and low cotton cost can be well utilized to take advantage of opening of markets. With surplus production, India can increase its share in the world cotton trade.
* Low labor costs can be effectively utilized to keep prices down and are useful to take advantage of opening of markets and at the same time make products more competitive to fight import flux arising out of free trade.
* Wide variety of salable designs can be marketed well in the open markets while it will be difficult for others to penetrate into the traditional Indian market.
* Wide variety of processes and technologies can deal with wide variety of demand and make the industry flexible with respect to the product offerings.
* Less waste generation would keep raw material costs and, therefore, product cost at low level. It would be definitely useful to compete on the basis of prices in the international markets.
* Institutional and academic support is useful for process control, process innovations for wide varieties of processes and technologies. Research institutes would also be useful in experimenting with the various cotton varieties so as to improve cotton yield and quality. They can also conduct various seminars on productivity improvement, process control and better ginning practices.
* IT can be exploited to support the product design through CAD. Integrated information systems would be useful to improve communication and coordination between small-scale industries and large-scale industries, to communicate over large distance, to avoid procedural delays, to improve productivity through computerized planning and control, to collect data from market and to promote the product in international markets.
* It is certain that because of in-competitiveness arising out of high power costs, India might lose avenues for more employment and even domestic market will be under threat of free trade regime. That is, free electricity will ultimately lead to more taxes, less employment and more trade deficit on account of lost opportunities and increased imports.
* Low cotton yield will not make the cotton available for international trade. It can be a limiting factor if the export target of $50 billion is to be achieved by 2010. Poor quality will make it mandatory to import better quality cotton and thus, will act against taking advantage of the opening of markets.
* Deficient network of power loom sector and organized mill sector will not allow to take the maximum advantage of the low production cost of power looms and the marketing expertise of the organized sector. It will have adverse effect on the exploitation of open markets and IT expertise available in the country.
* Old machines will restrict the production to low value added products leaving high segment open to competitors. With old machinery, it is difficult to take the maximum advantage of computerized controls and opportunities presented by the opening of markets. Old machinery is less productive and prone to more defective production. It will act against taking fullest advantage of open markets and it may not be possible to compete with outside production, which will flow in India without any barrier in free trade regime.
* Distance from user markets and procedural delays can have negative impact on delivery time, cost of transportation and, therefore, on the customer satisfaction. Both these factor would create need for exploitation of IT. Procedural delays bring down the customer satisfaction and trust in timely deliveries. It would affect repeat ordering. In open markets, it is difficult to attract customer unless he is not satisfied with the current supplier. Retaining the customer, therefore, assumes a greater importance.
* Lesser expenses on R&D will have adverse effect on the all the opportunities presented as the essence of competitiveness lies in process and product innovation. Currently expenses on R&D in India are .03 % of turnover of organized sector as against 1% in developed countries (Jasuja, 1999).
* Low productivity will reflect in increased prices, less availability of product in the market and poor ginning will reflect in the inferior quality of output; these factors will limit the share in open markets. This situation poses a good scope for support from research institutes and for IT exploitation.
* Less installed capacity lowers the total production capacity. Obviously, one cannot have water in the bucket, if it is not there in the well.
* Absence of known brand makes it difficult to attract customers who derive satisfaction from purchasing commodities of familiar brands. Known brand assures customer of after sales support and quality of product. In open market, known brand tends to attract more customers than un-branded product. It poses good opportunity to exploit IT for brand promotion. Absence of known brand is definitely a disadvantage in international competition.
* Threat of re-export may not be relevant in open economy as re-exported goods will be costlier than directly exported goods.
* Anti dumping duties levied against India may cause drop in exports making Indian goods costlier.
* Subsidies by competitors will make their goods more competitive in the international markets as it will have effect in reducing cost of production.
* Population growth has general implications. It will put extra burden on economy with increased taxes, increased demand for power and it will act against competitiveness of the Industry.

**3.3.4 Force field analysis**

Figure 3.2 shows the force field analysis and role of IT for Indian textile industry. As one can

observe from the diagram, the favorable factors outnumber the unfavorable factors as far as Indian textile industry is concerned and Indian textile industry might face difficult situation in view of the open regime. In order to seek the balance of positive and negative forces, assisting measures are suggested, which are shown in the diagram as additional forces required to maintain the balance.

Easy availability of RM

Low raw material yield

Poor Product Quality

Industry fragmentation

High Power Costs

Low Labour Cost

Variety of Designs

Less installed capacity

Investment to increase production base

IT for CRM, SCM, Planning & co-ordination of fragmented Industry

Power reforms

**Indian Textile Industry**

Training centres for quality improvement

Positive forces

Negative forces

Additional forces required to maintain the balance

Figure 3.2 Force field analysis for the Indian textile industry

**3.4 National Textile Policy 2000: Strategic direction**

In order to compare National Textile policy, 2000 against the findings of SWOT analysis, the strategic directions as given in National Textile Policy -2000 (National Textile Policy, 2000) are highlighted below:

**Spinning**

1. Encourage the spinning sector to continue to modernise;
2. Liberalise and encourage export of cotton yarn
3. Review form time to time the hank yarn obligation while ensuring supply of adequate quantity of yarn to the handloom sector.

**Organized mills**

* Integration of production efforts on technology driven lines
* Encouragement to setting up of large integrated textile complexes
* Strategic alliances with international textile majors, with focus on new products and retailing strategies
* Creation of awareness and supportive measures for application of IT for upgradation of technology, enhancement of efficiency, productivity and quality, better working environment and HRD

**Power Loom**

* Technology upgradation
* Modernisation of Power loom Service Centres and testing facilities
* Clustering of facilities to achieve optimum levels of production
* Welfare schemes for ensuring a healthy and safe working environment for the workers

**Ready Made Garments**

* Garment industry will be taken out of the SSI reservation list
* Joint ventures and strategic alliances with leading world manufacturers will be promoted
* Schemes with necessary infrastructural facilities for the establishment of textile/apparel park will be designed with the active involvement of state Government, Financial Institutions and the private sector
* Setting up of strong domestic retail chain to ensure easy availability of branded India product will be encouraged.

**Exports**

1. Forging of strategic alliances for gaining access to technology
2. Operation a brand equity fund exclusively for textile and apparel products, consistent with WTO norms
3. Restructuring AEPC and other Export Promotion Councils play the role of facilitators and professional consultants
4. Developing infrastructural facilities in the predominantly textile and apparel export oriented areas in close co-operation with State Government and Financial Institution and the private sector
5. Evolving a suitable mechanism to facilitate industry associations to deal with disputes under the various agreements of the WTO

**3.5 Suggested corrective measures**

The corrective measures fall into following different categories:

**Formation of the textile policy**

A policy is needed to deregulate the business as much as possible and it lies in the hands of the Government. It has been found that it is difficult to formulate a policy that will take into account needs of all the sectors. While deregulating government will also need to focus on the issue of unemployment. Machinery, which can be controlled manually to give quality production with the help of supervision would be appropriate technology in the Indian context where abundant labor force is available at low costs. Highly automated machinery may pose problems regarding maintenance, spare parts availability and highly skilled labor. It would be advisable, if the Government encourages the policy of formation of groups from diversified sectors to take the advantage of low production cost of the decentralized sector and marketing set up of centralized sector. If the functioning of very popular foreign brands are observed, one can notice the thrust that is placed on out-sourcing the production to small suppliers. Similarly the corporate sector can try to up-grade the technology of small sector and derive benefit through low costs of operation of small-scale sectors due to absence of heavy overheads. Big firms can develop marketing channels for their own and out-sourced production. Supply chain management assumes significant importance in such scenario. Textile policy should also take into account additional export subsidies offered by other countries if that is the case. The effect of such erroneous subsidies should be neutralized by application of anti dumping duties on products from such countries. The exact amount could be decided depending on the nature of subsidies offered and their impact on the prices of commodities. If there is no international commitment towards the issue of subsidies, India may have to offer subsidies to Indian textile industry as well to remain competitive in international markets. The issue of anti dumping duties on Indian goods needs to be addressed at diplomatic level. Some suggestions are made to make National Textile Policy more vigorous in directing the industry in the new millenium as given below:

* Provision in NTP, 2000: Export Promotion Councils will be restructured so as to become capable of devising dynamic export strategies; promoting financing; disseminating information on various aspects of the WTO agreements; extending legal advice to trade and industry in dispute settlements, etc
* Suggestion: NTP should provide for Marketing centres with supply chain management capability
* Suggestion: Export strategy should include building of retail outlets abroad for goods manufactured in India. It is particularly important for ready made garments.
* Provision in NTP, 2000: The Nodal Centre for Upgradation of Textile Education (NCUTE) will be helped to grow into an autonomous National level TexEd Resource Centre
* Suggestion: NCUTE should focus on training of power loom operators, and shop floor personals from organised mills sector. Although policy speaks of providing assistance in Human Resource (HR) development for decentralised sectors, training centres are not conceived for power loom industry.
* Statement in NTP,2000: Despite a 58% global share of looms, consisting of 3.5 million handlooms and 1.8 million power looms, technology still remains backward
* Comment: Although mills have less installed capacity, inclusion of 3.5 million handlooms in the overall weaving capacity cannot be justified for comparison.
* Provision in NTP, 2000: Textile policy gives thrust on organised industry
* Suggestion: Power loom industry is more competitive. According to a report prepared by the Prime Minister's Council on Trade and Industry, the cost of producing one metre of cloth by a power loom is 22 Paise, compared to Rs 1.60 in a composite mill
* Suggestion: Textile policy does not take into account proper coordination in the organized and the decentralized sectors. It can be achieved by out-sourcing the production to small suppliers. It would offer tremendous help for employment generation in a sector, which is cost effective.

**Technology upgradation**

It depends on availability of funds and interest rates. Indian government has come up with a scheme of Technology Upgradation Fund for the textile industry. The incentives that it offers are not very attractive. The Government can think of giving more incentives, if such machinery is used for export production. Low productivity in the weaving sector can be improved by going either for high speed shuttle-less technology or by increasing the number of power looms. Quality consciousness of the power loom operators can be improved by making provision for training programs for the power loom operators to take care of quality related issues. In spinning sector, problem is less pronounced and can be tackled with modernization of existing machinery.

**Infrastructure development**

Power tariff costs are most critical to all industries including textiles. Government can keep vigil on theft of electricity so that the burden of loss, due non-collection of dues, is not passed on to the industry. Discussion on ways and means of achieving low cost power production is out of scope of this thesis.

### 3.6 Management related issues: Role of the integrated information solution

**3.6.1 Quality related issues**

Quality management system can derive good assistance from integrated management software, which can offer aids in the form of easily accessible information on quality procedures, checks, responsibilities, troubleshooting advice and highlighting of violation of inspection norms. It would minimize the possibility of allowing defective production or inferior quality raw material to proceed further without inspection. Such problems, when detected at earlier stages, have two benefits. As defective production is blocked, value is not added to the product that cannot be sold and helps in cost reduction. In addition, instances of rejection in final product are also reduced, which helps in keeping delivery time and quality requirement as desired.

**3.6.2 Planning related problems**

To achieve good planning capabilities, system should be provided with the capabilities of simulation to visualize the effects of different courses of actions. The planning application, which is a part of overall integrated information solution, is extremely useful to judge the impact of changes from point of view of costs and profitability whenever changes are to be made in the existing production plan. Planned purchase requirements and shop orders, when attached to the specific customer orders, allow critical analysis of different customer orders along with production capacity requirement. It would be almost impossible to analyze the impact of different options within a short time without the help of computerized planning software. Any delay in making the decision on the production plan would mean losing customers in highly competitive environment for no reasons. Distance from markets can be a crucial factor when shipments are expected at short notice. For such varieties, it would be worthwhile to concentrate the supply of raw material like supply of yarn, which can be woven into fabric or the supply of fabric, which can be stitched to the required needs.

**3.6.3 Supply chain management**

Effective supply chain management depends on the effective flow of information to the various production units in the chain. The demand generated at the retail house should be quickly transmitted down the line for further action. Collective information of all production units of the supply chain constituted by various suppliers can be stored on computer and the firm can workout the capacity and material planning for its suppliers. Supplier evaluation schemes are useful in keeping watch on various aspects of the supplier firm. Without EDI (Electronic Data Interchange) and assisting IOIS (Inter Organizational Information System), it would be difficult to manage the business for profitability in the highly competitive environment.

**3.6.4 Flexibility of production**

Flexibility of production depends on two factors: The first one is the ability of the production machine to produce variety of products and the second one is the ability of the firm to adjust itself to ever changing need of the customers. Textile machines are fairly flexible to cater to the variety of products. The efficiency of making changes depends on the quick decisions that management can take regarding those changes. As suggested earlier, Integrated Information system is a good help as it can be used as an effective medium for communication and associated planning module can be used to quickly weigh the different alternatives to arrive at the most profitable alternative.

**3.6.5 Cost reduction**

Cost reduction is achieved through reduced levels of inventories because of speedy flow of the information. Any delay in the flow of information will show itself in the increased inventory levels. Inventory can also be kept at the minimum level by notifying clear instructions of the extra requirement attached with the actual demand. For example, the retailer knows that he needs X number of garments to replenish his stock. If he thinks that he would make provision for Y number of garments for ‘incase there is extra demand’, he should mention it clearly on the order form so that supplier down the line does not make any provisions for such unforeseen demand. Thus pile up of inventory is avoided. As same document flows to all supply points through integrated information management system, bullwhip effect is avoided. Capital does not get blocked in un-saleable inventory. Planning function also helps in purchase of raw material in the required quantity, thus avoiding build up of raw material inventory.

**3.6.6 Customer relationship management**:

An essential aspect of a successful business is to retain its customer base. The cost of attracting a new customer is always quite higher than the cost of retaining the old customer. A database to record and retrieve history of the customer, his preferences, frequency of orders, his problems, service requirements and additional expectations from the product would be very useful for new product design and development. Well-formulated procedures for customer dialog will be useful in having better customer relations. Fast responses to the customer queries create a good impact on customer’s perception of the organization. Such responses are possible only if a comparison of the current production schedule and the current product stocks with the new product demand is made possible through computerized planning software. One must be aware of the production capacities of customers and their markets. Through an internet enabled ERP solution, company can have a better control over the business as it will act as one of the players in the whole supply chain rather than as a single isolated production unit.

**3.6.7 Quick response**

Quick response depends on the flexibility of the production unit to switchover to different products, the ability to get the raw material on time from suppliers and the efficient transmission of customer demand. Without planning aid, through computerized system, it would be rather difficult to achieve quick response to the customer demand. Integrated system helps in reducing the delivery time as non-value-adding activities like repeat documentation are avoided at various stages. Proper allocation of the material to a particular customer order brings down the instances of the mismanagement in the production. Due to availability of the reasons for machine stoppages and defective production, corrective actions can be initiated accordingly. It improves up-time of the machinery and therefore, facilitates quick response.

**3.6.8 Formation of alliances**

As discussed earlier, groups can be formed from corporate and small sector industries for the mutual benefits. Alliances with overseas companies are also possible but the problem would be of the willingness from the part of overseas retailers. Corporate sector can open their own outlets in other countries to attract the foreign buyers.

**3.6.9 Marketing and advertising**

Marketing and advertising function can be assisted by the computerized system to calculate costs and benefits of the different marketing strategies. Actual effect of advertising campaign on the product sale can be studied from sales data for different periods. Such analysis would be useful in making profitable decisions regarding product sales. Building of brand image in India and abroad supported by the quality fabrics is also essential aspect of the garment business. It is most important of all that the Indian garments become a symbol of quality and novelty in India and abroad. Comparative statement of properties of the foreign brands and that of the Indian brands can be given to the consumer to bring him out of notion that the foreign brands are superior to the Indian brands. Consumer can also be supplied the details of the Indian supplier base of the foreign brands to bring him out of the psychological grip of the foreign brands. At times it would not be advisable to take attention of the customer to other brands unnecessarily; in such cases highlighting the quality aspects of the product is the only option. Advertising should be treated as an investment for sustaining the business and not as unnecessary expenditure. Niche markets can be captured only if consistent quality garments are supplied to the high-income group.

**3.6.10 Manpower training and management**

Manpower module of integrated system can be effectively used for continual assessment of worker’s performance for highlighting the training needs. With the help of integrated management solution, production and profits can be related to the employee to arrive at decisions regarding payments and incentives. In the absence of any system to record and answer employee queries, feeling of belonging to the organization cannot be cultivated and employees lack motivation to offer their best at work. Labor efficiency figures make it possible to reward the employees whose performance is above par where pay is not related to the production.

**3.7 Proposed Model for the Indian textile industry**

From SWOT analysis it is clear that proper coordination of the fragmented Indian textile industry is essential to enhance competitiveness of the industry. Figure 3.3 shows an IT enabled model for coordination of the fragmented Indian textile industry. The proposed model suggests that the following units can directly deal with the domestic and export markets.

* Processing units
* Composite Mills
* Weaving Mills
* Knitting units
* Spinning Mills
* RMG Manufacturing units
* RMG marketing centers
* Knitting cloth marketing centers
* Power loom marketing centers
* Hand loom marketing centers

Export and domestic markets consist of company owned retail outlets or retail chains run by independent bodies to promote textile products in India and abroad. Markets are also comprised of dealers, other retailers and even manufacturers who use intermediate textile products to produce the finished goods.

All units dealing with the markets can freely interact with each other to fulfil their raw material requirements and finishing needs. Marketing centers are provided for marketing of products from decentralized sectors. Individual weavers and garment manufacturers of decentralized sectors can be attached to the different marketing centers. These marketing centers from different parts of the country are free to interact with each other so as to make the maximum use of the available capacity and to avoid losing any export order due to non-availability of the capacity. Marketing centers can be run by individuals, government bodies or by cooperative bodies of respective manufacturing units. Apart from the marketing centers, the proposed model shows the dispatch centers to facilitate collection, maybe the inspection of the products if required and further dispatch to the customers. Marketing centers are expected to convey the material requirements to all the constituents of the supply chain for effective supply chain management and to avoid delays in the deliveries to the customers, caused by the delays in the supply of raw material at various stages of the supply chain. Timely information to all units will facilitate the material and capacity planning well in advance for the different units in the supply chain. The proposed model also envisages the support centers to provide machine maintenance services, testing services and training services to the decentralized sector. Organized sector too can derive benefit from such services, if required. Training is essential so that the fabric and garment producers follow the quality oriented manufacturing practices. Maintenance services will ensure that the machines in the decentralized sector are in good conditions, so as to produce the quality products.

As one can notice, the whole model rests on information technology for the support in conveying the required information to the different units presented in it. Organized sector, marketing centers, dispatch centers and individual producer are expected to be in contact with each other for conveying current status of production, to discuss the problems and to know the available capacity at any point of time. Although it may not be feasible to have computer at every individual handloom operator or power loom operator, access can be provided to group of manufacturers so that they can be in touch with the marketing centers. Marketing centers in turn can decide about how orders can be scheduled to different manufacturers depending on the available capacity. Different marketing centers can be connected to each other by computerized network to establish immediate contact within them and to answer the customer queries to improve customer satisfaction. Thus SCM and CRM are the two main functions, which the IT network is required to address to derive the maximum benefit of this fragmented industry.

In the survey it was observed that because of short of capacity, sometimes it is not possible for the individual mill from the organized sector to cater to all the customers who approach the mill for supply of the products. In such cases, the mill can take a look at the product range provided by the decentralized sector and outsource the production, and sell the goods maybe with reduced profit margin rather than losing the customer without earning anything. In addition, it is difficult to get the customer back once company loses him.

Dark arrows in the model suggest goods flow from tail to head together with information related to goods; the product that flows over the arrow is shown in the box in capital letters. Every goods flow has an implicit money flow and information flow in the reverse direction. Similarly, every information flow, which is shown by faint line, has an implicit information flow in reverse direction as feed back to the information provided. Lines suggest that supporting services are provided by the maintenance, training and testing centers to the industrial units.

* 1. **Summary**

The Indian textile sector needs a lot of revamping to remain competitive in the post quota era. An integrated information management solution is a great aid in improving the competitive ability in international markets. Important measures to increase competitiveness of the Indian textile industry are listed below:

* Investment to increase production base
* Power reforms
* IT for coordination of the fragmented industry and for efficient management of the business
* Marketing centers with SCM and CRM capabilities
* Training centers for quality improvement
* R & D activities to improve the cotton quality and production yield

National Textile policy needs to address the following issues

* Stress on having own retail outlets overseas rather than depending on the joint ventures
* Networking of the centralized mill sector and the decentralized power loom sector
* Making more investment in the power looms than in the organized mill sector
* Training centers for the power loom operators for better working practices to meet the export quality requirements
* Development of a supplier base for the RMG production from the small-scale industry and its integration with the organized sector

Since office of the Textile commissioner conducts routine exercise of gathering of statistics, it can include few more details related to product varieties, machine conditions, production capacities, raw material requirement, raw material availability, distances from the markets etc. which would be useful to add SCM capabilities. Actual software and IT infrastructure development can be given to the competent persons or organization for the use of Textile commissioner’s office. Textile commissioner Or Textile Research organizations can decide about the positioning of marketing centers, training centers and maintenance centers across the country. The Government or Joint Committee of Textile Research Organization will have to take the lead.

The need for an integrated information management solution is highlighted through a case study of a reputed textile unit in the next chapter.

# Chapter 4

# NEED FOR AN INTEGRATED INFORMATION MANAGEMENT SOLUTION: A CASE STUDY

**4.1 Introduction**

From the previous chapter, it is clear that the level of the exploitation of the information systems in the Indian textile industry is very low. This has adversely affected the profitability of the Indian textile sector. Companies are yet to realize the potential of such systems. Case study approach was taken to establish the need for an integrated information management solution for the Indian textile industry.

A good case provides simulated experience of management problems and situations. Most importantly however, a case can provide an excellent environment for "discovering learning - one can analyse data, synthesise it, evaluate it and exercise judgement on it (Truman, 2000). The analysis of case study leads to a managerial approach to the problem domain. (Leiss, 1999). *The present study shows the managerial implications of using IT for business improvements. From analysis and synthesis of gathered information a clear judgement can be exercised.* According to Wood and Braithwaite (1999), case study approach has three distinct advantages over other approaches: Firstly it focuses on application, secondly it represents and illustrates real world complexity, and thirdly it provides a context for practising skills in problem solving and managing the situation. *The case study approach is useful to improve learning of managers and users in industry with respect to information technology to drive the point of requirement of integrated information management solution. The present case study brings out the benefits of the proposed action for only convincing facts can emphasis the need for an integrated management solution in every day business life. Managers, who are content with existing performance, need to know how much loss they incur by not going for extensive use of IT. Competitive ability assumes greater importance keeping in view the open regime, which is to follow in the next few years.*

**4.2 Case Details**

**4.2.1 Objectives of the case study**

Case study was carried out with the following objectives:

**i)** To stress the benefits of integrated information management solution through highlighting the

scope for improvement in

* Cycle time reduction
* Cost savings
* Sales volume
* Customer satisfaction through
* Quality
* Delivery time
* Communication
* Machine up-time
* Employee satisfaction

**ii)** To judge the utility of the prescribed questionnaire from following view points:

* Appreciation from the industry
* Ease of interpretation
* Exhaustiveness
* Information extraction

**iii)** To judge the utility of event diagrams from following view points:

* Appreciation from the textile industry
* Exhaustive representation of the organizational functions
* Level of users' understanding of the event diagrams
* Effective representation of the departmental process flows
* Users' interest in the discussions

**4.2.2 Tools used**

**i)** A structured questionnaire was developed to cover the following functional areas of an organization:

* Financial Accounting
* Production
* Purchase and Supplier Management
* Inventory
* Customer Management
* Marketing
* Product Development
* Manpower
* Quality Control

The complete questionnaire is given in appendix 1 of this thesis.

**ii)** Event diagrams for the following modules were presented to the participants:

* Finance
* Financial Accounting
* Accounts Payable
* Accounts Receivables
* Production
* Bill of Material
* Operations
* Material Planning
* Capacity Planning
* Production Accounting
* Materials
* Supplier Management
* Purchase
* Inventory
* Sales
* Customer Management
* Product Development
* Marketing
* Sales Monitoring
* After-sales Service
* Manpower
* Recruitment
* Allocation
* Training
* Personnel

Event diagrams are given in the section 6.2 of this thesis.

**4.2.3 Details of the participating organization**

The companyis a part of the multi-dimensional Group of companies which today is one of India's leading corporate houses. It is India's first 100% export oriented composite textile unit with spinning, weaving and printing under one roof. It has modern technology, latest machinery, rigid raw material selection, computerized control systems and a very well trained manpower, making it one of the leaders in the industry in a short period. It is located in north India near a big city. President (Technical) of the company was officially contacted for the purpose of the case study and he readily gave his consent as study was conducted for academic purpose.

Tables 4.1 to 4.5 give company profile, technological details, production capacities and product range of the participating unit.

Table 4.1 Company profile

|  |  |
| --- | --- |
| Year of establishment | 1993 |
| Status | 100% Export Oriented Unit –vertically integrated Composite Textile Mill |
| Activity | Manufacturer – Exporter |
| Product Range | 100% Cotton wider width piece goods for bed linen (90" - 106"), 100% Cotton premium fabrics suitable for apparels and home furnishing made ups (Yarn Dyed and Piece Dyed - 48" & 67") |
| Annual Turnover (Rs) | 57 Crore |
| Number of employees | 500 |
| Number of suppliers | 100 |
| Number of competitors | 500 |
| Location | North India |

Table 4.2 Technology Details: Spinning (25200 Spindles )

|  |  |  |
| --- | --- | --- |
| Blow room line | 3 | RIETER, Switzerland |
| Cards (C-50) | 16 | RIETER, Switzerland |
| Comber (E7/ 5A) | 8 | RIETER, Switzerland |
| Drawframes (SB2/RSB 851) | 8 | RIETER, Switzerland |
| Speed Frames (LF 1400 A) | 8 | LMW |
| Ring Frames (LG 5/1) | 25 | LMW |
| Autoconers (238) |  | SCHLAFHORST, Germany |

Table 4.3 Technology details: Weaving (120 Looms)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Warping Machine | 1 | Benninger | Grey width  cms | Processed width  cms |
| Sizing Machine | 1 | Benninger Zell |
| Projectile Looms (E7100 EP 150") | 24 | Sulzer, Switzerland | 122, 180 | 112, 160 |
| Air Jet Looms (Omni 2P 110") | 96 | Picanol, Belgium </TBODY> | 269 | 254 |

Table 4.4 Technology details: Processing (Printing Machine)

|  |
| --- |
| Width Capacity: 250 cms |
| Color Capacity: Max 16 Shades |
| Computer Controlled Color Kitchen |
| Fully Computerised Design Development/Screen Making |
| Memory of 16 Million Color Combinations</TBODY> |

Table 4.5 Production capacity and product range

|  |  |
| --- | --- |
| Spinning | 3.2 Million kgs. Per Annum, (100% combed cotton yarn counts (Ne) ranging 20's, 30's, 40's,& 50's with an average count of 34's. ) |
| Weaving | 28.0 Million SQ. Mtrs Per Annum (100% Cotton wider width fabrics suitable for bed linen in the width range of 90" to 106" woven on **Picanol Air Jet Looms.** 100% Cotton yarn dyed and piece died premium fabrics for high end mens wear and home furnishing made ups in the width range of 48" to 67" woven on **Sulzer Projectile Looms)** |
| Processing | 68.0 Million SQ. Mtrs Per Annum |

**4.2.4 Survey procedure**

To start with, a presentation was given to a group of about fifteen persons, which included President (Technical), Personnel Manager, Asst. Personal Manager, Production Executives, Quality Assurance Executives, Purchase Manager, Production Managers, R&D in-charge and planning personnel. After the presentation, six executives took the responsibility of filling up the questionnaire. Each one was contacted separately and the questionnaire was explained to him in detail. Questionnaire was left with participants for the discussion with other departmental persons and again after two to three visits, final response was obtained.

The integrated information system was represented in the form event diagrams (Refer to chapter 6 for complete description of event diagrams). Event diagrams were shown to all the respondents and steps included in the event diagrams were discussed in detail. They were asked to give their opinion regarding the event diagrams, regarding its suitability from adoption point of view and regarding coverage of different function of respective departments. They were also asked to suggest modifications in the event diagrams, if necessary, to make them better representative of their respective functions.

Table 4.6 shows details of the respondents who answered the questionnaire.

**4.3 Results and Discussions**

**4.3.1 Event diagrams**

All the aggregate rating for event diagrams was 4.4 in the scale of 1 to 5. Respondents were keen on getting system developed according to the event diagrams supplied. They felt that the procedures prescribed through event diagrams were practicable and had enough built in control to ensure proper communication between different departments. Respondents conceded that there were procedural lapses in existing mill practices, which resulted in delay in decision making and wanted to adopt procedures suggested in the event diagrams to make the working of the organization more efficient. Event diagram was emerged out as an excellent tool to

### Table 4.6 Details of the respondents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | Designation | **Education** | **Experience**  **(Years)** | **Computer Literacy** |
| 1 | Manager Exports | B.Sc., Diploma in Marketing Management | 10 | MS Office |
| 2 | Asst. GM Personnel | LLB, PG Diploma in IR | 20 | MS Office, Windows |
| 3 | Asst. Manager Accounts |  |  |  |
| 4 | Asst. manager Purchase | B.Sc., Diploma in Computers, PGD in Materials Management | 10 | MS Office, Purchase System, Computer Fundamentals |
| 5 | Executive – Process Development and QA | M. Tech. (Textiles) | 2.5 | Windows, MS Office |
| 6 | President (Technical) | B. Tech (Textiles) | 25 | Windows, MS Office |

discuss requirements of personnel from production and other departments. All the respondents understood what event diagram wanted to convey and participated in the discussion to decide about applicability of event diagrams to their respective departments. All the users retained a copy of the event diagrams for their record. The response to the event diagrams shows that it is easy to assimilate even for the persons not having computer background and it is informative enough to solicit the user participation in building an information system. An important aspect of user engagement or user ownership of the information system is taken care of by active participation of users in the system study process, right from the beginning. It is really important, as systems do fail, if users feel that information system is being imposed on them. In latter case users resist the information system, while in the former case users feel that it is their system and are extremely cooperative in implementation stage to make the system bug free. Thus, event diagrams are useful from all angles: simplicity of construction and understanding, exhaustive coverage of procedures, quantum of information display, ease of modification and user participation.

**4.3.2 Cycle time reduction**

Table 4.7 shows the expected reduction in cycle time, if integrated information system were employed in the organization.

Table 4.7 Cycle time: Present and Expected

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Activity  No | Activity | Present Requirement Days | Expected Requirement Days | Expected Reduction  Days |
| A1 | Order Receipt | 5 | 1 | 4 |
| A2 | Sample Development | 20 | 16 | 4 |
| A3 | Raw material from stock | 0 | 0 | 0 |
| A4 | Packing | 2 | 2 | 0 |
| A5 | Transportation | 10 | 8 | 2 |
| Total Expected Reduction in Cycle time (Days) | | | | 10 |

## Following activities present the scope for cycle time reduction:

**A1**: Marketing office of the company is situated in a big city while works are situated at about 150 km from the city. The first activity shown in the table involves receipt of inquiry from the customer at the marketing office, forwarding it to factory and getting response from factory on possibility of acceptance of the order. Out of 5 days, 2 days are lost in communication and 3 days in making decision at factory on availability of production capacity and raw material. Planning module of the integrated system will be a great help in reducing decision making time to less than one day with prompt communication so that there is no delay in passing of the information to the factory over the net. The whole exercise of order confirmation can be dealt with in a day.

**A2**: Sample development time is expected to improve because there are no communication delays between various departments and availability of raw material can also be traced out quickly with the help of on-line system.

**A5**: The improvement in the transportation time is the result of well planned and executed orders for which transportation arrangements can be made well in advance and thus avoiding any delays on account of waiting for the transportation from the factory to the customers.

**4.3.3 Scope for the reduction in the cycle time**

* Allocation of material to the specific customer order is not possible within the current system. Such allocations are useful for making the deliveries as planned, as there is no possibility of the material, which is required by one order, getting consumed for different order. In such cases, earlier order would get delayed, if the material were not available in the stock while production time is spent on other order, which could have waited without causing any problem.
* In most of the departments, reports are recompiled to suit their individual requirements. On an average 50% of the reports received from the other departments are recompiled and obviously there are chances of introduction of errors at every stage. On an average 30% of the department’s time is wasted in such recompilation. The delays caused in documentation at every stage will finally result in the increased delivery time. The computerized system is useful from this point of view as well.
* No trouble shooting advice is available from the computer. Such advice is definitely useful in taking remedial measures to improve efficiency of the department as solutions to the problems can be offered faster.
* Requisition tracking is not possible. It can lead to uncertainty in the production department regarding the supply of the raw material. On line requisition-tracking system would serve the purpose. It would also be useful in following up the requisition or purchase order to avoid delays in the supply and therefore, delays in the execution of the customer orders.

**4.3.4 Scope for cost savings**

* The company loses 2% of its sales value in discounts, which are the result of the surplus production. Implementing quality management system can help to bring down the excess production. As management will be assured of the quality right from the raw material stage,
* Supplier development module, which can focus on quality, cost and delivery aspects of suppliers would be useful in proper selection of the suppliers.
* 30% of the sales revenue is not materialized on the account of incorrect coordination of the information. To calculate this figure, export manager was asked to give his judgement about lost orders because of lapse in the coordination of the information in the follow up of the order. [Order value lost / Total sales value]. An integrated system can definitely serve useful purpose in this connection.
* 10% of the total value of purchases can be attributed to the higher prices due to placing of urgent orders at higher prices. Implementation of production planning system can bring down this figure substantially to the range of 3% to 4%. It may not be possible to bring down the figure to 0% because there could some genuine orders, which need execution on urgent basis and the customer is ready to bear such costs. Thus, the proper planning will ensure that the loss, due to increased costs, drops down to almost 0%.
* Details of the supplier's business are not available in the current system. The company is not aware of the problems and opportunities of the markets of its suppliers. Such knowledge will be useful in making the selection of supplier as distinction can be made in the capability of different suppliers regarding supply of raw materials on time and of desired quality and cost.
* Web enabled system could be useful to inform supplier about company's requirements for supply as soon as they are created. This would help reduce inventory levels and thus, working capital requirement is also reduced and, therefore, indirect costs.
* For about 5 months in a year, the actual consumption of the raw material is found to be less than the expected consumption - A case of over stocking. While for about 3 months in a year, there are stock outs. That is, the actual consumption of raw material is found to be higher than the expected consumption. Both these situations demand effective communication without delays and assistance from computerized planning software.
* The response recorded on percentage of amount blocked in slow moving items was 10% of the total inventory value. It is possible that such items were purchased at higher expectation of the consumption and later on could not be consumed due to change in the requirement. Purchase decisions can be improved by using computerized planning software.
* It is difficult to balance the future financing needs of the company but the problem does not assume threatening proportions because all sales are made against Letter of Credit. Still in the absence of proper planning, company may have to bear some extra interest burden.
* About 90% of bills are paid on time. With planning system in place, 100% bills can be paid on time. It has a good effect on suppliers who offer supplies on credit as they are assured of the payment on the date decided in the contract. In the absence of such assurance, suppliers can charge on higher side to compensate for the interest for the delayed period, which would reflect in increased costs.
* Current system does not provide any information regarding extra expenditure attributed to unplanned expenses and therefore no control can be exercised on such expenses.

**4.3.5 Scope for the reduction in the machinery down time**

* 5% of the total machinery down time is attributed to the non-availability of the raw material in the stores. This is due to absence of the proper planning system and due to communication delays at every place arising out of information recompiling. Prompt communication coupled with the effective supplier selection module and planning system would be useful in bringing down the machinery down time.
* Absence of any system to manage the tooling inventory to asses their life and deterioration can affect the quality of the production adversely as timely maintenance operation to restore the machine to its desired condition would not be possible. It would also lead to increased machinery down time.
* Figures of production loss due to breakdown maintenance and analysis of the reasons responsible for breakdown maintenance are not available. In absence of such analysis control cannot be exercised to reduce the instances of breakdowns and it thus adds to the machine down time and to the delays in the delivery of the customer order.
* Analysis of the reasons for efficiency loss is not available, which makes it difficult to exercise the control on improving efficiency of the production unit. Lower efficiency would also result in increased delivery time and increased down time.

**4.3.6 Scope for the improvement in the sales**

* Only 20% of the inquiries are converted into the orders. Many of the inquiries cannot be converted into the orders because the export manager is not in a position to know whether a particular inquiry is answered or not. Inquiries are untraceable. Number of inquiries that are not answered is not known. Even the status of a inquiry that is answered is not available on the computer. Therefore, any of the customer calls regarding the inquiries cannot be answered quickly. This leads to the customer dissatisfaction. Integrated system will be useful in answering customer queries on-line.
* About 75% of the customers place repeat orders. Repeat orders are affected by three factors - Price, quality and delivery. Integrated system will definitely be useful on these accounts.
* Price is one of the causes of losing customers; there is ample of scope for cost reduction and therefore the company can offer lower prices to attract customers by making use of the integrated information management solution.
* There is no proper system to record customer expectation and expected trend in the product demand. It affects the sales adversely due to erroneous prediction of demand. A direct feed back from consumer can be sought through web enabled system to solve the current problem of forecasting of the future demand.
* Cost figures associated with product attributes that are lacking are not available. Therefore, proper analysis regarding new product development is not possible. This can adversely affect the sales and new product development.
* More product promotion efforts are required. The present confusion arising out of the handling of the inquiries is holding the management back from embarking on new product promotion schemes.
* Up to date financial records are not available for making decisions related to finance. The company is not aware of the financial status either of the customers or of the suppliers. Such knowledge is useful in production planning because the chances of repeat order and on-time delivery of required raw material gets affected by the financial position of the customer and the supplier respectively.

**4.3.7 Scope for the improvement in the customer satisfaction**

* Current system is ineffective in tracking the problems related to the customers. The response regarding effectiveness falls in unsatisfactory category. Capacity planning for received order also falls in average category. Efficient capacity management system can bring down the delivery time required for the execution of the order and improve customer satisfaction.
* Customer management scheme will be very useful in maintaining better customer relations with prompt response and by knowing their past history. Well-formulated procedures for customer dialog will be useful in having better customer relations. It takes approximately three days to answer any of customers’ queries. This period can be brought down to a day, which will have a very good impact on customers’ perception of the organization. Economics of different channels for sales can also be worked out. The company, as of today, is not aware of the problems of its customers. Nor it is aware of the production capacities and markets of the customers. Through an internet enabled ERP solution, company can have a better control over business, as it will act as one of the player in the whole supply chain rather than as a single isolated production unit.
* Quality assurance module of the proposed system can be effectively used to improve the quality aspects of the end product. The proposed system provides for storing all quality procedures with concerned persons and their roles. As of today, there is no system, which prompts for the required quality checks at different stages. In the absence of such systems, inferior raw material or defective production can pass on to the next stage because it is not possible to know whether checks are carried out or not. Computerized system can keep a check on inspection requirements at different stages and ask for inspection record while recording the production. It would thus minimize the possibility of allowing defective production or inferior quality raw material to proceed further without inspection. Such problems, when detected at earlier stages, have two benefits. As defective production is blocked, value is not added to the product that cannot be sold and helps in cost reduction. In addition, instances of rejection in the final product are also reduced, which helps in keeping delivery time and quality requirement as desired. Quality assurance function of the company can delay the production process as there is no system to workout requirements of inspection time, testing instruments and testing material required to carry out the quality assurance checks.
* About 10% of the orders cannot be delivered on schedule because of the improper coordination of the information. Communication can be improved with the help of an integrated information system.
* Profitability analysis of different channels is not available currently. It would be useful to have such information readily available to make sound decisions regarding the sales strategies. Similarly changes in the market share, cost comparison with the competing products and analysis of sales promotion scheme would also be feasible. None of these features are currently available for making decisions. Well, under current scenario where there is only one channel of operation, this feature may not be required at this stage.

**4.3.8 Scope for the improvement in the employee satisfaction**

* At present, production and profits cannot be related to an employee to arrive at the decisions regarding payments and incentives. There is no system to record and answer employees’ queries. In the absence of such system, feeling of belonging to the organization cannot be cultivated and employees lack motivation to offer their best at work.
* Labor efficiency figures are not available, which makes it difficult to reward the employees whose performances are above par, where pay is not related to the production.

**4.4 Concluding comments**

**i)** Integrated information management solution offers a good scope for improvement in

* Cycle time reduction
* Cost savings
* Sales volume
* Customer satisfaction through
* Quality
* Delivery time
* Communication
* Machine up-time
* Employee satisfaction

The organization should target for integrated information management solution as a tool to remain competitive in the global and local markets. It is more important, considering the lifting of trade barriers and the end of the quota system. To survive in such a fierce competition, companies will have to take all measures to improve their profitability, reduce costs, reduce delivery times, reduce machine down time and improve product quality. An integrated system can offer a great aid in such efforts.

**ii)** The questionnaire received a good appreciation from the company. In general, participants were reluctant to give replies to descriptive questions. All objective type of questions were answered by the participants. Respondents found the questionnaire interesting and returned filled up questionnaire according to the schedule. Questionnaire was effective enough to extract the information related to company's present procedures and to highlight scope for further improvements, which is evident from the findings listed earlier.

**iii)** All the participants rated the event diagrams as either excellent or good. Respondents also participated in the discussions. Participants even suggested minor corrections to the event diagrams. It shows that event diagrams received good appreciation from the industry on following grounds:

* Exhaustive representation of organization functions
* User's understanding of event diagrams
* Effective representation of departmental process flows
* User's interest in discussions

**4.5 Generalization**

All the points mentioned regarding the questionnaire and event diagrams can be generalized because those tools were administered to the persons from different functional areas, different age groups and from different educational background. Even the benefits derived from an integrated management solution can be generalized, as according to a survey (Shrivastav et al., 2000) the present level of the computerization in the textile industry is poor. The sequence of events in itself will not vary substantially from one composite mill to other and therefore, the processes presented in the event diagrams also have a general implication.

**4.6 Possible barriers in the implementation of an information system**

* Communication gap between users and designers
* Lack of considering exhaustive requirements
* Lack of user participation
* Possible bugs in the system
* Rigid system to accommodate design changes at later stage of development
* Resistance to change the functioning style
* Complexity of operation
* Infrastructure problems
* Insufficient user training
* Incorrect approach towards implementation
* Inflated claims on the part of suppliers

**4.7 Suggested mechanisms to overcome the implementation barriers**

The proposed tools (questionnaire and event diagrams) are quite useful to elicit user participation during the analysis and designing phase of the project. Since both the designer and the user are to work on the same event diagrams, chances of communication gaps are expected to reduce greatly. Construction of the event diagram is an iterative process and designing process envisages regular interaction with the users through user meetings and presentations to ensure that exhaustive requirement study is carried out. Requirement study deliverables also contain details about information groups and information elements in user understandable language, which is useful in getting comments and corrections from the users regarding the contents of the system. The development platform is supposed to run the system from the supplied design and therefore, there is no possibility of introducing bugs in the program writing. Even corrections in the virtual programs are easy to make since only the required part of the program is to be checked from the database records, which store the program information. The proposed system is flexible enough to accommodate changes any time in the system. This is because only changes in design are to be completed and they are automatically enforced in the running system. The complexity of operations is removed through displaying only those options to which user has access and providing automated help at every stage of the operation. On-line help is provided at every stage to tell user which data is missing from which file rather than keep him guessing as where to look for the correction. Calculation of the required workstations can be carried out systematically in the design stage for which designer is expected to make entries in the respective event and table records. The project proposal stage lists the actual dates by which hardware is required to be in place. Users should be provided the training on the system regarding what to expect from the system and what inputs are necessary to get the desired output together with the required operations to run the system. Resistance to change in functioning style has to be dealt at the highest level, making it clear to everybody that strict action would be taken, if old practices were not given up. Inflated claims of the supplier can be found out by thorough testing of supplied prototype and by checking with the experiences of the other users of the same supplier. Regarding implementation strategy, instead of going for all the modules at a time, it would be advisable to implement one module at a time. On some occasions where applications are not mission critical, old system can be discarded from a cut off point and new system is made operational. For mission critical operations, parallel run would be advisable. Here are a few implementation guidelines:

* Ensuring the proper documentation of the system particularly of the user manual, which outlines the procedure of operating the system. System manual is equally important for system personnel.
* Checking the availability of the necessary input data.
* Proper data conversion from the earlier system
* Building of master data.
* Thorough checking of master data.
* Proper delegation of the job responsibilities
* Proper testing of the systems for presence of bugs.
* Checking of systems for necessary validation checks.
* Checking of the output reports for their contents and correctness.
* Checking the response time of the system.

**4.8 Summary**

From the analysis of the response, it is evident that an integrated information management solution offers a good scope for improvement in functioning of an organization in terms cycle time reduction, cost reduction and increased sales. The case study also brings out the utility of the questionnaire in analyzing functioning of a business establishment. The event diagrams represent the business procedures up to the satisfaction of the users and can be adopted by a textile mill with or without modification.

Next chapter deals with the suggested methodology, which can be applied for designing of an information solution and for business analysis.

**Chapter 5**

## DEVELOPMENT OF INTEGRATED MODEL – I

**5.1 Introduction**

Several definitions of system appear in the literature. The most general definition of system offered was, ‘It is possible to view all entities as system of components and each of those components is, in turn, system of finer components (Simon, 1962)”. It means a system is a set of components and sub-components till we reach a point where further decomposition is not possible. The drawback of such definition is it does not take into account the happening in the system and resources required for those happenings. A Simple definition that can cover all possible systems is offered here. **System is a set of related events.** (Chiplunkar, 1997-c) Since all systems contain some activity or other, this definition applies to all. Events are recorded along with their sequence of operation, components and resources requirements. Any system, whether social, biological, technological, astronomical etc. is essentially characterized by events that are related to each other and happen in certain order. All these events share a common goal or the objective of the system, although every event has its own objective to achieve so that the ultimate objective of the system can be achieved.

Broadly, a business system can be divided into number of activities that are inter-linked. It can be said that business system consists of number of events that lead to conversion of raw materials into finished products. So, the approach to analysis is decomposition of the whole business system into number of smaller units of events. Since the functional grouping in any organisation essentially involves grouping of similar activities together, the following method could be adopted to analyse the business, which is quite similar to the top down approach.

* Describe the business in the shortest possible steps to arrive at **Basic Activities (application areas)**.
* Describe the steps involved in basic activities to arrive at **Activity Groups (modules).**
* Describe steps involved in the activity group to arrive at **Main Activities (sub module).**
* Detail out the steps involved in the main activity to arrive at **Activities (events)**.

Thus, an **Activity (Event)** is associated with actual business dealing, which needs recording new information or manipulating existing information or both.

Problems visualised in the existing information system analysis and design techniques are described below:

“Determining information requirements for an information system can, at best, be described as a difficult process. Historically, systems analysts simply asked managers what information they needed. This assumes that managers are able to express their information needs in a way that will allow the analysts to design information system. Often, this assumption is not valid. Managers do not know what information they actually need. They make their best attempt to specify their information needs. Analysts, alternatively, may not know that actual information requirements are likely to differ from what managers say they want. This leads to an information “no man’s land” (Yadav, 1983)”. The result is that some of the requirements are certain to be unidentified (Valusek and Fryback, 1985). Information requirement determination is more difficult when one attempts to determine requirements across the organizations. (Clemons and Kleindorfer 1992, Levinson 1994). Wetherbe (1994) gives four fundamental mistakes made while determining the information requirements:

* Viewing system functional instead as cross functional
* Interviewing managers individually rather than jointly
* Not allowing trial and error in detailed design process
* Asking the wrong questions during the interview

The proposed methodology for analysis and design takes a very simple approach of constructing event diagrams (ED). Users and systems analyst work on the same platform of ED for giving and analysing the requirements. User is expected to draw the ED depicting their own activities and to record the information that they use and generate while carrying out those activities along with their objectives in carrying those activities. Systems analyst then analyses the ED and makes his own proposal of the final system after the careful analysis of the supplied information to see that whether the objectives of the activity are met. Thus, system analysis relies on the over all analysis of the activity rather than any problem definition. This approach facilitates the over all analysis of the system to bring out majority of shortcomings of the present system. ED does take into account interactions of various functions of the organization and therefore, views system as cross-functional rather than functional. If it is not possible to interview managers jointly, as it may be required while developing inter organizational information systems, ED made by one manager can be discussed in detail with others whose activities are linked. This would facilitate the modification of business processes to adopt the best of such processes. The development platform suggested allows for trial and error in detailed design process. Thus, the proposed designing methodology is targeted to reduce the communication gap between different users and the communication gap between user and system designer.

**5.2 Development phases**

Figure 5.1 gives development phases conceived in the designing methodology. It is termed as Event Related Open System, EROS (Chiplunkar, 1997-c) methodology because it is based on events, which are related to each other and word ‘open’ signifies that these systems are open ended. Any event can be introduced at later stage into the system without disturbing other events. Additional hierarchy of events can be introduced any time in the system again without affecting working events defined earlier. Of course, events related to new events might need some change in their behaviour but such change can be accommodated with least efforts.

DELIVERABLES

Operation Manual

Run Time Version

Source Code (Optional)

**Project proposal**

**(1,M) START**

**Event Analysis**

**(2,M)**

**Data Analysis**

**(3,M)**

**Operation**

**Analysis (4,M)**

**development**

**(5,O)**

**implementation**

**(7,M) END**

Initial

Estimate

(Deliverable)

Review

**testing**

**(6,M)**

Initial

Model

(Deliverable)

Unit

System

Acceptance

Review

Final

Estimate

(Deliverable)

Final

Model

(Deliverable)

System

Training

Final

Proposal

(Deliverable)

Review

Initial

Proposal

(Deliverable)

Initial

Model

(Deliverable)

Review

Final

Model

(Deliverable)

Initial

Model

(Deliverable)

Review

Final

Model

(Deliverable)

Fig 5.1 EROS system development life cycle

**5.3 Event analysis**

**5.3.1 What is an event?**

* Event is an activity in the system.
* It is associated with well-defined information elements.
* It is related to one or many of other events in the system.
* It has definite sequence of operation.
* It lasts over a finite duration.
* It can be avoidable or mandatory**.**

**5.3.2 Essentials of an event**

* **Event Hierarchy** 1: Application. 2: Module. 3: Major Event. 4: Event
* **Event Number** This number may or may not denote the sequence as it occurs in the system. It would be utilised in identifying this event uniquely in the system.
* **Event Name** This is a short name given to event which would appear on ED.
* **Is Event Optional?**  Whether system can work without occurrence of this event.
* **Base Event**  This gives the earliest event, which should be complete to take up the current event during operations.
* **Event Contents** What information does the event carry?
* **Event Storage** How often does the event repeat? What is the duration for which the event is active? What is the duration for which details of inactive event should be made readily available?
* **Performance Requirements** Desired event response time.
* **Event life** Time period up to which information related to the event should be made readily available.
* **Event Relation** On which events this event is dependent ? How?
* **Data Analysis** Database building.
* **Operation Analysis** Operations that are associated with the event.
* **Resource Analysis** Resource Requirements including time, cost, inputs and outputs.
* **Event Location** At which location event takes place?

**5.3.3 Construction an event Diagram (ED).**

ED is used to represent the events in the system. Each event can be analyzed for requirement of data, operations and resources. Interactions between various forces, events, modules, applications can be shown through the interaction diagrams (ID). EDs are useful for intelligent information system design. This methodology can also be used to develop a system for system design. All organizations have definite goals such as making profits, offering free services or maybe both or any other objective that one might think of**.** To achieve these goals, the organization is engaged in many **activities**. Because all the activities are directed towards the final goal, they necessarily form a chain. Functional grouping in any organization essentially involves grouping of similar activities together.

* **Basic activities-Applications**: Describe the business in the shortest possible steps.
* **Activity Groups-Modules**: Describe the steps involved in basic activities.
* **Main Activities-Sub-Modules**: Describe steps involved in the activity group.
* **Activities-Events**: Detail out the steps involved in the main activity

A typical business establishment is engaged in basic activities of

* Arrange finance and capital goods. (Finance)
* Arrange human resources. (Manpower)
* Arrange materials. (Materials)
* Produce products. (Production)
* Sell products. (Sales)
* Offer technical support services. (Quality Assurance)
* Offer administrative services. (System)

Activity groups: The basic activity “Produce Goods” can be divided into

* Define products or define bill of materials (BOM)
* Define operations required to convert raw materials into product (Operations)
* Work out material requirements (MRP)
* Work out capacity requirements (CRP)
* Keep record of produced goods (Production Accounting)

Main activities: Activity group “Keep Record of Produced Goods” can be divided into

* Recording of goods received from sub-contractor (Sub-Contracting)
* Recording of goods produced from company’s production facility (Production)
* Ensuring optimum production performance (Efficiency Analysis)
* Generating various performance related reports for record (Reports)

Activities: Main activity “Recording of goods produced from company’s production facility” can be divided into

* Release shop order for production (Shop orders)
* Receive feedback about production status. (Production note)
* Inspect the products (Inspection)
* Classify the products (Product classification)
* Analyse quality problems (Problem analysis)
* Produce Production Analysis report (production analysis)
* Make rework orders for shortfall (Rework orders)

Figure 5.2 illustrates the construction of ED for production accounting function as described above. First level ED is called as system diagram and it is given in the Figure 5.3

EDs also provide certain notations so that the diagrams are more expressive of the business. Table 5.1 shows event notations that can be used in the ED.

Parallel events can be found out from the base event of an event. All events having the same base event are parallel events.

Inputs, which can be by passed, are represented in an oval shape. Conditions on which they are bypassed are clear from the ED.

Output of the events can be represented in the event box and they will be input to next event if nothing is mentioned.

The representation of the system differs from the conventional Structured System Design (SSD). The context diagram of SSD represents interaction with external entities.

**5.4 Data analysis**

This is a very standard approach adopted by many designers to designing of database. It is described in brief in this section with some modifications.

**5.4.1 Representation of physical organization of the client’s business**

Figure 5.4 shows the procedure for arriving at place identifications. Place identification is a unique number that represents a particular smallest unit of the business. The unit can be department, section or sub section. In most of the cases sub department or section in the following hierarchy gives the smallest unit. Company can be split up into divisions, divisions into sites or locations, locations into departments and departments into sub departments or sections. Place identifications are very convenient for using in database and one number can give the exact origin of the document or goods. Data transfer requirements can also be worked out in terms of place identifications.

**efficiency**

**N(1)M(2)**

**(3,m)**

**Production**

**(2,o)**

**E(1,2)**

70 Shop Order

(1,m)

80 Production Note (2,m)

**Sub Contracting**

**(1,o)**

QTS

110 Production Analysis (6,m)

120

Rework

Orders

(7,o)

Application

(Hierarchy-1 event)

Module

(Hierarchy-2 event)

Transaction (Hierarchy-4 event)

Event which produce output

**Legend**

**Reports**

**(4,0)**

90

Inspection

(3,m)

105 Problem

Analysis (5,m)

QSP

100 Product

Classification (4,m)

QSP

**30 Materials**

**(3,m)**

**10**

**BOM**

**(1,m)**

**20**

**Operations**

**(2,m)**

Sub Module

(Hierarchy-3 event)

Transaction (Hierarchy-4 event)

Event that expects input

**M**: Compulsory event **O**: Optional event **1,2,3** : Sequence of events within another event **10,20,30** : Sequence of events within the same hierarchy **TS**: Trouble Shooting

**30**

**MRP**

**(3,m)**

**40**

**CRP**

**(4,m)**

**50**

**Production**

**Accounting**

**(5,m)**

**10 Finance**

**(1,m)**

**20 Manpower**

**(2,m)**

**40 Production**

**(4,m)**

**50**

**Sales**

**(5,m)**

**70**

**Administrative**

**Support (7,m)**

**60**

**Technical Support**

**(6,m)**

**Business Information System**

Figure 5.2 Construction of an event diagram

4 Advertising

**1**

**Finance**

**2**

**Production**

**3**

**Materials**

**4**

**Sales**

**5**

**Manpower**

**6**

**Quality**

**Assurance**

**Integrated Information Management Model For Textiles**

1 Resources

2 Accounting

1 Bill of

Material

2 Operations

3 Material plan

4 Capacity plan

5 Production

Accounting

1 Supplier

Management

2 Purchase

3 Inventory

2 Product Development

3 Marketing

6 After sales

1 Recruitment

2 Allocations

3 Training

4 Personnel

1 SQC/SPC

2 Trouble

Shooting

3 Maintenance

**7**

**System**

5 Sales

Monitoring

1 Customer Management

3 Payable

1 Project proposal & management

4 Receivable

5 Costing

4 Business

Events

Record

2 Event Analysis

3 Data Analysis

4 Operation Analysis

5 User Control

6 Administration

First Level Module or Applications

(Hierarchy-1 Events)

Modules

(Hierarchy-2 events)

Integrated System

External Agents

Legend

**1,2,3:** Event numbers within another event

Operators

Managers

Suppliers

Customers

Service providers

Partners

Transporters

Dealers

Retailers

Agencies

Banks

Financial Institutions

Government officers

Equity holders

Figure 5.3 System diagram Table 5.1 Event Notations

|  |
| --- |
| **X** Event number X of the current hierarchy |
| **X.Y** Event number Y which is child of event X |
| **X.Y.Z** Event number Z, which is child of Y and Y is child of X. It is possible to extend this notation up to any level down the line. |
| **X:Y** Event number Y which is parent of X |
| **X:Y:Z** Event number Z which is parent of Y and Y is parent of X and so on. It is possible to extend this notation up to any level up the line. |
| **X:Y’** Event number Y which lies in one hierarchy up of the X |
| **X:Y:Z’** Event number Z which one up of Y and Y is one up of X and so on . It is possible to extend this notation up to any level up the line. |
| **In all above cases X is current event.** |
| **A** Absolute hierarchy of event can always be mentioned if required by giving subscript For example 1.2A means it is an event having identification 2 in second hierarchy and is child of event 1 of the first hierarchy. While 1.2 means child event 2 of the event 1 of current hierarchy. |
| **E(I1,I2,I3,.)** Shows happening of any single event from the list of events. E(1,2,3) means that for any cycle of operations, out of events 1,2 and 3, only one event takes Place. That is events 1,2 and 3 are mutually exclusive. |
| **M(I)** To show dependence of existence. If M(1) is written in the event box having event number 5, it means that event 5 in Mandatory only when event 1 has taken place. Otherwise it does not take place. If there are two prior events, which need execution of this event at later stage then M(1), M(3) could be written to denote that the current event-5 is Mandatory if event 1 occurs or event 2 occurs or both of them occur. |
| **M(I1,I2,I3,...)** M(1,3) would mean same as M(1), M(2) |
| **S(I)** S is used as a stop signal on the current event. S(1) means next event in the System is not possible until event 1 has taken place. The notation M(1) means current event-5 is mandatory if event 1 has taken place while notation S(1) denotes that in order that event next to 5 to happen, event 1 must have happened. S(1),S(2) tells that system does not proceed to the next event unless event 1 and event 2 have taken place. |
| **S(I1,I2,I3,...)** S(1,2) would mean same as S(1), S(2). |
| **N(I)** To show non-existence of an event. If N(1) is written is the event box having event Number 5, it means that event 5 is bypassed (or not required) if event 1 has happened. If there are two prior events, which do not need execution of this event at later stage then N(1), N(3) could be written to denote that the current event is not required if event 1 occurs or event 2 occurs or both of them occur. |
| **N(I1,I2,I3,...)** N(1,2) is same as N(1), N(2) |
| **M(NI)** To denote that Current event is mandatory if event I does not occur. N(NI) would mean that current event is not required if I does not occur. (Combination of M and N) |
| **G(I1-I2)** G is used to give transfer signal after completion of current event. G(1-10) means After current event 5, instead of going to next event go to event 10 if 1 has taken place. G(1-10), G(2-10) would mean go to event 10 if 1 has taken place or 2 has taken place or both of them have taken place. G(1-10,2-10) would mean the same as G(1-10), G(2-10). |
| **G(I1,I2-I3)** G(1,2-10) means go event 10 after current event only if event 1 and 2 both have taken place.. |
| **F(I1-I2)** F is used to denote flow or transfer signal depending on incoming event. It says that is control to this event is transferred from event I1 then proceed to event I2. F(1-10) means after current event 5, instead of going to next event go to event 10 if current event is taken up after event 1. F(1-10), F(2-10) would mean go to event 10 if current event has taken place after event 1 or event 2. F(1-10,2-10) would mean the same as F(1-10), F(2-10). |



Place id 1 2 3

Figure 5.4 Client organization

**5.4.2 Detailed event analysis**

* Check if any document is associated with the **event**.
* Finalize the **information groups** that the event would contain.
* Give suitable headings to **information groups and elements of this information group.**
* Assign the **structure name** to this information group which would store the group elements in the computer.
* Decide the **hierarchy of the information groups** which means to see that if any information group (**child information group**) gives details necessary for some other information group in the event (**parent information group**).
* **Header structure** is the structure name of the parent information group.
* Ensure that all the elements of the information group would carry **values that can be different** when repeated more than once for the given contents of the all higher level information groups in the hierarchy if such parent groups are present or otherwise

**5.4.3 Event storage**

* Decide how many times during a day or a month or a year a new **record** would be created in the information group. This gives the **Frequency** of the event.
* Finalize the duration for which the event information is necessary to be kept on computer’s hard-disk. This gives the **retention period** for the event. After this duration the specific event information records would be removed from the hard-disk and put on tape or floppies. Space requirements or **volume** of event can be determined from retention period and event frequency.

**5.4.4 Event relation**

* Decide which event (**Base Event**) needs the reference of other event (**Related Event**) of the same module or of the different module and whether this reference is essential.
* Finalize the relationship .  **Relationship**

**Base Related**

**Event Event**

### One base event information record one one

is referred by one related event record.

One base event information record one many

is referred by many related event records.

Many base event information records many one

are referred by one related event record.

### Many base event information records many many

are referred by many related event records.

**5.4.5 Database formation**

* Review **Structure Names (Transaction Structures)** defined in Event Analysis.
* From the possible contents of an information element decide the **Field** for this element. **Field Definition** would include length, type and description of the field. It is advisable to keep field definition **Unique** throughout the system. Field is mandatory if this element always has information to store for every record. Description can be used for automated help messages.
* If the field is very long and there is a possibility of its repeating many times, one might go for a separate structure (**Reference Or Master Or Support Information Structure**) containing its identification, description and other relevant details. This separate structure would be useful to store the information related to this field. Store the identification of this information element in the current structure. All such identifications are called **Foreign Keys**.
* Decide on **Field Or Group Of Fields** which would distinguish one record of the structure from rest of the records. This is **Primary Key** for the structure. It is always unique.
* Decide if **Index** would be created for the primary key. Assign some name to it.
* From **Event Relationships** information decide which structures would be referenced by the structure under consideration. Add necessary **Foreign** **Keys** to it. If the reference is essential the Foreign key representing referred structure is **Mandatory** in the structure under consideration.
* There is a possibility that some field or group of fields other than primary key has unique contents for each record. These are **Unique Keys** for this structure. Usually indexes are needed for unique keys.
* One might want to do summarization of the structure information for a field or a group of fields other than unique keys and primary key. For such requirement, one would decide **Non-Unique Keys**. They are so named because many records can have same contents for these keys.
* **Search Key** is the key, which is used to search the required records from the structure. It can be unique or non-unique.
* When one needs field for a structure, which is already defined while finalizing some other structure, and if it serves some different purpose, the information specific to the structure should be recorded after creating the program. **Field or Data Dictionary** will give the general purpose for which this field is used in the system.
* It is advisable not to have **Same Structure For Child And Parent Information Groups**.
* After Finalizing of all the structures and fields in the system, it would be a good exercise to check whether all information groups with their elements are given a **Representation** in the system.
* One should record the different branches, which need different series for the given structure. If series are further dependent on contents of some field of the structure, it should be recorded. This way of telling the system regarding the number of **Sequences** thatare required for the given structure.
* At this point, it is necessary to decide which locations of the establishment would be dealing with which modules and structures. This will specify **Operating Data Requirements** for one branch of establishment. While deciding operating data requirements one should specify
* Whether new record can be created in the structure at this branch.
* Which fields can contain the information while creating new record?
* If record is already created, whether the contents of the existing fields can be updated.
* Can this record be removed from the structure at this branch?
* **Data Reconciliation Requirements** will specify the other branches, which will have access to the fields, which are accessed by the branch under consideration.
* **Data Base Procedures** will outline all the operations - which are independent of programs - to be performed while adding, changing, viewing or removing the record from the structure. It can include changes in its own contents and Changes in contents of other structures

**5.5 Construction of an interaction diagram (ID)**

From the event data analysis and collection, events interacting with other events, would be found out. ID explains the relationship between events of different applications or modules. Arrow indicates direction of information flow. Arrows can be numbered so that the sequence of flow is known. An arrow can be referred to by “ID name.arrow number” or by “ID numner. Arrow number”. Boxes within the application tell about the events whose data elements are transferred. All flows are related to application mentioned at the center. The number of the first level IDs is equal to number of the application areas in the system. They differ from standard data flow diagrams. Arrows indicate that the information of a specific event is required at some other application in the system. It is possible to club one or more events together in a group unlike data flow diagrams in which two processes can not be described in the same process box. ID also tells the application in which the events are originated. That is ID defines the primary responsibility of supplying raw data for the event. Details of contents of event are available in the system. Only those events are listed which form a part of the flow. It is a convenient way of representing system as events can be listed either at arrowhead or at arrow tail. This makes representation clearer and less cluttered. IDs are simple to construct, easy to understand and more informative. Detailed flows are worked out at later stage of design. A screen will be provided for designer to list data elements, tables, keys, values passed, values received etc. See figure 5.5 for ID constructed for a module for production function.

Organization details

Other Details

Operational Information

Securities

User&system Manual

Items

Stocks

Subcontract information

Issues

**Manpower**

**Quality Control**

**Production**

Inspection Note

Rework Orders

Test results

Efficiency reports

Material Plan

Product Structures

Machines database

Problems

Product Orders

Targets

Labour

Organization

Allocation letter

Appointment letter

Training schedule

Training report

Capacity Plan

Production Note

**Materials**

Maintenance Plan

Quality Policy

Tests

Trouble shooting advice

**Sales**

Problems

**System**

Manpower Requirement

**Interaction Diagram**

**PRODUCTION**

**Finance**

Budget

Costing

**Users**

Figure 5.5 Interaction diagram for the production module

**5.6 Operations analysis**

Operation analysis includes determinations of system users, delegation of responsibilities for data entry, report generationand system administration. It also consists of regulating access through security provisions. Error handling procedures with on line help should be provided to operations so that they are not stuck up while doing operations on the system. The proposed system takes care of access securities automatically once they are defined in designing stage. Operation analysis lays out procedures for back up, restore, user registration, audit trail and disaster recovery plan.

**5.6.1 Programs**

1. Outline context information, program flows and field flow.
2. Context information: Persons, departments, companies, other systems that interact with the system to give input to the system, accept output from the system or both.
3. Program flows: Structure names and fields which the program reads from hard disk, offline storage, keyboard, through network or writes to screen, printer, storage devices etc.
4. Field flows: Part of the screen flow associated with the field.
5. Arrive at pre-requisit programs from event records via data structures.
6. Look for the operations, which could be same for many programs and put them as a separate program known as Common Procedure.
7. Adopt the following method to write program logic
8. Decide sequence of fields, their base structures and help messages.
9. Structures and fields which will be altered through the program.
10. Structures referred and fields retrieved from referred structures.
11. Field value checks for range, contents, default values.
12. Before field operations: Conditional computations.
13. After field operations: Conditional computations.
14. Loop: At which field does it begin? At which field does it end? In which condition program should enter into the loop or skip the loop? Or should the loop be executed only on user’s request or only once in the program? In which condition program should come out of loop?
15. Control transfers: Which field control should be transfered from? Which field control should be transfered to? On which condition? Should control be sent back to sending field after executing operations at receiving field?
16. Programs to be executed before and after this program.

**5.6.2 Error handling**

* List out all possible errors.
* List out all possible actions.
* Link errors and actions to specific structures and specific field in the structure.
* Link all errors and actions to specific program and specific field in the program.
* Device a general help program for the system.

**5.6.3 Security provisions**

1. Decide exact locations where data can be accessed.
2. Decide all individual users of the system.
3. Decide structures and fields accessible to every user with access conditions .
4. Decide branch of organization structure whose records would be accessible to specific user with the range of records for specific duration.

**5.6.4 Administration**

* Decide backup procedure.
* Decide restore procedure.
* Decide system audit trail procedure.

##### Decide user priorities

**5.7 Advantages of proposed tools**

* Whole module can be viewed at a glance.
* Divisions within the modules are known.
* Sequence of operation within the module and sub module is known.
* Events, which are to be recorded prior to entries in the module, are known with their respective modules.
* Logical flow of information within the module is known.
* Logical flaws in the system can be detected at higher level of abstraction.
* Events can de defined as mandatory and optional, which helps in deciding nature of references to these events through other events.

**5.8 Framework for the analysis of business processes and information systems**

5.8.1 Introduction

**This section is focused on analyzing the complete business environment with the help of information technology. It takes into account various interactions between different business processes while conducting exercise of business analysis. It also provides a framework based on ED to record logical flow and other relevant details, which can be used for design of information system coupled with business analysis. Each event can be analyzed for requirement of data, operations and resources. Interactions between various forces, events, modules, applications can be shown through ID. In addition, driving forces for business restructuring and their contents are also listed. Suggested EDs are useful for intelligent information system design. This methodology can also be used to develop a system for system design. Refer to section 2.3 for detailed discussion on business analysis.**

It has been recognized that for the successful implementation of Integrated Information Management Solution, corresponding changes in the business practices should take precedence**.** Schneider (1999) state that consultants believe that evolutionary change in business from ERP will not occur until organizations begin to reorganize their businesses around processes, which means pitching the old organization chart and starting anew. Business analysis is different from systems analysis and therefore existing IS tools can not be effectively used for business analysis. Business restructuring has been revisiting industrial environment in different forms like Business Process Reengineering (BPR), Total Quality Management (TQM), Supply Chain Management (SCM), Enterprise Resource Planning (ERP) and so on. All these theories need support from comprehensive information system to tackle the related issues. Process redesign is the essence of quality improvement programs or supply chain management exercise. Similarly other techniques, like ERP, are also based on process changes for better management of business. As one will notice TQM, SCM, ERP too try to analyze all business process to retain the existing customer base and to improve the market share by offering better quality product at reduced costs. These techniques focus on improving product quality by maintaining quality raw material inputs, controlling the processes through statistical methods and arriving at optimum process sequence. SCM takes care of quality through process variability, and of market through demand variability while TQM takes care of supplier through different quality checks on supplier which include delivery time and supplier’s flexibility while customer care is taken through customer relationship management to meet customer expectation through continuous design change. ERP software needs to have added capability to support TQM or SCM or BPR. Product cycle includes many process related different business areas from marketing, administration and production to raw material procurement. Highly competitive atmosphere made it imperative to look into problems of suppliers as well. The advent of communication revolution made it possible to link different organizations to each other through electronic data transfer facility. In this context, business restructuring needs to take into account all the factors that can affect business performance. It is also necessary to have a common platform to judge the overall effect of different forces on the ultimate business performance. Such platform should take care of conflicting requirements of different forces, if any, to arrive at standard business practices. The scope of this section is limited to propose a methodology based on Event Related Open Systems (EROS) principles for business analysis with the objective to propose a common platform for information systems analysis and design, and business analysis.

**5.8.2 Motivation**

Literature review, reported in chapter 2, points out the deficiencies of the existing methodologies. The solution proposed by Valiris and Glykas (1999), to overcome these deficiencies is again a complex one, which is based on object oriented methodology. Object orientation requires object perspective in addition to three perspectives namely, data perspective, process perspective and network perspective. In addition, roles, responsibilities and cultural and human management issues need separate treatment. Exact procedure of building model is not described at length nor sufficient light is thrown on modelling tools used for this purpose. It is also not very clear how the proposed model (ARMA) is going to overcome deficiencies of existing methodologies. The conceptual modelling tools described so far in the literature need assistance from each other to arrive at complete business model, which is different from information system model. Not a single tool is capable of analysing all aspects of business. The EROS methodology proposed through this thesis allows for analysis of the business and at the same time has capability of providing necessary abstraction, which is essential for information systems. Although data model is required to analyse entity relationship and event relationship, it is not done in isolation as it is done with other structural views. A need was also felt to divide organisation-balancing forces further with each having singular characteristics. The attempt is to provide a methodology, which is simple and at the same time comprehensive enough to take into account all the four views - data, structural, behavioural and management theoretic. Software can be made available to assist the whole exercise.

5.8.3 General description

**The proposed model considers nine business analysis drivers – Market, Product, Finance, Technology, Process, Work Force, Culture, Environment and Project. All these business forces interact with each other directly or indirectly and they are all connected through an information system. Each factor has its own sphere of operation, which is included within the large business sphere. Business sphere decides the boundaries of business operation. Information travels to and from one sphere to another in the form of data elements and changes the values of basic data elements that decide behavior of individual sphere and therefore behavior of business sphere.**

**Figure 5.6 shows conceptual model for various driving forces involved in business analysis. Figure 5.7 depict the broad sequence of analysis that can be followed while conducting business analysis exercise.**

Ecology

Process

Technology

Work Force

Project

Finance

Product

Market

Organisation

Culture

Individual Limits which cannot be crossed

Limits for Integrated Business Environment

**IT**

**Figure 5.6 Business process analysis**

Business Processes Analysis

Environment

(8,M)

Technology

(5,M)

Products

(2,M)

Projects

(9,M)

Process

(4,M)

Finance

(3,M)

Culture

(7,M)

Work Force

(6,M)

Markets

(1,M)

**Figure 5.7 Sequence of analysis**

5.8.4 Driving forces for business analysis

On the background given in the literature review, nine driving forces for business process reengineering, which are visualized, are discussed below.

**i. Markets**

Today’s world is world of competition. Company can survive only if it can satisfy its customers by meeting their expectations on cost, quality and delivery of the product. Any business that does not incorporate this vital force in business strategy will die out some day or other. Business must be market oriented. Company should produce what market demands rather than try to sell what it produces. Company should also consider marketing and advertising strategies, which are necessary to promote the product. A continuous feedback from markets is essential to know market trends and to include them in product design.

**ii. Product**

Calculation of product resource requirements along with ensuring product attributes within specified control limits is yet another force that decides product sales. In order to produce products according to conformance to the standards, efficient resource planning system and quality management systems are extremely important. Unless these requirements are taken into account while designing business processes, company would find it difficult to push its product into the market.

**iii. Finance**

Business improvements can be achieved only if initial investment needs and ongoing expenses of business analysis and improvement are met. Financial constraints must be well known to conduct any business improvement exercise.

**iv. Process**

While taking into account process design appropriate to technology to achieve efficient administration, careful analysis of different processes involved in business cycle that starts from order receipt and ends in delivery of product to customer needs is necessary. Cost, time, resource utilization and associated variability to arrive at stock levels are important factors while analyzing processes. Economics of all alternative process sequences can be worked out to select best of the processes.

**v. Technology**

Changes in manufacturing technology affect production economics and product cycle time. Fashion garment sector specially requires very short lead times. Naturally, technology selection has an impact on over all business performance. Future technological trends, if not taken into account, would make it difficult to compete in future markets when faced with competition from superior technology in terms of quality and productivity. Technological changes, affecting communications and e-commerce, are forcing reorganization of business processes.

**vi. Workforce**

Persons, who tackle production and administration issues, govern the outcome of business. Capable person can fully utilize the market and production potential to make the business profitable. Different training programs can be designed to bring skills to the required level. Business improvement exercise needs to provide adequate emphasis on filling the gap between present and required skill level and job practices.

**vii. Organization Culture**

Work culture is an important parameter that influence employee moral and therefore quality and quantity of the product. After careful study of factors affecting employee behaviour at work, work environment needs to be selected. Jayawardhane (1995) pointed out that if workers are totally security and money oriented, hierarchical organizational structure suits well otherwise culture of production team, in which employee is empowered to take decisions regarding production related matters, is more suitable. Clear-cut responsibilities and rewarding schemes for efficient performance are important for healthy organizational culture.

**viii. Ecology**

In many countries, strict regulations governing environment protection impose restrictions on usage of technology and raw materials. Additional processes to recycle waste or make it pollutant free may be required to meet government regulations.

**ix. Projects**

The business improvement project itself should be managed well to make it successful. Only careful planning and execution of business analysis project or any other project like SCM, TQM can bring in rewards. Project management team should keep close watch on implementation and seek feedback to judge the effectiveness of different stages. It is necessary to provide for framework to plan and manage the project.

**5.8.5 Role of the information technology**

Information technology (IT) can act as an enabler in business improvement. It provides platform to

* Manage business improvement project
* Provide link between various business drivers discussed earlier
* Optimize processes such as transportation, product mix decisions, etc.
* Provide platform to record various parameters of all forces.
* Allow cost benefit analysis of various process sequences.
* Study complete supply chain economics and delivery time requirements.
* Arrive at best possible business process within the constraints of the forces that affect business performance.
* Judge impact of reengineered processes to make business improvement as an on going activity.

IT, as discussed earlier, has been playing important role in business process restructuring. IT is useful in business modeling and to judge interactions of various business drivers to arrive at best business practices. Analysis and design of information systems can be coupled with realigning of business processes, which is discussed in depth in the next section.

**5.8.6 Business analysis: Project phases**

Figure 5.8 shows different stages involved in a business improvement project.

Business Improvement Through IT

Business Review

(1,M)

Project Formulation

(2,M)

Event Analysis

(3,M)

Operation Analysis

(6,M)

Data Analysis

(5,M)

Resource Analysis

(4,M)

IS Implementation

(9,M)

Implement BPR

(8,M)

Development of IS

(7,M)

Figure 5.8 Project Phases

**5.8.6.1 Business Review**

**Step 1** **Decide project in-charge**.

Decide on the main person who would carry out the job of business analysis. He is the person who will be with the project from the beginning to the end and designated as project in-charge. He could be from a consultancy organization or may be from the company. He should have sufficient knowledge of system designing, integrated management solutions. He should be aware of industrial practices and should be able to guide the project team on various issues related process analysis and implementation of suggested changes.

**Step 2 Prepare Questionnaire and Event Diagrams**

Project in-charge would work out an exhaustive questionnaire to elicit the current state of processing sequence of information and physical goods from various departments. He would also prepare EDs based on his knowledge of business for an information system and business system to minimize the communications gaps and to assist management on various issues.

### Step 3 Formulate strategy for business improvement exercise

Work out a strategy for business improvement exercise. Most advisable way is to take business review at different sites before deciding on changes in business processes and information system solution. Later on company can aim at radical implementation after software is ready, tested and implemented at one site. It would also be convenient to conduct business review at one place and present its finding at other sites so that the process of business review can be completed in shorter duration.

**Step 4** **The beginning**

Project in-charge should conduct a presentation to a group of about 10 to 20 top persons, which may include President, Personnel Manager, Production Manager, Production Executives, QA manager, QA Executives, Purchase Manager, R&D in-charge and Planning personnel. This presentation would emphasize the need for business analysis exercise and the advantages that company would derive from such exercise. The presentation should focus on the aspects of need for integrated management solution and necessary business process changes for successful implementation of such system.

**Step 5 User team selection**

A team of persons would be selected who will take active participation in the review of current business. These persons, who are from the end users, are actually involved in implementing business processes and information systems in their respective departments.

**Step 6** **Interview the user team members**

Project in-charge would contact each one from the user team separately and explain the questionnaire to him in detail. Questionnaire could be left with team members for discussion with other departmental persons and again after two to three visits, final response should be collected. Project in-charge should show end users the EDs that he prepared. Steps included in the ED should be discussed in detail. Users should be asked to give their opinion regarding the EDs, regarding its suitability from adoption point of view and regarding coverage of different function of respective departments. Users should also be asked to suggest modifications in the EDs, if necessary, to make them better representative of the respective functions.

**Step 7** **Analyse the response**

Project in-charge should analyse the response obtained and arrive at scope for improvement in sales, improvement in customer relation, improvement in supplier base, improvement in cycle time, improvement in machine uptime, improvement in cost savings and improvement in employee satisfaction.

**5.8.6.2 Project Formulation**

**Step 1** **Define physical organisation of the company**

Make a representation of organisation in a manner which would be useful to link occurrence of event to specific location and to depict flow of information and goods from one place to another in a compact manner which can be used for IS design. Refer to figure 5.4

**Step 2 Finalise event diagrams**

Finalise on EDs after incorporating changes suggested in phase one. Please refer to section 6.2 for ED for various business functions.

**Step** **3** **Decide team for the project**

Decide on team structure for management of the project. It would depend on the size of the project. All teams members will report to project in-charge.

**Step 4** **Make a project plan**

Prepare a detailed project plan with project phases and their schedule and locations.

**Step 5** **Work out project requirements**

Arrive at the detailed requirement of resources, manpower and cost requirements at various stages to manage the project. Decide hardware and software platforms.

**Step 6** **Decide on project review procedure**

Decide procedure for collecting feedback and review meetings.

**Step** **7** **Prepare final estimate of the project**

Make cost estimate of the whole project and present the plan, which is divided into weeks to the Management.

**5.8.6.3 Event Analysis**

Refer to Section 5.3 for complete description of Event Analysis and steps involved in it.

**Step 1** **Construction of event diagram**

Prepare EDs as discussed earlier. Figure 5.9 shows an ED for purchase function which makes use of notations described in the table 5.1

**Step2** **Record event details**

Record necessary event details as described earlier.

**Step3** **Construct the interaction diagrams (ID)**

Construct the IDs as described earlier. Refer to figure 5.10 for ID for the market function.

**Step 4 Analyse events**

Events are now analysed for their physical connections, actual flow of documentation, non-value adding processes, bottle neck events and different sequences can be found out to select the appropriate sequence of events in an operation.

**5.8.6.4 Resource analysis**

**Step 1** Analyse inputs to the event

* Items
* Quantity
* Conditioning period
* Ordering period
* Frequency
* Quality criteria
* Inspection procedures
* Procurement policy
* Supplier management
* Alternative arrangements for emergency
* Industry standards for consumption
* Optimisation of input Mix

**Step 2** Analyse outputs from the event

* Product
* Quantity
* Product characteristics
* Quality checks

**Order**

**(3,M)**

**Pre Purchase**

**(1,M) Start**

70 Payment Terms

(6,M)

**Pre Order(2,o)**

130 Entry(1,M)

140 Amendment

(2,o)

160 Printing

(4,o) N(3)

10 Items (1,M)

**Reports (5,o)**

**End**

**Post Order**

**(4,M)**

MIV

20 Po Types

(2,M)

50 Cancel (3,o)

F(4 . 4A-3:2’)

Or F(200-3.2’)

30 Purchasers

(3,M)

180 Follow up

(2,o) M(N1)

N(1)

170 Delivery

(1,o)

200 Solutions (4,o)

M(3) G(N1-1)

G(N4-3. 3A)

190 Complaints

(3,o)

40 Suppliers

(3,M)

50 Supplier Item

Relations (4,M)

MSM

60 Supplier

Rating (5,M)

80 Rate Contract

(1,o)

75 Purchase

Conditions

(7,M)

MSM

MSM

MSM

FFA

MIV

QTS

125 Order Pay

Term (6,M)

100 Inquiries

(3,o) E(1,3)

90 Requisition

(2,o)

110 Quotation

(4,o)M(3)

120 Comparison

(5,o) M(4)

Legend:

**MIV**: Inventory **MSM**: Supplier Management **FFA**: Financial Accounting **QTS**: Trouble Shooting

**M**: Compulsory event **O**: Optional event **1,2,3** : Sequence of events within another event **10,20,30** : Sequence of events within the same hierarchy Event that produces output Event that expects input

MIV

Figure 5.9 Event diagram for the purchase function

**Market**

Cultural Requirements

Skill Requirements

Market Plan

Culture development program

Quality Analysis

Design developments

Process Sequence

RM mix

Product service plan

BRP implementation team

BRP implementation schedule

BPR implementation feedback

New Process Analysis

Environment safety measures

RM content

Safe handling instructions

**Product**

**Ecology**

**Project**

**Finance**

Budgets

Finance Resource Availability

Problems

Available Technology

Product Range

Possible Quality and Quantity

Technology upgradation plan

**Technology**

Technology Trends

**Culture**

Customer feedback

**Process**

Process Control Strategy

Time requirements

Training

Rewards

Worker Dialog Procedure

**Work force**

Market Trends

Advertising Plan

Market Development Strategy

Fig 5.10 Interaction Diagram for Markets

* Sales policy
* Disposal policy
* Customer management
* Distribution management
* Industry standards for production
* Product mix optimisation

**Step 3** Analyse manpower Requirements

* Qualification
* Experience
* Working methods
* Responsibilities
* Performance criteria
* Reward schemes
* Cultural requirements

**Step 4** Analyse technological requirements

* Machines
* Maintenance policy
* Safety measures
* Spare parts requirement
* Operating instructions
* Critical factors affecting product quality

**Step 5** Analyse timerequirements

* Duration of the event
* Machine time
* Personnel time
* Productive time
* Unproductive time

**Step 6** Analyse associated costs

* Machine cost
* Labour cost
* Input cost
* Product selling price
* Value addition
* Profitability

**Step 7** **Select the most viable sequence of events**

**5.8.6.5 Data analysis**

Refer to section 5.4 for complete description of the data analysis

**Step 1 Build a database**

Build a database to manage the events through the computer. It includes Entity Relationship (ER) models and information groups and related information elements. Tables, fields and their attributes are defined. Heavily normalised structures are created and operations at field are notified. It includes entry condition, validation for ranges and references, pre-field and post-field triggers, database procedures to update or check other tables, sequences and so on. In ER diagram additional notation M and O is used to denote whether presence of any of related entities is mandatory or optional used for deciding not-null characteristic while creating database tables.

**Step 2** **Formalise data reconciliation needs**

Data reconciliation point to the required data transfers from and to different location. It includes data distribution and data consolidation requirements.

**Step 3** **Decide networking requirements.**

Work out site map for LAN set up, severs, clients and so on.

**Step 4** **Arrive at input and output formats**

After consultation with users, formats for inputs and outputs are decided.

**5.8.6.6 Operations analysis**

**Step 1** **Decide on programming.**

Arrive at coding requirements for different events or group of events. Access rights are also decided at this stage. Such securities can be related to execution of program or for a particular operation in the program like adding a record, deleting a record and so on. Field securities can also be decided if development software allows implementation of field securities.

**Step 2 Decide exact operating procedures**

Decide on sequence of operation for entry, report, query, and validation procedures.

**Step 3** **Decide exception handling procedures**

Decide procedures for error handling for both information system and business processes.

**Step 4 Decide responsibilities**

Decide who is responsible for data input, data validation and generating reports

**Step 5** **Decide report requirements**

Who is going to use reports generated from the system ands with what frequency

**Step 6 Decide back up and restore procedures**

Decide on time schedule and required operations for back up procedures. Also decide on restore procedures to load back up at later date.

**Step 7 Work out disaster recovery plan**

Disaster recovery plan should be worked out for unforeseen situations like fire.

**5.8.6.7 System development**

**Step 1** **Coding**

This activity is actual writing of programs as conceived in earlier design stages.

**Step 2** **Testing**

Testing tries to identify bugs in the program to make it more perfect.

**Step 3** **Debugging**

Debugging is the activity of correcting bugs in the program to make it more perfect.

**5.8.6.8 Implementing the improved business processes**

**Step 1** Outline new roles and responsibilities

**Step 2** Conduct training programmes if required

**Step 3** Initiate cultural change

**Step 4** Address the problems arising out of change of environment

**Step 5** Announce targets to be achieved in specific time frame

**Step 6** Give rewards for average and excellent performance

**Step 7** Collect feedback from the users and incorporate necessary changes

**5.8.6.9 Implementing the information system**

**Step 1** Ensure that required hardware is in place

**Step 2** Ensure that networking facilities are working smooth

**Step 3** Ensure that persons from development team are available to address concerns of users of new system

**Step 4** See that sample outputs from the new system are in accordance with old system with live test data

**Step 5** Convert all old data from old system to new system

**Step 6** Collect feedback from the users and incorporate necessary changes

**Step 7** Go live with the new system

Make the business improvement as on going activity by analysing the changed needs again after implementation of new business processes and IT.

**5.8.7 Broad data requirements for analysis**

Table 5.2 summarises the broad data requirements for BPR driving forces as discussed earlier. These data requirement need to be analysed according to the process mentioned earlier in the section 5.4 which described data analysis in detail.

A universal report writer would be available with the project implementation team to generate various reports from selection of required information from the database without much knowledge of computers. Reporting would include analysis of various sequences for their cost effectiveness, expected life of machine and product, expected and available cultural development, expected and available skill set, need for training, comparison of company's product with competitors'. Selection of event sequence can be done depending on economic, technical and operational viability.

**5.8.8 Implementation problems and solutions**

Major problems in the implementation are related to:

1. Organization culture

* Sharing information
* Improper training of end users and stakeholders
* Resistance in giving information to implementation team. ( haggling over new report formats, coding formats etc. )
* Not laying down of proper laws by senior managers
* Change of working style from supervisory to team work

1. Conversion of the system from old to new
2. Unfamiliarity of people with new procedure and tendency to do the job in the old way
3. Outflow of trained people
4. E-commerece, data warehouse and bar-coding requirements
5. Integration and testing with other systems
6. System response time

###### Solutions

1. Change business processes in line with new ERP processes. Change in daily activities and behavior of many employees e.g. ware house operator, marketing operator can foresee demand and make some decisions regarding to sales to customer depending on information available from finance and production.
2. Decide the best strategy for implementation. Implement at one unit and take it to other units when it runs well. Better to change only those business procedures, which are necessary for coordinating the information from the different units.
3. Ensure proper training of end users and stake holders in IT, Planning and other business processes.
4. Make Cross-functional teams from IT and manufacturing.
5. Device a retaining policy for skilled staff.
6. Take care of reporting analysis needs in the designing stage.
7. Resist customizing or including optional features and include only what can be promised on time.
8. Take disciplinarian approach to getting the job done in new way.

Table 5.2 Broad data requirements for the business analysis exercise

|  |  |
| --- | --- |
| Area | Data Requirements |
| Market | Product Range, Product Quality, Service Quality, CRM Quality, Product Features, Market Requirements, Market Trends, Product Development,  Technology Development, Product Service Requirements, Work Force Requirements, Required Organisation Culture, Partners and Alliances, Problem and Knowledge Management |
| Product | Quality, Cost, Finance Management, Market Trends and Feedback, Profits  Process Sequence, Resource Requirements, Supply Chain, Technology Requirements, Work Force Requirements, Required Organisation Culture  Safety Measures, Environmental Precautions, Reused material,  Optimisation of Transportation, Distribution, Product Mix, Problem and Knowledge Management |
| Finance | Resources, Product and Process Cost, Administrative Costs, Environmental Precautions Costs, Value Addition, Bottle Neck Problems, Training Costs  Cost of Quality, Facilities Requirements, Savings And Profits, Problem Management, Knowledge Management |
| Technology | Product Range, Possible Quality, Technology Cost, Finance Management,  Market Trends and Feedback In relation to technology change, Economics of Technology, Resource Requirements, Service Requirements, Spare Part Requirements, Work Force Requirements, Required Organisation Culture  Safety Measures, Environmental Precautions, Energy Conservation, Problem and Knowledge Management, Maintenance Requirements |
| Process | Time, Cost, Safe Practices, Skills Requirements, Work and Time Studies  Environmental Precautions, Value Addition, Bottle Neck Problems  Morale Requirements, Quality Consciousness, Facilities Requirements,  Problem and Knowledge Management |
| Work Force | Product Range, Quality Practices, Technology Handling Capability,  Skill Set, Team Set-up for Quality In All Areas, Training Needs  Training Costs, Salary Requirements, Working Conditions, Facilities Requirements, Reward Schemes, Safety Practices, Problem and Knowledge Management |
| Organization Culture Organization Culture (contd) | Working Conditions, Reporting Structure, Inter Group Relations  Workers-Manager Relations, Morale Requirements, Quality Consciousness  Empowerment, Employee Orientation (Money, Security, Management Participation, Job Enrichment, And Such Issues), Facilities Requirements,  Reward Schemes, Safety Practices, Problem and Knowledge Management |
| Ecology | Product Hazards, Process Hazards, Water Contamination, Air Contamination  Recycling Cost, Safety Measures, Energy Conservation Techniques,  Waste Treatment, Green Procedures |
| Projects | Quality Projects, Product development projects, New project analysis,  Service, Project Aim, Project Team, Project Plan, Mile Stones, Project Evaluation, Project Returns, Project Cost, Business Performance Indicators  Ongoing Improvement Loop, Awareness Requirements, Knowledge and Problem Management |

1. Reorganize the business functions so as to suit the fixing of the responsibility according to the new system.
2. Explore the possibility of using EIA (Enterprise Integration Application) tools.

**5.9 Summary**

Event Related Open Systems offers a designing methodology based on decomposition of system into smaller events. This chapter introduced ED and ID as analysis and design tools, which are suitable for business analysis as well as system analysis. ED also provides for notations to depict behavior of the system with the same diagram. ID represents the information flow between the events. There is also provision for external agents to interact with the system. Any event will have specific data needs and operation needs. All events can be analyzed for the resource, time and cost requirements as well.

A systematic procedure is suggested for business process analysis which combines analysis and design needs of information system. The proposed tool of the ED can be effectively used for dialog between analyzer and end user. ED gives the cycle of operation within a process. All four necessary views of organization are tightly integrated with each other. For example, in classical methods of business process reengineering, data view is separate and is represented by Entity Relationship (ER) diagrams. Structural view of organization is expressed by Data Flow Diagrams, Network diagrams are used for showing behavioral view. As discussed earlier, it is difficult to integrate all these views. In addition, organizational theoretic of roles and responsibilities is not taken into account. The proposed methodology offers following advantages:

* It has only one backbone to support all views namely data view, structural view and behavioral view. In addition, roles and responsibilities and cultural requirements of an event can also be defined. IDs are actually constructed from EDs and therefore there is no chance of discrepancy between IDs and EDs. Again, IDs are constructed after data analysis for required events, and therefore they represent exactly what event has to pass on.
* Structural view is available in the form of EDs. It offers hierarchical view of the organization. Event diagram also have some behavioral attributes, for example, one can know whether system is producing output for user or expecting data from user. It also tells whether event can be skipped or not and under which conditions it can be skipped or cannot be skipped. It can also represent conditions in which iterations are required. For example the figure 8.5 shows such case of iteration between delivery and follow up. It suggests that follow up should made till material is delivered to the factory.
* Base event recording for every event gives complete network of the same events to give behavioral view of the organization and thus it is fully integrated with structural view.
* As discussed earlier it clearly differentiates the responsibilities for different departments of an organization, helps is deciding procedures for communications.
* It can have excellent support from relevant information system, as the business analysis methodology is not different from system designing methodology.

The next chapter presents the event diagrams and the interaction diagrams for the proposed integrated information management model.

**Chapter 6**

**DEVELOPMENT OF AN INTEGRATED MODEL - II**

**6.1 Introduction**

This chapter deals with high level design specification for the integrated information management model in terms of event diagrams (Chiplunkar, 1997-b) and their explanations. The event diagrams along with system diagram (fig 5.3), interaction diagrams (section 6.8) and associated information elements (appendix 5) gives the overall idea of the information model and its contents.

**6.1.1 EROS (Event Related Open Systems) Methodology**

While adopting EROS (Chiplunkar, 1997-c) designing methodology, the following points where taken into account:

* The analysis of questionnaire supplied in appendix 1, brings out the scope for improvement in business. Managers, thus, get the clear vision of business drivers*.* That is the proposed methodology is supported with an exhaustive questionnaire to diagnose the business to arrive at the scope for improvement in sales, customer relations, supplier base, cycle time, machine uptime, cost savings and employee satisfaction.
* The design phase clearly specifies the architectural requirements and the procurement schedule. The emphasis is given on the fulfilment of requirement. The problem is not expected to arise at implementation stage as it is well thought over in advance with proper analysis of user usage requirements.
* Emphasis is laid on human aspects of user engagement, user ownership. Designing methodology is simple enough to solicit active user participation.
* The designing methodology provided can be used to analyse business processes along with information system. In the proposed methodology, implementation of new business processes precedes implementation of information system. Thus, lack of preparation is avoided. System provides for detailed analysis of user requirements including number of users, frequency of usage and other related issues, which will be evident from event records (section 5.3.2).
* The proposed model developed through the proposed methodology provides for the analysis and design of existing processes along with the analysis of market changes and technological changes to decide necessary course of action. It provides a base for process and product innovation. Such innovations then can be absorbed in the existing business depending on their viability.
* The proposed methodology supports both the views: holistic and individualistic. It can consider individual limits of the various business forces as well as combined limits of the business environment. Provision can be made for recording of roles and accountabilities of actors and to arrive at proper delegation of authorities without generating internal conflict among them.
* Event diagram, a tool used for business process analysis and design, is useful from all angles: Simplicity of construction and understanding, exhaustive coverage of procedures, quantum of information display, ease of modification and user participation
* Event diagrams, supported by interaction diagrams, obviate need for data flow diagrams and give compact representation of business processes in addition.
* Proposed methodology for business analysis provides for recording of all information in a manner which can be handled by information system. It implies that subjective information is broken down into small elements, which can be associated with individual events as an object or as an attribute of an object. The same set of tools is proposed for system analysis and business analysis.
* The proposed designing methodology takes a logical approach right from the beginning and consistency in all the perspectives is maintained as all other views are derived from event diagrams.
* The proposed development platform combines the evolutionary prototyping capabilities with system designing. This allows to test the system at all stages without any additional coding efforts*.*
* The whole process of analysis would be facilitated by a universal report writer combined with proposed CDBMS (refer to chapter 7) EASY program through which users can define and take out various analytical reports of their own.
* Any event can be added to the system and thus, the system provides for a way to accommodate such event by pointing out required changes depending on the analysis of new event regarding its position and relation with respect to other events. The definition of system is very generic – “System is a set of related events”. Any system, whether biological, mechanical, geographical, astronomical is characterized by a number of sequential events, either repeating or non repeating or maybe combination of both, in its life cycle. Therefore, proposed model can be used for analysis for any kind of system thus providing for universality of application. There is no limit on number levels of abstractions until finer elements of data and operations can be worked out for the smallest unit of the model, which is the event of the highest hierarchy. Internal consistency is assured as event relations can be worked out exhaustively and model allows for depiction of all relations and interactions of a single event with all other events. System can always be divided into smaller components for ease of development and smaller modules can be integrated into a larger system. The proposed methodology stands good on these aspects of a good theory.

**6.1.2 Philosophies taken into account while designing the model**

* Not only quality of information but quality of product should also be included in the strategic drivers for modern information management solution. In addition, employee satisfaction needs to be given due consideration while designing information management solution.
* The proposed model can provide for plenty of MIS reports to control the business through exception reporting.
* The proposed model offers adequate support for storage and access of the gathered information during and after the redesign process, especially for non-participants in the redesign exercise, as information system design can be coupled with business analysis and redesigning of business processes.
* The proposed model makes use of easy-to-understand graphical notations and is supplemented with information related to different perspectives. For example, it allows to record information related to event analysis, data analysis, operation analysis and resource analysis.
* The proposed model provides for simulation capabilities to visualize the capacity problems, material availability problems and financial problems of a future date. Ad-hoc and standard reports are always possible. Interfaces can be worked out with different statistical models so that data can be passed to such models to decide about demand forecast, market trends and so on. Provision can also made to provide assistance regarding make or buy decisions though costing module. Past trends are stored and past decisions with their context can be viewed to aid decision-making process. It also provides for expert system capabilities through its trouble-shooting module. Figure 6.1 shows coverage of model with respect to information system’s support to decision making.

Legend:

MIS: Management Information System

DSS: Decision Support System

DP: Data Processing System

EIS: Executive Information System

System Domain

Figure 6.1 Model Coverage.

* The proposed model can take into account both internal and external factors and can produce any ad-hoc report as per management's requirements. It also considers supply chain management issues. The model can provide for calculation of all financial indicators and system can be programmed to suggest corrective actions, if the business is running out of control. One can make decisions regarding the new product development, product promotion schemes, marketing channels and new investments. It can gather data from external sources. Further development of interfaces with various analytical tools would be an added advantage. There is a provision for knowledge management through trouble shooting module, which provides for expert system capabilities and event notations, which depict the behaviour of the system.
* The model can provide well-integrated view of all business perspectives namely process view, behaviour view and data view. All these views are tightly coupled with backbone of event diagrams. In addition, cultural requirements, roles and responsibilities of employees also can be taken into account.
* The proposed model takes into account the service industry as well. It has a built in support for the project management function. IT project, spanning over many sites, many platforms and requiring efficient management of skilled staff on many platforms, can make use of the facilities provided within the model to plan the work effectively. It provides allocation of resources like materials, machines, manpower, cost and time to different projects and to different sites within the same project. Current state of project can be viewed any time. Various changes to the plan can be made depending on the project feedback from different sites. Figure 6.2 shows the domain, which could be addressed by the proposed model.

Figure 6.2 Areas addressed though the proposed model

The model can be supplied with interfaces with other analytical tools to help managers making decisions about their day to day activities and strategic planning. Events can be introduced in the model to transfer the information from database to s

uch tools and accept the results back. For this reason BPR, CRM and SCM are shown partially covered although system takes into account capacity and material planning, supply bases and markets of suppliers, partners and customers. Partial Coverage of PDM is due the fact that interconnection with designing software to explode resource requirement is not provided for in the current model. Partial coverage of KM arises because the procedures for capturing knowledge from various information elements are not fully visualized. The model does take into account analysis and synthesis of recorded information. It can keep the track of different variables that led to a particular decision, thus helping in arriving at rules of business governance. A separate trouble management is also provided to help building analysis to offer solution to problems. Problems and their solutions can also be captured as and when such situation arise. CM is fully covered because it is clear from the earlier analysis that with the event diagram all four views of an organization can be analyzed and in addition, they are tightly coupled with each other as every thing rests on strong backbone of event diagrams. The model also provides for planning and management of projects covering area of PM. Different paths from source to destination can also be visualized through suggested event diagram not only that it also facilitates time and resource analysis for each event of a project. All data and operation needs of ERP, DW can be well addressed through the current framework showing the complete coverage of ERP and DW. For the same reason DP and MIS are fully covered. DSS and EIS need support from analytical tools and therefore shown partially covered. The scope of model includes System Analysis Design (SAD) and System Development (SD). It is because SAD is also divided into sequence of events and is treated just

Legend:

BPR: Business Process Reengineering

CM: Conceptual Modeling

CRM: Customer Relationship Management

DW: Data Warehousing

ERP: Enterprise Resource Planning

KM: Knowledge Management

PDM: Product Data Management

PM: Project Management

SAD: Systems Analysis and Design

SCM: Supply Chain management

SD: System Development

Model Domain

like any other computerized system. System Development is automatically taken care of through a set of programs to run the supplied design without any development efforts, thus model encompasses area of system development. It is a step towards Code-less DBMS, which is capable of running the system from the supplied design without involving substantial development efforts. The current research work is focused on the ERP aspect of the model.

**6.1.3 How to read event diagrams?**

System diagram gives total scope of the model. Module name appears at the top of the diagram. Sub modules appear as the boxes in the first row. Events associated with each sub module are listed below it in the sequence in which they would appear while running the system. (Refer to the section 5.4.3 for detailed description).

**Legend for reading event diagrams:**

**M**: Compulsory event

**O**: Optional event

**1,2,3**: Sequence of events within another event

**10,20,30**: Sequence of events within the same hierarchy

Sub Module

Sub Module

giving output

Event that expects input

Event that gives output

It is important to note that the events, which are shown as output events, may need some input to produce the output; such finer elements can be considered at the detailed design level, for which screen will be supplied to the designer. Refer to appendix 4 for details.

**Chapter 7**

**DEVELOPMENT OF AN INTEGRATED MODEL - III**

**7.1 Introduction**

Database Management Systems have always been progressing towards making the job of programming as easy and as simple as possible. Although RDBMS has succeeded to a great extent in achieving this aim, it is still complicated enough for users to write their own queries, to create their own screens or to generate their own reports. Through this chapter, an attempt is made to throw some light on the potential of a file based or codeless DBMS (CDBMS), which essentially stores programs, reports, queries as file records (Chiplunkar 1997-a). The term codeless implies that the programmer is not expected to write any hard coded program for creating or manipulating database information. He or she is supposed to change the information in system database just as any user of commercial information system manipulates information from different files or tables. In an attempt to automate programming itself, concept of Easy Program (Chiplunkar 1997-a) was originated. Antony and Hamlet (2000) came out with the idea of automatic implementation of formal specifications for objected oriented design. They did not get rid of coding altogether and neither it was conceived as a DBMS. The proposed CDBMS is based on the structured system analysis and design techniques and a mechanism is provided for reusability of code to reduce designing efforts, which is the main target of the object oriented technologies.

Levene and Loizou (2000) furnished a brief history of evolution of database concept and listed out three levels of database architecture and various essential components of DBMS software. During the 1960’s databases were viewed as collection of files and DBMS was therefore a file system. In the late 1960’s and early 1970’s the introduction of concept of data model gave rise to the hierarchical data model(Tsichritzis and Lochovsky 1976) and the network data model (Bachman 1969, Bachman 1973, Taylor and Frank 1976). The relational data model was introduced in 1970 (Codd 1970). During 1970’s there was much debate between proponents of network data model and relational data model. Till today DBMSs supporting relational data model are most popular in the market.

**7.1.1 Levels of database architecture**

Three levels of data abstraction in DBMS architecture as given by Tsichritzis and Klug (1978) are given below:

* Physical or internal level: It consists of physical schema and physical database. The physical schema is the description of the storage and access methods used to store the information in the database on the media available within the computer system and the physical database is actual data as stored on the storage device of the computer system.
* The conceptual or logical level: It comprises of the conceptual database schema and conceptual database (or simply schema and database). The schema is the description of the information about the enterprise as it is modelled in the database and the database is the abstraction of the information being modelled.
* View or external level: It consists of the the portion of schema viewd by various end users.

**7.1.2 Essential components of DBMS software**

Levene and Loizou (2000) listed out the essential components of a DBMS system as given below:

* Data Defination Language: DDL is used for defining schemas of three levels of abstraction (physical, conceptual and view).
* Data Manipulation Language: DML allows querying and updating of the information in a database. It includes inserting new data and deleting or updating existing data. Some DBMS systems refer to inserting new data as Data Creation Language (DCL).
* Efficiency in query response time and utilization of storage space.
* Integrity and consistency: It is an ability to implement defined constraint to keep database consistent all the time.
* Concurrency control and data sharing: When multiple users are using the system, care has to betaken for sharing of the data with the necessary controls.
* Transaction management: It involves committing the record and transaction rollback or roll forward
* Recovery from failure: Ensuring that the system failure, be software or hardware do not corrupt the database. Recovery facility should ensure that the database be returned to its most recent consistent state prior to the failure.
* Security: granting and revoking of access
* Database administration facilities: They are usually provided as a part of DDL. Defining integrity and security constraints

This chapter mainly deals with the logical implications of using CDBMS in accessing and presenting the data and therefore, touches all the three aspects without going into the exact storage details or specific methods for data storage and retrieval, indexing methods and memory management techniques. Such methods can be incorporated while designing the final database. For the time being, physical data organization is left to the programming language in use (C or C++). A data dictionary can be provided to give details of field name, field length in bytes, field type, and field offset value from the beginning of the physical record of the file to allow user to deal with file or table without concerning physical representation of the record. Being common to all DBMSs, it is not explored in detail in this thesis. The issues related to user interface for defining physical schema, conceptual schema and view schema are discussed. Data dictionary tables are provided to tackle the definition and implementation of these schemas, for which no further coding on the part of programmer is required, the definition of schemas is thus fully implemented. A DBMS is expected to have the following components:

**7.2 Description of Codeless Database Management System (CDBMS).**

This section offers description of Codeless Database Management System in terms of the various DBMS components.

**7.2.1 Data Definition and Manipulation**

**7.2.1.1 Data Definition Language (DDL)**

Data Definition Language takes the following form. A screen is provided to user to give table name, drive, directory, event number, event hierarchy, volume, frequency and brief description of the table. The field window asks for field name, field type and field width including decimals. After definition of the field, field is added to field directory table with field attributes. Table structure stores only field names and does not store field attributes. If the field, which is being entered, is already present in the field directory, its attributes are automatically fetched. On-line help is also available to see all the fields present in the field directory and to select a field for the current table. Changes to fields, which are present in the field directory, can only be made through field maintenance operation. Easy program maintains only one record for one field in the field directory. DDL also offers facilities to record field checks and field references. As stated earlier multiple references can be specified for any field with their execution sequence. DDL also provides for some other facilities like defining before field and after field calculations and field control transfers, which are to be strictly followed while inserting new record in the file or while updating the record from the file. All integrity constraints like entity integrity, domain integrity and referential integrity are fully implemented.

Indexes can be defined in the separate options as and when required. All the indexes defined through the index option will be updated for every new insertion of a record or, if key values of any of the indexes are altered through the update mode. DDL does not create table and indexes soon after the definition. This feature can be well utilized by the designers to design table structures prior to their creation. Creation of indexes and tables is done through a separate operation.

**7.2.1.2 Data Manipulation Language (DML)**

New records in the table can be created through add option in simple programming or through add type of dynamic query. Complex programming add a record in a table only if the record is not found in the table on selected index and after user confirms the add operation. DML is again driven through various screens for simple programming through update, delete and query operations. Through dynamic query, it is possible to select, update and delete records from a table or tables, again through various screens. User is not expected to provide language key words for any operation in Easy program, be it DDL, DML or report and query writer.

**7.2.1.3 Dynamic Query Language (DQL)**

DQL is quite powerful compared to the structured query language (SQL). It allows multiple fields to be selected for updates, multiple tables to be selected for update or delete operation, in addition to the facilities provided by SQL. A field can be defined as non-display, display only or updatable and queries can be stored just like any other program. User can even define additional field level calculations to be performed at any desired field even if the field is a non-display field in the query. All the summary and sorting can be done even on non-display variables. DQL can have self join, as many times as required in a query and there is no limit on the length of a query. The name ‘Dynamic’ is to highlight its operation, which, like any other component of Easy DBMS, stores the information related to the query in various tables in pieces and combines them at the time of execution. It is possible to change only a part of a query information without accessing any other part of the query. User can be given the access to only that part of query which stores, say for example, sorting order. User can add, delete or update fields in sorting order, mark whether each field is ascending or descending and run the query without touching any other part of query.

**7.2.1.4 Report Writer, Simple and Complex program**

CDBMS provides an in-built report writer and programming facility through virtual programs to create simple and complex screens for the user interface. The report writer allows defining the selection of the field values for all the selected fields at the run time. Report writer also provides all the facilities mentioned in queries. It has the usual features like suppressing repeating values, calculation of averages and totals and so on. No where, in the reports or in the queries, complex SQL is required. User has to just tell the system about the selection of the table, field and joins with other table. Queries, reports and programs treat the first table as the driving table and process the selected records of the first table one by one. Records from other tables fetched according to the join strings. Simple and complex programming interface allows the data entry apart from query and also allows manipulation of the existing information.

**7.2.2 Transaction level view**

“The extract process must convert the original legacy system identifiers into proper data warehouse keys that link to the respective data warehouse dimensions. This is basically a lookup process. (Kimball, 1998)”. Look up process is automatic in Easy DBMS and templates are available to select a lookup process, which can be changed to fit the program requirement without much additional efforts, once such template is defined in the system. Lookup processes are also capable of fetching required data, making comparisons and directing flow of transaction accordingly. “You almost always add key-like information to the transaction fact record. You can add an audit key that points to a special dimension record created by the extract process. This audit dimension record can describe data lineage of the fact record, including the time of the extract, the source table, and the version of the software that ran the extract. (Kimball, 1998)” Audit trail procedures can be built in EASY program so that a record of all the activities of a user is available in a separate table with original and updated values, if any updates are made, along with the time and date stamps.

**7.2.3 Integrity and consistency**

**7.2.3.1 Integrity checks**

CDBMS can implement all types of data base integrity checks, which include

* Entity integrity checks: Primary key not null, unique key (Functional dependency constraints)
* Referential integrity checks: Foreign keys. Foreign key constraints are special class of inclusion dependencies. An example of general form of inclusion dependencies is checking of the foreign keys in more than one reference relation at a time. It can also take form of checking foreign key of the referenced relation or checking of any combination of fields from referenced relation and referencing relation in any other relation.
* Domain integrity checks: Field value range and field size checks.
* Cardinality constraints: For example, total number of managers do not exceed total number of employees.
* User defined integrity checks: Database consistency checks
* Dynamic constraints: Two states of database need to be examined in order to test the satisfaction of database constraints. For example state before update and state after update. CDBMS has special provision to retain both the states for any required comparison.

All these integrity checks are implemented thorough all the operations like programs, queries and reports.

Integrity checks can be summarized as follows:

1. Check existence or non-existence of record in some other table.
2. Check existence or non-existence of record in the base table.
3. Make both above checks compulsory or optional.
4. Multiple existence or non-existence checks on sequence of tables for entry in the base table at single field.
5. Predefined field checks which include

Mandatory field (Field must contain some value other than zero or null)

Field type check (Field cannot accept information of any other type)

Field range check

Field top value and bottom value checks

Sequences defined

Database triggers

**7.2.3.2 Database consistency**

# Consistency of database is assured, if all the integrity checks are well defined at the proper places. Just definition of such checks is what is required in CDBMS. All such checks are implemented without any further programming or coding. CDBMS allows conditional execution of the database triggers.

# 

**7.2.3.3 View consistency**

CDBMS puts output of a query in a separate table different from the base table. Therefore, once query is executed, there is no chance of changing of the values, which have appeared on the screen, unless query is executed again. Easy program, by default, stores the query definition for future use. The output of the query is also stored in different directory and can be viewed anytime, until it is deleted specifically or overwritten by execution of the query next time. There is another query type, which fetch information every time from the base table, so that user has access to current information, always. In such query type, user seems to be little bit confused to find different information while navigating the selected records. That is, one user sees one value; goes to next selected record; meanwhile another user changes the information in the table and the first user when goes back to earlier record, sees another value. Easy program can provide both types of queries, depending on the requirement query type can be selected.

**7.2.4 Efficiency in query response time and utilization of storage space**

**7.2.4.1 Indexing issues**

“Traditionally, in many ways, the classic OLTP system is the polar opposite of the classic Decision Support System (DSS) system. These differences mean that the skills required to build and maintain an OLTP application successfully are very different from the skills required to build a successful DSS system. As one example, the use of indexes in OLTP systems must be thought out carefully, but in DSS applications, Database Administrators (DBA) can essentially get away with adding just about any index they can think of. Assuming the query optimizer is reasonably intelligent enough to determine correctly when to use an index, (granted, query optimizers aren't perfect here), the only real downsides to adding too many indexes in a DSS application are the increased disk space usage and, consequently, the additional time required to update several indexes after a batch load or large incremental update. However, in an OLTP system, every time you change the value of an indexed column in a particular row, you also have to update the index to reflect the change. This additional overhead slows the application down. Therefore, in OLTP systems, the tradeoffs of adding an index must be considered. (Rudin, 1998)” Easy program proposes to deal with the issue in the following way- More common indexes are stored in the system database and are updated as and when records are added, changed and deleted. To run other queries and reports, which use less common indexes, indexes are generated before execution of the program, query or report. They are not updated every time change is made in the table. This will ensure fast performance of Easy program and at the same time user need not to worry about index creation and maintenance. Easy program can decide whether to use the index, depending on number of records to be searched. Auto index search tells whether to use index, which is already defined, or to create a new index for the specific task.

“Organizations are trying to find ways to combine OLTP and DSS functionality into one encompassing architecture for two reasons: first, to have the most up-to-the-minute data available for DSS analysis, and second, once the analysis is done, to be able to make changes to the data in real time. For example, in a retail environment, an analyst could use up-to-the-minute sales statistics in a DSS fashion to determine the optimal set of products to put on sale and then immediately change the prices of those products as well as enter orders to increase the inventory levels of those products. But, this is a very difficult proposition. (Rudin,1998)” Easy program has just aims to achieve this difficult task.

**7.2.4.2 Large Input Output (IO) requirements**

“To avoid this situation, (large IO requirements) administrators of large On Line Transaction Processing (OLTP) systems are sometimes forced to split up the database across several machines. (Rudin,1998)” Easy Program allows data to be stored on any machine, which is accessible to the user through the network. Thus, data can be split up on different machines to avoid IO bottlenecks.

**7.2.4.3 Large number of processes and threads**

Easy program has facility to store all the necessary information to run a program in a separate file. All the file pointers, to show specific file position, to show next action to be taken on the file, are available even after program execution is temporarily suspended. Assigning different processes can be possible to run two programs simultaneously with the help operating system’s capability of executing multiple programs at any given time. Further work will be necessary to incorporate multithreaded capabilities in Easy Program.

**7.2.4.4 Storage on disk**

CDBMS is a free expandable database. Database goes on expanding as long as space is available on the disk. Roll back segment definition is not necessary. Table space maintenance is not necessary. Extent calculation is not required. It depends on operating system’s facility to organise the data.

**7.2.5 Concurrency control and data sharing**

**7.2.5.1 Data locks**

“In addition, users depend on absolute integrity in the processing of their work. Losing a transaction or executing the same transaction more than once are considered severe problems (this scenario is referred to as transaction integrity) (Rudin,1998).” To handle the concurrency issues and to maintain the data integrity, Easy program can maintain records in a lock table with row number or record number at the start of the transaction and remove the record from the lock table at the end of the transaction. Alternatively, every record can have additional field to denote lock status.

**7.2.5.2 Avoiding dead lock**

Before the lock request, lock status of the requesting row will be checked. If row is already locked for update, it is also possible to check which table and which row has demanded the lock on the requesting row. In case, the demanding row has demanded the table other than the requesting table, which in turn has not locked the current row, or if lock request is made for different row of the demanding table, lock request may be granted. Otherwise, wait process can be started with the periodic check on the lock status of the current row. Once row is made free, requesting row will be allowed to place lock on the required table.

**7.2.6 Transaction management**

**7.2.6.1 Transaction control**

A transaction can be defined as a single program or a set of multiple programs. Easy program will treat transaction from the beginning of the change in the base table till the completion of corresponding changes mentioned in all the triggers (program triggers and database triggers) by default. No user will be allowed to access corresponding records from different tables in between. Rows can be inserted into tables by demanding exclusive lock till blank row is appended at the end and later on exclusive lock can be released and lock is put on individual row. “With row level locks, ‘Locking Granularity’ is achieved (Rudin,1998).”

**7.2.6.2 Transaction automicity**

“Atomicity implies that either all or none of the changes made by this transaction are visible. In other words, if atomicity is supported and a user is in the middle of executing this transaction, the changes are not visible to any other concurrent users until the transaction is committed. (Rudin,1998)” The work file makes it possible that until records are committed, user has access to the old information.

**7.2.6.3 Current view, rollback and roll forward mechanism**

The provision can be made to write records in a working file, which is constructed from the all tables selected for update in the program. All changed values are written into the work file before transferring to the actual tables. Thus before committing the update transaction, all other queries other than update and delete will get the original data from the base tables. In the event of rollback, simply no records are updated in the base file. A field is available to mark complete transfer of record. If system crashes in between the transaction, roll forward recovery is possible. All the records which, were not written earlier to the base tables can be written at the start of the next run. Even rollback is possible at the start of the next run if necessary for which it will be essential to maintain a before image file.

**7.2.7 Recovery from failure**

Easy program can allow on line backup on any device. Every change can be written to two different disks without any additional disk mirroring software. In such cases, Easy program can be made to write the same changes in two directories or disks. It would be made possible by selecting two tables simultaneously when one table in default directory is selected for operation. Not only that, in the event of problem with one disk, control can be changed to other disk with change in default drive for the project. Thus Easy Program is a **fault tolerant** system.

**7.2.8 Security issues**

CDBMS provides for excellent security measures. The access to the various operations in the program is divided into four categories: Super user, Administrator, Programmer and User. There are different projects and each project can have many users, which share the same tables of the project. Tables from one project can be exported to other projects, if required. Inter project access is prohibited but it can be provided. Easy program also provides for the following securities for any individual user.

1. Access to program
2. Access to program action (Add, Update, Delete etc.)
3. Access to field (Display + Update, Non-display, Non-update)

All these securities are fully implemented by checking in the respective files in which the security information is stored and by changing the field attributes of the current field for the current session. User will not have access to the information through any of the components of CDBMS namely programs, queries and reports, for which he has no access. Even it would possible to keep check that for the current table, user would have access to information related to only his department, although the table may be used by different persons from different departments.

**7.2.9 Other issues**

**7.2.9.1 Setting procedures**

CDBMS does not require any complex setting procedures. Its file management system works on the directory structure of the operating system. One does not need to define complex procedure for many operations. For example, it is a free expandable database

**7.2.9.2 Multiple critical success factors**

“Criteria such as high-performance, predictable response times, high availability, reliability, and scalability are all important. So are data integrity, transaction integrity, and the ability to share resources efficiently among many users. (Rudin,1998)” Regarding the scalability, Easy program is a DBMS, which is data driven. It stores the data related to the various applications in its tables. And therefore, it is scalable to any extent. The runtime program may need changes according to the changes in the technology but user programs remain same and can be run without any changes to them.

**7.2.9.3 Platform independence**

Easy program is very much platform independent. The run time program needs compilation differently for different platforms like Java Virtual Machine. The Easy Runtime Program will access the data from various tables and run it according to the operating system. Thus, any program written by the user is platform independent. The program is not compiled before execution. Easy picks up the data related to the program from is database and coverts it to commands while executing the program. Easy Run Time Program will take care of operating system variations and thus, the user program can run on any platform irrespective of the operating system.

**7.2.9.4 Data mining**

Easy program can be used to find the rules of the business governance. It needs an interface with the external statistical tools to arrive at general rules. Easy program has provision for marking events and flow of events. Every event has the necessary data elements and the data related to the program. Events have different notations to denote their behaviour. This behaviour can in be enforced, if Easy program is made to run through the events rather than directly on the tables. This would ensure the proper sequence of execution of the events. A process of selection of the various field values can be traced to the back event and the relationships between different field values can be found out. This would, in turn, trap the knowledge of the experts who are making the decisions. Thus, Easy program provides for expert system in itself. It can also be used to find the relationships between sales of different products, customer behaviour and so on.

**7.2.9.5 Magical frame-work, object orientation and reusable code**

“Create a magical framework with common business services shareable across all enterprise applications. Such a framework will allow organizations to share objects within and among enterprises and allow application architects to create new systems with as much as 90 percent reusable code. The fact is, while we had the technology, tools, and even a few examples of organizations leveraging the power of frameworks, the all-encompassing framework that spans the enterprise never really appeared. Enterprise frameworks are failing for several reasons, the most damning of which are scale, tools, and the Web. (Linthicum,1998)” The reusable code has been a major target of the object orientation. Easy program plans to handle the reusability of the data related to the program through the templates. A template stores the data related to a typical method. Such method can be accessing a table and fetching the required fields from a table. The only variable is passing values. Easy program can provide separate template routine to execute template with different variables similar to calling functions with different arguments and different return values. The templates are easily modifiable and can be attached to a specific field of the table. Easy program itself is a reusable code, for it is a procedure to execute any program in Easy DBMS without further writing of code. That is, Easy program is a magical framework that can execute the Structured System Design and designing is made easy with the use of templates at the field level. Easy program allows web programming facilities as well although further work is necessary in this direction.

**7.2.9.6 Remote Method Invocation (RMI)**

Easy program stores the data related to any program in its tables and while running the program, fetches the data related to the program from these tables and converts it to commands on the user machine to execute the program. The tables containing the program can reside on any computer and in any directory, which is accessible on the network or on the internet. Accessing easy program from any other location is actually accessing the data related to the program from that location. Thus, Easy program has capability to execute remote programs on the user computer, which is very much similar to Remote Method Invocation provided by JAVA. Easy program can treat a single program as an applet, once it is supported by multithreaded operating system. Easy program, therefore, can be termed as a WEB based DBMS system.

**7.2.9.7 Intelligent DBMS**

In Easy program, tables and programs can be linked to the business events and the behavior of the events can be depicted by the event notations, which can tell what should be the next event in the sequence, which depends on many factors like:

* Whether event is mandatory or optional
* Whether event can be skipped on certain condition
* Whether or not one of the group of events is must
* Which event has called the current event and so on

This incorporates decision-making abilities in the system. It also helps in trapping the business rules. Thus, Easy program can also be called as intelligent DBMS.

**7.2.9.8 Parser**

Easy DBMS does not depend on the user to supply the key words for any of the database operations. The complete program information is stored in the tables, in the form of various fields. Queries and executable statements are constructed at the run time and therefore, are always correct without exception. Thus, there is no need of parser to check whether syntax is correct or not. Even some run time checks like existence of table, existence of field can be incorporated while defining query, reports and screens.

**7.2.9.9 Stored procedures**

Easy program has everything stored in its database. The stored procedures, which reside on the server and which are accessed by the users, can easily be written in Easy DBMS. In fact, Easy program does make any distinction between client procedures and server procedures. This is because to execute a program, Easy program has to fetch the data associated with the program from the directory and drive specified in the system tables, which store the program information. This makes it extremely easier to extract any program information from anywhere on the net work and execute on the client computer. Easy program, therefore, can be used as web based application developer, where instead of the directory and drive IP address is stored as an identifier of the place where data related to specific program is kept. Easy Program allows both client-server communication and peer to peer communication.

**7.2.9.10 Searching the tables**

DBMS provide the following algorithm for searching related records:

1. Search the table sequentially to select the requested records. Pick up all the record numbers, which match the selection criteria. Store them in a separate file and drive the selection of records from main file through the file, which has already recorded the record numbers of the selected records. While doing this exercise, any index can be made active according to the requirements. A screen displays all the variables from the selected table and user is expected to provide the selection value and the selection operator against the field name. Actual condition, which can be changed if required, is displayed before the execution of the query. The index is used only as a sorting order and actual records are accessed according to the record numbers that are stored in a separate file.
2. For multi table queries, a file is maintained to denote the hierarchy of the selection, current record number and further action to be taken after the current record is processed. After selecting the required records from all the tables, the selection condition is matched. Depending on the query type either the records which have matching value from all the tables or the records which have matching value in the driving table irrespective of search results in other tables are selected. The search table keeps a record of the index used and makes it active whenever the table is accessed. Since the file keeps the record of each tables hierarchy wise, one table can be selected at many hierarchies with different index selection. Program also has auto index search and creates index for searching the table, if the required index is not found in the system tables.

**7.2.9.11 Link with the organizational structure**

Easy program provides in-built hierarchical structure to record the physical hierarchy of the organization and also provides a reporting facility to calculate and to compare the totals of numerical values along the hierarchy with the help of the report writer.

**7.2.9.12 Automated value help**

Easy Program fetches value help from the referencing tables according to the referencing key definition. User can also specify additional fields whose value he expects to see on the screen on pressing the help key. User is expected to key-in the first letter and is directed to the corresponding value. If user chooses not to give the selection, the first value in the list is shown. Help can also be made automatic to appear for making the selection from the displayed values.

**7.2.9.13 Automated textual help**

Automatic textual help appears on the screen as soon as user approaches the field. It is derived from the field descriptions provided at the time of creation of the application. User can change the description so as to suit the individual program, if required.

**7.2.9.14 Consolidation and distribution procedures**

Easy Program also provides in-built support for the queries, which can distribute the numerical value according to the given percentage to the child tables. Similarly, consolidation of values from the child tables to the parent table is also possible.

**7.2.9.15 Multiple sequences**

Sequence maintenance is extremely easy and one can have multiple sequences for a given table depending on a key field value.

**7.3 .9.16 Data independence**

“Data independence or physical data independence means the physical level of the database can be modified without the need of making any changes in the conceptual level. In general, higher data independence cannot be achieved, since deletion of the table or one or more fields of the relation will necessarily disturb any view that refers to the deleted table or field. A weaker type of data independence is called as growth independence (Date, 1986)”. All the database management systems so for proposed, including RDBMS, support the growth independence which means conceptual level does not need change for addition of tables or addition of fields in the table. CDBMS, on the other hand, can enforce the higher independence by deleting respective records from the application programs, which contained deleted table or deleted fields.

**7.3 Data model**

A data model is a combination of the three components (Codd, 1982).

* The structural part: A collection of data structures which define the set of allowable databases

Table 7.1Comparison of hierarchical, network, relational and codeless DBMS models

|  |  |
| --- | --- |
| Criteria | Description |
| Type | **Hierarchical** |
| Structural Part | Database schema is the collection of tree types and database is collection of trees called forest. (Figure 7.1) |
| Integrity Part | Record identity and referential integrity. Referential integrity assumes the form that every child must have only one parent. |
| Manipulative Part | Tree navigation  GET first record type where condition GET next record type where condition  Visit the current record if not visited. Visit the leftmost child record if not visited Go back to parent record |
| Type | **Network** |
| Structural Part | Database schema in the form of directed graph called data structure diagram A network data structure can be regarded as an extended form of the hierarchic data structure. The principal distinction between the two is that in a hierarchic structure, a child record has exactly one parent whereas in a network structure, a child record can have any number of parents (possibly even zero). A network database consists of two data sets, a set of records and a set of links, where the record types are made up of fields in the usual way. |
| Integrity Part | Record Identity, Referential Integrity. Every set occurrence, which contains only one instance of owner record type (referential integrity) and zero or more instances of member record type. (Figure 7.2) |
| Manipulative Part | Network Traversal  FIND record type USING attribute  FIND first record type IN set type  FIND next record type IN set type  Given an owner record process its member records in some order  Given a member record process its owner record  Given the member record, process the other member records in the set occurrence. |
| Type | **Relational** |
| Structural Part | A database schema is a collection of relational schemas and a database is collection of relations. A relation is a two dimensional table. Each relation is characterised by relation itself, tupels and attributes. |
| Integrity Part | Primary key (Entity integrity), Foreign keys (Referential integrity) |
| Manipulative Part | Relational algebra is collection of operators like selection, projection and join, which take relation as input and generate relation as output.  Relational calculus declarative counterpart of relational algebra. Commercial query language like SQL (Structured Query Language) is based on relational calculus. |
| Type | **Codeless** |
| Structural Part | Database schema is collection of hierarchical events, relations being linked to events and database is collection of relations. The relations are used to describe an event in terms of its information elements. (Figure 7.3) |
| Integrity Part | Unique key, foreign key, not null and other field value checks, and database consistency checks. |
| Manipulative Part | Navigation through event notations. See figure 5.1 on page 122 for event notations. Manipulating relations through relations. Dynamic query, Report writer, Simple and Complex Programming. All these components are virtual in the nature, in the sense that even declarative language takes the form of relation and operates on the other relations, which are to be manipulated through the declarative language. |

* The integrity part: A collection of general integrity, constraints which specify the set of the consistent databases or set of allowable changes in the database.
* The manipulative part: A collection of operators or interface rules which can be applied to an allowable database in any required combination in order to query and update the parts of the database.

Table 7.1 shows the comparison of hierarchical, network, relational (Levene and Loizou, 2000) and codeless DBMS models.

LNAME

CNAME

Taught By

DNAME

LNAME

No Hours

Teaches

Course

Lecturer

Department

Lecturer

Employs

Student

Department

Course

Teacher

Timetable

Figure 7.1 Hierarchical model

Figure 7.2 Network model

Record type: Department. Set type: Employs Attribute: Lname

Event 1

Event 1.1

Event 1.2

Event 1.1.1

Event 1.1.2

Event 1.1.3

R22

R1

R4

R3

R6

R5

Figure 7.3 Event model for CDBMS

**7.4 Basic Concepts**

Sections 7.4 to 7.12 discuss a framework for making a codeless database management system or file based database management system.

* Easy program environment can be divided into projects. Project is group of related files or tables.
* A project can have many persons or users operating the system, modifying the system. Each of them can have limited access to the system in terms of program execution and field value change.
* Field definition is unique through out the project. It means One FIELD: one TYPE :one LENGTH :one DECIMAL(if applicable)
* When new field is created while defining table structure, it is written to table FDEF. If changes are to be made to field definition later on, option FIELD DEFINITION in DATABASE menu is made available. While creating table field definitions are picked up from FDEF and are not stored separately for every table.
* Field types are limited to C: Characters (255 Max.), N: Number, D: Date. Even EASY program execution files does not contain any logical variables. Logical variables can be substituted by condition which is always true (like 1=1) or which is always false (like 1=2). Boolean variable type can be tackled by defining check in as Y, N or 0,1 or TRUE, FALSE while defining database.
* Each table must have a SEARCH KEY, which can be UNIQUE or NON-UNIQUE. Search key is the key on which EASY connects the table to other tables in COMPLEX PROGRAM AND AUTO REPORTS.
* COMPLEX program checks for all unique keys before deciding whether to insert a new record or update the existing one. If unique key is not specified for any table, it is better to handle that table through SIMPLE program where separate options for add, update and delete are provided. In COMPLEX program such tables will never be updated and every time EASY will create a NEW record in these tables.
* Keys can be defined in INDEX DEFINITION option. CREATE INDEX option creates indexes according to these definitions.
* EASY SIMPLE programming, COMPLEX programming and AUTO reporting take care of all the validations, which are defined while creating database.
* Although by default EASY does not display any fields from tables in which data is validated, they can be displayed either through alteration of DEFAULT program or by selection of fields from these files as DISPLAY ONLY. If validations are in place before creating program they would be considered while creating program. To accommodate changed validations after creation of program, either recreate program or make changes (or add records) to the tables which stores program validations.
* Since connecting search keys are checked automatically, heavily normalised database can be used without any hesitation. In fact it would be desirable characteristic to take fullest advantage of FIELD based programming in which long PROCEDURES doesn't fit in well.
* Loops handling: It is possible to have as many nested loops as required. Because it is just marking of starting and ending of loop rather than having DO WHILE statements, there is no limitation on nested loops. Provisions are available for conditional entries, exits and perpetual loops. One can exit from the loop in between and transfer control to some other field and program execution continues from that field onwards (Permanent transfer) or exit from the loop, execute some operation at some other field and continue program execution from sending field.(Temporary transfer).
* Each field can have conditional value assignments before or after the field. It is possible to assign conditional values to any other field of the program in the same way. All calculations can have multiple steps. Please refer to topic on FIELD VALUE ASSIGNMENTS. It is possible to skip a field on condition, transfer the control to some other field before or after, temporarily or permanently. All validations or references are checked ONLY AFTER THE FIELD ENTRY.
* Up-arrow and down-arrow are used for field to field navigation and F1 for changing the working windows.
* EASY allows to add, to update or to delete a record in other file while inserting into or deleting from or updating base table before or after the operation.
* EASY user can be assigned any of following status for EASY operations. S: Super Users A: Administrator P: Programmer U: User.
* Super user can have access to all options displayed in all menus. All others can not execute all options displayed. Please refer to operations for further details.
* 'User' status can have access to only pre-assigned EASY programs.
* Field access securities are checked at run-time. Fields to which a person doesn't have update right are made non-updatable, fields to which a person doesn't have display right are made non-display for the current session. And for all these all that is needed is to just tell EASY this person, this place, this table, this field, this right.
* Multiple sequences are possible for one table. For example, Purchase Order (PO) can have separate sequences for different companies, within company for different divisions, within division for different sites and up to sub department level. Added need is different sub transaction may require separate sequence eg. RAW MATERIAL is a separate series, SERVICE PO is a separate series and the like. EASY not only has provision for defining all such different series(sequences) but also in built procedure to implement them without any further programming..
* EASY executes checks even for non-display variables. It will skip the execution if one choose to skip the field or transfer control permanently before field.

**7.5 Database design for simple program**

Database design for simple program: Table structures can be defined through this option. First window is the table definition window which takes inputs for table name, why this table being created or purpose of the table, transaction volume or number or transactions for time unit mentioned against volume unit (day, month, year etc.), retention period and retention period unit. Table purpose is used for naming windows and giving program description when the said table is used in any program and therefore it is mandatory field. Others are information fields and are not used in any program.

Second window is field definition window. Sequence number decides the position of the field in the table. Field name, purpose of the field, field type, field length, decimal points that field will be having (Applicable for numeric field only), value checks if field inputs are limited to a set of few characters or numbers. Value check is for information only. Field purpose is used to give default help message whenever this field is approached in simple program and complex program.

If one switches to table validation window at this point, value checks will be shown against checks in field of TABLVALD. If validations are confirmed at this stage, EASY will enforce them while running program provided no changes are made in PRGVALID table.

Third window is table validation window. Base file variable string is used to seek record in VALIDATEIN. Field in this string are separated from each other by '+' sign. It is desirable to index table on converted string of numeric field and on ALLTRIM value of character field: PROJECT\_ID+STR(TRANS\_ID)+ALLT(TRANS\_TYPE). VALIDATEAT is a display field whose contents are same as that of field name of field definition window. EASY tries to locate matching INDEX file for VALIDFIELD and VALIDATEIN table. If found, it is displayed against VALIDINIDX otherwise user will have to enter name of index file which will be used for search at VALIDINIDX.

Field can have default value, top value, bottom value. If any of these values and checks are entered, no other information should be included in the current record. References can be given from next record onwards. It is not possible to have CONSTANT values and TABLE REFERENCES or VALIDATIONS in one record of TABLVALD.

There is no restriction on number of tables, one can refer to or on multiple search of one table. Each reference will be a separate entry. Variables, which you want to pick-up from VALIDATEIN, are entered against SELECTVAR field. Field separator given against field CHK separates the variables. Similarly program variables to which value of selected variables is to be assigned are mentioned against EQUATEWITH separated by the same field separator. There should be one to one correspondence between contents of SELECTVAR and EQUATEWITH.

It is possible to write expression at default value of any field. Expression or value assignment from other field by typing f: at the start.

If CHKEXISTS variable of TABLVALD is set to 'Y', check will be successful if EASY finds record in VALIDATEIN file. If it is set to 'N', check will be successful if EASY can not locate record in VALIDATEIN file. If COMPULSORY is set to 'Y', program execution will continue only if check is successful. A message that string mentioned in VALIDFIELD could not be traced in file VALIDATEIN is displayed if check is unsuccessful.

Sequence number tells EASY the order of executing checks. Thus it is possible to extract some field from one reference TABLE and depending on value of extracted field extract another field from the same file or other file subsequently.

Please note that the field B\_A (whether to execute check before or after) is not taken into account while executing program. All checks are executed after the field entry.

**7.6 Simple programming**

After creating table and defining indexes and validations option create SIMPLE PROGRAM can be executed. SIMPLE programming doesn’t require SEARCH KEYS or UNIQUE KEYS.

Simple program creation routine takes inputs from

TDEF : Table Definitions.

TSTR : Table Structures.

FDEF : Field Definitions.

TABLVALD : Table Validations.

Please note that TDEF, TSTR and FDEF tables are common for SIMPLE programs, COMPLEX programs, REPORTS , AUTO REPORTS and QUERIES. TABLVALD table is referred to only while creating simple program.

It writes records in

PRGLIST : EASY program record.

PRVARSAY : Text display strings.

PRGVARBL : Program variables.

PRGVALID : Program validations.

VALUEHLP : Automated value help on pressing F10.

PRDBFREL : Program variables, which can be updated.

SELCTSET : Select areas and data files used in these areas.

Entries in TDEF, TSTR, FDEF and TABLVALD are recorded when database for simple program is created. As stated earlier validations, which are defined before creating program, are considered for checking and value selection help. For more explanation of input tables please refer to topic on DATABASE DESIGN FOR SIMPLE PROGRAM. Name of the simple program is same as that of the TABLE for which it is created. Simple program is created using only one table.

EASY writes checks to be executed, value ranges in PRGVALID table while creating SIMPLE program. Therefore, when changes are made to TABLVALD contents, one should also be changing contents of PRGVALID or create simple program again.. It implies that if certain ranges, references are added to PRGVALID or its contents are changed as might be necessary for a particular program and option to create simple program is run for same table again, all earlier changes to the program will be LOST.

SIMPLE program creation routine does give such warning and one can leave the operation in between.

SELCTSET table assigns select areas from 15 onwards for tables mentioned in TABLVALD and the base table.

PRVARSAY contains text string positions and text attributes. While creating program field names are taken as screen prompts. If any text string is to be added or removed, it can be achieved through running SIMPLE program for PRVARSAY.

PRGVARBL file contains memory variables, file variables, base file and field attributes including display position. During creation of SIMPLE program, field type and length are picked up from FDEF table. If a memory variable is to be used without any reference to the file variable, run ALTER SIMPLE PROGRAM to ADD such variable. Changing default variable names should be avoided as far as possible.

One can assign unused sequence numbers or new sequence numbers to all variables which are of non-display type. If it is required to insert some variable in between , it is possible as sequence numbers are generated in multiple of 10. All memory variables are initialized using this file. Therefore one should be careful while making program alterations. Please refer to topic on simple program alteration.

PRDBFREL table contains base file name, field name and respective variable name. This file has been introduced to take care of non-display variables which are selected from other files or tables. If variable is not present in this file it will not be written to the disk. This change is incorporated after development of complex program to bring similarity of operations in both program execution algorithms.

If variable is present in PRGVARBL but not in PRDBFREL, no error will be reported. If variable is present in PRDBFREL but not in PRGVARBL, program execution will terminate giving error as 'FIELD NOT FOUND'.

EASY SIMPLE program searches record in VALIDATEIN table on VALIDFIELD string given in TABLVALD. It uses VALIDINIDX as index file for searching the record. Row and column fields are provided to display selected variables mentioned in EQUATEWITH of TABLVALD. Field values of these variables are derived from variables mentioned in SELECTVAR field of the same table.

VALUEHLP collects fields from TABLVALD. Variables mentioned in VALUEHLP thus must be present VALIDATEIN file. SIMPLE program checks for presence of fields in SELECTVAR field for existence in VALIDATEIN table. Should there be some problem with automated value help please look into these aspects in VALUEHLP table and TABLVALD table.

If CHKEXISTS variable of TABLVALD is set to 'Y', check will be successful if EASY finds record in VALIDATEIN file. If it is set to 'N', check will be successful if EASY can not locate record in VALIDATEIN file. If COMPULSORY is set to 'Y', program execution will continue only if check is successful. A message that string mentioned in VALIDFIELD could not be traced in file VALIDATEIN is displayed if check is unsuccessful. Simple program as of now does not support field level calculations and conditional value assignments. Complex program can be used, in case these features are needed.

**Simple program alteration**

Col. What it Signifies ?

1 Sequence of the variable as it is taken up for execution in the program. This sequence will be of importance when one is selecting some variables from VALIDATEIN file and equating them with other variables. Variables with which you equate should be taken up for execution after the value assignment.

2,3 Row and column for get position of memory variable. It can be anything for non-display variables

4 Memory variable name.

5,6 Row and column position for text display string.

7 Text display string.

8,9 Display windows for memory variable and text strings.

10,11 Display and update attribute (Y = yes, N= no)

12,13 Base table and base field

14 Whether to retain the value of memory variable after writing the record.

(Y-retain, N-initialise with spaces or 0)

15,16 First variable and last variable of the program

**7.7 Database design for complex program**

Table structures can be defined through this option. There are in all seven windows, which define the complete behaviour of a table.

First one is table definition window for giving table name, why this table being created or purpose of the table, transaction volume or number of transactions for time unit mentioned against volume unit (day, month, year etc.), retention period and retention period unit. Table purpose is used for naming windows and giving program description when the said table is used in any program and therefore it is mandatory field. Others are information fields and are not used in any program.

Second window is field definition window. Sequence number decides the position of the field in the table. Field name, purpose of the field, field type, field length, decimal points that field will be having (Applicable for numeric field only), value checks if field inputs are limited to a set of few characters or numbers. Value check is for information only. Field purpose is used to give default help message whenever this field is approached in simple program and complex program.

Third window is BEFORE FIELD VALUE AND CONTROL. Through this window default value of the variable, value range - bottom value and top value, value checks (set of permissible values for the variable) can be defined. These validations are executed before accepting input for this variable during program execution. Through this window, one can also decide

1. Whether to skip the field if some condition is satisfied.

2. Whether to take up some other field for operation.

3. Assign values to field depending on fulfilling of a condition.

If default value is a constant, which can be numeric or character, it can be put against DEFVALUE field. Constants are enclosed in DOUBLE or SINGLE QUOTES. EASY depending on type of variable assigns value as string, date or number. For assigning variable, which can be from database or a memory variable, 'f:' is necessary at start without any leading spaces. If reference is to other database variable, one can give input as f:filename.fieldname. It is also possible to write a small expression up to 30 characters. EASY will evaluate the expression and assign the outcome of the expression as default value. While writing expression character constants will be enclosed in SINGLE or DOUBLE QUOTES. IFVALUE and ELSVALUE work in the same fashion..

Value range for checking inputs can be entered against CHKIN. one can give only CONSTANTS in this field. Individual values are separated by ','. It is not necessary to put individual values in SINGLE or DOUBLE QUOTES whatever may be the variable type. In order to assign value on CONDITION to a field before accepting input, condition can be written up to 200 characters. While specifying condition, 'IF' should not written at the start. Condition can have memory variables, database variables, constants, arithmetic operators or logical operators. Since it is not possible to decide on type of variables used in condition, one WILL ENCLOSE character constants in SINGLE or DOUBLE QUOTES.

If the condition evaluates to be true, EASY will assign IFVALUE to variable only if IFVALUE is not blank. It will also transfer the control of program execution to the MEMORY VARIABLE mentioned against IF\_FIELD, if it has some value. If the condition evaluates to be false, EASY will assign ELSVALUE to variable if ELSVALUE is not blank. It will also transfer program execution control to the MEMORY VARIABLE mentioned against ELS\_FIELD, if it contained some value.

For all variables mentioned in this window, EASY will assign one memory variable while creating complex program.

Sequence of operations is listed below.

1. Check condition

2. Transfer control

3. Assign default value, if value or else value to the field.

4. Perform multiple step calculations.

If T\_P field contains value 'P', EASY will not transfer program execution control back to this field. Program will move further from IF\_FIELD or ELS\_FIELD. (Permanent Transfer) If T\_P field contains value 'T', EASY will transfer program execution control back to this field after finishing execution at IF\_FIELD or ELS\_FIELD (Temporary Transfer).

Fourth window is for multiple step calculations to be performed before accepting input for this field. MEMVAR is the memory variable name corresponding to the field, which is still displayed in field definition window and stored in file BCALS as FNAME. RNAME is the memory variable (may be corresponding to another variable from same table or different table), to which value is to be assigned. In order to assign value on CONDITION to a field before accepting input, condition can be specified up to 200 characters. Conditions are checked in the similar fashion described earlier. The sequence in values are assigned is given below

1. Assigns to variable value mentioned against FIELDVALUE if FIELDVALUE is

not blank.

2. Check condition.

3. Assign IFVALUE if condition is true and IFVALUE is not blank.

4. Assign ELSVALUE if condition is true and ELSVALUE is not blank.

5. Repeat same sequence till all records for this field are exhausted.

In the absolutely same manner one can work with fifth and sixth window. Fifth window deals with after field value assignments and control transfer. Sixth one deals with after field calculations. The difference is all the actions defined in these windows are taken after the FIELD is executed. Base table for fifth window is BFTVELID and for sixth window it is BCONFLDV. Seventh window is TABLE VALIDATION (Reference) window. CHKSTR is a variable string with which EASY tries to seek record in VALIDATEIN. Fields in CHKSTR are separated from each other by '+' sign. It is desirable to index table on converted string of numeric field and on all trim value of character field. PROJECT\_ID+STR(TRANS\_ID)+ALLT(TRANS\_TYPE). REFSTR is corresponding string from the VALIDATEIN file with + as a field separator. VALUEHLP file collects input from this field and SELECTVAR field for complex programs. VALIDATEAT is a display field whose contents are same as that of field name of field definition window. EASY tries to locate matching index file for CHKSTR and VALIDATEIN table. If found, it is displayed against VALIDINIDX otherwise one will have to enter name of index file which will be used for search at VALIDINIDX. There is no restriction on number of tables one can refer to or on multiple search of one table. Each reference will be a separate entry. Variables, which are to be picked-up from VALIDATEIN file are entered against SELECTVAR field. Variables are separated by field separator given against field CHK of the same window. Similarly program variables to which value of selected variables is to assigned are mentioned against EQUATEWITH separated by the same field separator. There should be one to one correspondence between contents of SELECTVAR and EQUATEWITH.

**7.8 Complex programming**

After creating table and defining indexes and validations one can run option create COMPLEX PROGRAM. As stated earlier SEARCH KEY and at least one UNIQUE KEY must be defined prior to running this option.

COMPLEX program creation routine takes inputs from

TDEF : Table definitions

TSTR : Table structures.

FDEF : Field definitions.

BVELID : BEFORE field value assignments and control transfer.

BFTVELID : AFTER field value assignments and control transfer.

BCHECK : Table validations.

BCALS : Before field calculations and conditional value assignments

BCONFLDV : After field calculations and conditional value assignments.

Please note that TDEF, TSTR and FDEF tables are common for SIMPLE programs, COMPLEX programs, REPORTS, AUTO REPORTS and QUERIES. All other tables are referred to only while creating and executing COMPLEX program.

Records are written to following tables. These records are specific for any program. Changes in these records will affect only that program for which it is made. While changes in input tables will affect all the programs, which are created after the change has been made.

PRGLIST : EASY program record.

DENTRY : Program variables and text display strings.

DVELID : Before field value assignments and control transfer.

AFTVELID : After field value assignments and control transfer.

DCHECK : Table validations.

DCALS : Before field calculations and conditional value assignments.

CONFLDVA : After field calculations and Conditional value assignments.

VALUEHLP : Automated value help on pressing F10.

PRDBFREL : Program variables, which can be updated.

SELCTSET : Select areas and data files used in these areas.

Entries in TDEF, TSTR, FDEF and TABLVALD are recorded when database for SIMPLE program or COMPLEX program is created. As stated earlier validations, which are defined before creating program, are considered for checking and value selection help. For more explanation of input tables please refer to topic on DATABASE DESIGN FOR COMPLEX PROGRAM.

DENTRY file contains memory variables, file variables, base file and field attributes including display position. During creation of COMPLEX program, field type and length are picked up from FDEF table. If it is required to use memory variable without any reference to file variable, ALTER COMPLEX PROGRAM provides facility to ADD such variable. Changing default variable names should be avoided as far as possible.

One can assign sequence number = 0 to all variables which are of non-display type. If it is required to insert some variable in between, it is possible as sequence numbers are generated in multiple of 10. All memory variables are initialised using this file. Therefore one should be careful while making program alterations. Please refer to topic on COMPLEX program alteration.

PRDBFREL table contains base file name, field name and respective variable name. This file has been introduced to take care of non-display variables, which are selected from other files or tables. If variable is not present in this file it will not be written to the disk.

If variable is present in DENTRY but not in PRDBFREL, no error will be reported. If variable is present in PRDBFREL but not in DENTRY, program execution will terminate giving error as 'FIELD NOT FOUND'.

Thus when one adds memory or change variable through COMPLEX program alteration, one should add that memory variable to PRDBFREL as well. This can be achieved by running simple program for PRDBFREL.

EASY COMPLEX program searches record in VALIDATEIN table on CHKSTR string given in DCHECK. It uses VALIDINIDX as index file for searching the record. REFSTR string contains corresponding variable names from VALIDATEIN table. Row and column fields are provided to display selected variables mentioned in EQUATEWITH of DCHECK. Field values of these variables are derived from variables mentioned in SELECTVAR field of the same table.

VALUEHLP TABLE collects fields from DCHECK. Variables mentioned in VALUEHLP thus must be present VALIDATEIN file. COMPLEX program design routine checks for presence of fields in SELECTVAR and REFSTR for existence in VALIDATEIN table. Should there be some problem with automated value help please look into these aspects in VALUEHLP table and DCHECK table.

If CHKEXISTS variable of DCHECK is set to 'Y', check will be successful if EASY finds record in VALIDATEIN file. If it is set to 'N', check will be successful if EASY can not locate record in VALIDATEIN file. If COMPULSORY is set to 'Y', program execution will continue only if check is successful. A message that string mentioned in VALIDFIELD could not be traced in file VALIDATEIN is displayed if check is unsuccessful.

Complex program creation routine writes information in one more important file: DEXIT. This file is a record of starting field of a loop, ending field of loop with their sequence numbers according to DENTRY file. Entry condition, exit criteria, skipping condition, whether entry is governed by change of some other variable, memory variable for input from screen against entry, exit or skip prompts.

Entry into the loop: When EASY finds loop starting indicator in DENTRY file it asks user 'Wish to make entries in TABLENAME' and waits for the response from the keyboard. This response is checked with default entry condition response = 'Y'. Thus if user gives input 'Y' EASY enters into the loop. Otherwise it goes to the next loop in the sequence. If VENTRY prompt field is blank default prompt is 'Switch to next window'. If CONFVAR is blank EASY does not ask any input from the screen.

If VENTRY is set to 'always' EASY enters into the loop without checking condition. Another way to achieve the same result is not to specify any entry condition and keeping CONFVAR blank. If skipping condition given in VSKIP field evaluates to be true, program execution will continue from the next loop in the sequence. If VSKIP is set to always, EASY will never enter in the loop unless F1 is pressed. On pressing F1 key one can change working window. Take the highlighted bar to the desired window and press enter.

If ONCHANGE field is not blank, EASY will enter into the loop only if value of the variable in field ONCHANGE in changed. If ONCHANGE is not blank, EASY overrides VENTRY and VSKIP conditions. If VENTRY is set to always and VSKIP is set to always, EASY will skip the loop.

Thus, it is possible to create programs with multiple windows with restricted or unrestricted entry to different windows. If user does not have access to any of the fields in the window, EASY will just enter into the loop and come out of it without accepting any inputs.

If VEXIT is 'after every record' or having condition that is always false, EASY will be in perpetual loop. One can exit from such loop with the help of F1 key.

If VEXIT is blank, EASY by default asks 'Continue?' and waits for input from the keyboard. If the response is N, EASY proceeds to next loop in the sequence. If VEXIT is blank and CONFVAR is blank or if exit condition is always true, EASY will execute loop only once .

WINDOWS: EASY records window identity with its attributes in table PRWINDOW. PRWINDOW has details such as window starting position, window ending position, Heading. In case it is required to change Height, Width and Window title, SIMPLE program for PRWINDOW can be run to change the desired record. If record is removed from this file, which has reference in DENTRY table, complex program will terminate giving error 'WINDOW NOT DEFINED.'

While creating COMPLEX program variable can be selected for update, for display only, non-display for calculations and value transfers. Variables, which are not required in the said program, can be rejected.

**Complex program alteration**

Col. What does it signify?

1 Sequence of the variable as it is taken up for execution in the program. This sequence will of importance if one is selecting some variables from VALIDATEIN file and equating them with other variables. Variables with which you equate should be taken up for execution after the value assignment.

2,3 Row and column for get position of memory variable. It can be anything for non-display variables but preferably it should be 0.

4 Memory variable name.

5 Picture clause for accepting or displaying variable

6,7 Window in which memory variable and text string are displayed and whether window should be closed as program moves to next field.

8,9 Display and update attribute (Y = yes, N= no)

10,11 Base table and base field

12 Whether to retain the value of memory variable after writing the record.

(Y= retain N = initialise with spaces or 0)

13,14 Row and column position for text display string.

15 Text string

16 Last variable of the table (At this point decision is taken on inserting, updating or deleting record from the file.

17 Loop start or end indicator (S for start, E for End)

18 Loop identity number

19 First variable (Y for first variable of program and first table) (A for first variable of a table)

20 Last variable of the program

21 Search file at this variable. (B for before, A for after)

22 Whether to execute the variable only once in the program

**7.9 Auto report**

Auto reporting depends on the same files with which COMPLEX program is executed. Usually, file search indicator (PEND) of first file in sequence is set to 'A' which tells EASY to search the file with search key after the field. It is not that one cannot run COMPLEX program if this indicator is set to 'B' which tells EASY to search the file before the field. In latter case whenever one opens the program, all the variables pertaining to this file will have value of the first record. If a new value is to be entered, one will have to make key-field blank then enter the new value and press up-arrow so that before field operations are executed. This is the only difference.

Auto report execution requires this indicator to be 'B' always. Because One gets the report without furnishing any additional information, it is as good as automatic and therefore the title 'AUTO REPORT'.

During creation of COMPLEX program EASY puts header and line records for constituting tables in RHEDFOOT and RDISPLAY tables respectively. There is another header file RSTAND, which contains common header routine. one can store more than one common header routines in different files or tables and call them whenever necessary. Records in RSUMMARY table can be created or updated through simple program, for printing summary totals, averages, count on change of any variable in the program. Auto report performs all before field operations and after field operations including validation checks. Auto report by default prints all display and update fields. The printing order or printable variables can be changed through SIMPLE program for RHEDFOOT (report header) and RDISPLAY (report detail lines).

Auto report starts printing from level 0. It looks for variable complying with SEARCH KEY. If master detail structure has hierarchies beyond 2 levels, Auto report goes levels down up to the last level. It prints all records satisfying the SEARCH KEYS of all tables in hierarchy in reverse direction.

For example there is a table containing balance sheet heads, another table containing Balance sheet sub heads linked to heads table through head-id, third table having schedules linked to subheads through subhead-id, fourth one of sub schedules linked to schedule with schedule-id. AUTO REPORT will produce output something like-

Head Subhead Schedule Sub Schedule

Id Desc Id Desc Id Desc Id Desc

1 xx 1 xx 1 xx 1 xx

2 xx

2 xx 1 xx

2 xx

2 xx 1 xx 1 xx

2 xx

2 xx 1 xx

2 xx

2….

**7.10 Report Writer**

It works on similar principles except that it stores records in hierarchical fashion so that self join is possible.

**7.11 Dynamic Query**

Dynamic query is query which asks user to decide action, select variables from files, table joining strings, summary options and sort options through on screen dialog. Query components are stored in different tables. Because it stores values in different tables, query is always saved before execution.

DYNAMIC QUERY makes use of following tables.

QRYLIST : Query record.

QHEDFOOT : Header information.

QDISPLAY : Display detail information.

QJOINS : Table joining conditions.

QSORT : Sort order.

QFILTER : Record selection criteria.

QSUMMAR : Summarise query fields on change of some field.

Operation sequence is

1. Create query

2. Execute query

**7.12 Keys and Buttons**

This section gives the keys and buttons which are employed in the Easy program to facilitate various operations.

**KEYS**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**KEY FUNCTION**

F1 Change working window

F2 Change variable sequence

**KEYS (Continued from the previous page)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**KEY FUNCTION**

F3 Show keys

F4 SOS - QUIT

F5 -

F6 -

F7 -

F8 -

F9 -

F10 Value Help

F11 Close all windows

F12 Return to menu

ESC Accept selected record

Previous Field Up Arrow

Next Field Tab, Down Arrow

Navigate selection Up Arrow AND Down Arrow

Last record Page down

First record Page Up

First Window Home

**BUTTONS**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Add Insert record

No Action Don't write entries

**BUTTONS (Continued from the previous page)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Select Select record for update

Update Write updated entries

Remove, Delete Delete the present record

Next Next record

Previous Previous record

Start First record

Last Last record

Finish, Over, Exit End operation

**7.13 Summary**

This chapter presented the concept of codeless database management system (CDBMS) and discussed various aspects pertaining to CDBMS in relation with standard DBMS software. CDBMS or EASY program is a file based development platform, which does not require any hard coded programs to be written. It has automated routines for generating programs. While generating programs, it does not create code as is the case with other languages, but puts the record of program in various files or tables. A background program accesses these tables to run user programs. User is not expected to know programming language. It has also been observed that CDBMS offers many more facilities compared to RDBMS. This chapter also gave a framework for making CDBMS software and discussed various operations in detail.

## Advantages of CDBMS

* Platform independent
* Evolutionary prototyping capabilities coupled with structured system analysis and

design

* Speedy development as most of the programs will be ready to execute soon after

design stage

* Fast customization as changes are required only in design
* Full accordance of running system with system documentation. This is because

live system is driven from the same tables from which documentation is

available. That is, live system is always documented.

* Web enabled programming with powerful data handling capabilities.
* In built support for knowledge management

***Limitation of CDBMS and avenues for future search***

* It lacks array handling capabilities. Further work would be useful in this direction.
* Protocol interface required to be added to add web programming facilities.
* Lacks multithreading capabilities.

Next chapter summarises the thesis.

**Chapter 8**

**SUMMARY AND CONCLUSIONS**

**8.1 Summary of work**

The present research work successfully achieved the following objectives:

* Analysis of the competitiveness of the Indian textile industry through SWOT analysis based on the available data to suggest the necessary measures along with the required changes in the national textile policy to make the industry more competitive in the international markets.
* Proposal for IT enabled model to represent all the sectors from the Indian textile industry to derive benefit of the low cost of the decentralised sectors and the marketing expertise of the centralised sectors with the emphasis on the supply chain management, customer relationship management.
* Highlighting of the specific needs of textile sector from its comparison with the other manufacturing industries.
* Presentation of an instrument to analyze the business performance in the form a structured questionnaire to address the various issues from different functional areas of a business organization.
* Highlighting of the role of the information technology in improving the competitive ability of a reputed composite textile unit through the analysis of the response obtained to the questionnaire in a case study.
* Design of a general information management model which can be applied to the textile industry based on event diagrams and interaction diagrams with the detailed discussion on application of production planning and control in connection with a composite textile mill.
* EROS (Event Related Open Systems) designing methodology based on event driven approach.
* Introduction of event diagrams and interaction diagrams as tools for system analysis and design.
* A framework for business analysis based on EROS principles.
* Introduction of principles CDBMS (Codeless Database Management System) to support the development of proposed model and supporting data model based on the event model.

Keeping in view the objectives, this thesis can be visualized as consisting of five different sections. First section dealt with literature review. In second section analysis of competitiveness of Indian textile industry was carried out and a suitable model for Indian textile industry as a whole was suggested. This section also highlighted the need of integrated information management solution through a case study of a composite mill. Third section was dedicated to designing methodology. Fourth one to integrated information management model and fifth sections speaks of codeless database management system - Easy Program. Block diagram in the figure 8.1 shows the steps involved in carrying out the research work.

**8.2 Contributions of the present work**

Broadly, the contributions of the present work can be spelt out as given below:

* Classified the literature into the following categories. Each category is further divided into subcategories.
* Business perspective
* IT perspective
* Issues related to the textile industry
* Proposed an instrument to analyse business performance in the form of a structured questionnaire consisting more than 300 items to cover the functions of financial accounting, production, purchase, supplier management, inventory,

Conducted Literature Review

Prepared Questionnaire

Conducted Case Study

Offered Suggestions Regarding Textile Policy for India

Prepared IT Enabled Model for Indian Textile Industry

Anaysed Indian Textile Industry

Discussed EROS Principles

Explained Construction of System Diagram

Explained Construction of Event Diagram

Explained Construction of Interaction Diagram

Prepared Event Diagrams and High level Interaction Diagrams for IIMMT

Furnished Information Elements for IIMMT

Discussed Application of EROS Principles to BA

Discussed PPC application for Textiles

Introduced Codeless DBMS Concepts

Information Technlogy

Integrated Information Management Model for Textiles

Event Related Open Systems

Business Analysis Production Planning and Control Database Management System

Figure 8.1 Summary of the work done

customer management, marketing, product development, manpower and quality control.

* Sought the justification for using the integrated information management system to assist the business operations in the textile industry through a case study of a textile unit. It was observed that the integrated information management solution offers a good scope for the improvement in the functioning of an organization in terms cycle time reduction, cost reduction and increased sales. Case study also brought out the utility of the questionnaire in analyzing the functioning of a business establishment. It was observed from the case study that event diagrams represented the business procedures up to the satisfaction of the users of the textile unit and can be adopted by a textile mill with or without modification.
* Strengths, Weaknesses, Opportunities and Threats related to the Indian textile industry were observed as given below:
* **Strengths:** Availability of raw material (RM), variety of RM, low cost of cotton, cheap labour, low production cost, variety of designs, wide variety of processes and technologies, high conversion yield.
* **Weaknesses**: High power cost, low cotton yield and poor quality, high cost of RM for man made fibres, deficient network of small sector and organized sector, old machines, distance from the market, procedural delays, less research spending, low productivity, less installed capacity, no known brand.
* **Opportunities**: To take advantage of institutional support, exploitation of information technology (IT), increasing per capita consumption of cloth and open markets.
* **Threats**: Free trade, anti dumping duties on Indian goods, subsidies offered by other nations to their exporters, population growth.
* Proposed an integrated IT enabled model for the Indian textile industry having following features.
* Representation for all sectors from textile industry.
* Marketing centres with complete supply chain planning capabilities.
* Training and maintenance centres for decentralised sectors.
* Coverage of all business functions.
* Suggested following changes in National Textile Policy (NTP) – 2000
* NTP should provide for Marketing centres with supply chain management capability
* NCUTE should focus on training of power loom operators, and shop floor personals from organised mills sector. Although policy speaks of providing assistance in HR development for decentralised sectors, training centres are not conceived for power loom industry.
* Export strategy does not include building of retail outlets abroad for goods manufactured in India. It is particularly important for ready made garments.
* Power loom industry is more competitive and therefore it is a candidate for further investment to increase production base.
* Suggested Important measures to increase the competitiveness of the Indian Textile industry as given below:
* Investment to increase production base
* IT for coordination of fragmented industry and efficient management of business
* Training center for quality improvement
* R & D activities to improve cotton quality and cotton production yield.
* Suggested an implementation framework for the proposed integrated information management model and discussed a framework for designing of a production planning control system for a composite textile mill.
* Introduced designing methodology comprising the following elements
* System diagram
* Event diagrams
* Notation to depict system behaviour through event diagrams
* Interaction diagrams
* Introduced EasyDBMS or CDBMS (Codeless Database Management System) concept having following potential
* Built in intelligence
* Code-less programming (Virtual programs)
* Web programming facilities
* Superior query builder
* Built in report writer
* Built in securities up to field level
* Offered Data Model for CDBMS
* Discussed a framework for developing CDBMS software.
* Emphasized universality of event model by presenting event model for representation of
* Business and information system analysis
* Textile processes
* Data model for CDBMS
* 27 Modules of the integrated information management solution as given below:
* Financial resources
* Financial accounting
* Accounts Payable
* Accounts receivable
* Costing
* Bill of material
* Operations
* Material planning
* Capacity planning
* Production accounting
* Supplier management
* Purchase
* Inventory
* Customer management
* Product development
* Marketing
* Advertising
* Sales monitoring
* After sales service
* Manpower recruitment
* Manpower allocation
* Training
* Personnel
* Quality control
* Trouble shooting
* Plant maintenance
* Business events

The proposed methodology offers following contributions to analysis and design function.

* Active participation of users - The model adopts a very simple approach of listing activities to analyse business process needs. It is an easy way to represent the whole business. Non-system persons can easily understand such approach and therefore their active participation in designing the system can be solicited. They are expected to enter process sequence and related information through a user friendly software, which would construct event diagrams from the information supplied by the user. Such information can then be analysed by experts or consultants or by top management.
* Correction of flaws at higher level of abstraction – Logical sequence of events is expected right from the first level. It is compulsory to give whether process is mandatory and optional. If more than one origin is suggested for any event or data element, software can bring out the discrepancy right at the point when event details are recorded. All these contribute to detection and correction of logical flaws in the business processes at higher level.
* Clearer understanding of the business – The diagrams carry much more information and are less cluttered. This gives the clearer understanding of the business.
* Two way design- Top down, Bottom up - Interaction diagrams are worked out after individual events of all modules are finalised. Thus the designing is done in both ways, top to bottom and bottom to top
* Assistance in fixing responsibilities - Interaction diagrams also tell you the module in which the events are originated. That is they define the primary responsibility of supplying raw data for the event and thus assist in fixing the responsibilities. As the department and concerned person will be held responsible for correctness and effectiveness of supplied data, event diagrams also tell the primary responsibility for supply of raw data. If different modules need the same information, primary responsibility can be fixed according to origin of the data.
* Assistance in deciding field characteristics - If the event that is defined as mandatory is to be referenced in any subsequent events, key fields related to referred events must be defined as mandatory.
* Direct relation of system elements to events - All system elements like fields, tables, programs, queries, reports are directly related to business processes as system elements are grouped according to events.
* Common procedure for business analysis and information system analysis - A systematic procedure is suggested for business process analysis which combines analysis and design needs of information system as well. It proposes tool of event diagrams, which can be effectively used for dialog between analyzer and end user. Event diagrams give the cycle of operation within the process. All four necessary views of organization are tightly integrated with each other. For example, in classical methods of business process reengineering, structural view or data view is separate and is represented by ER diagrams. Process view of organization is expressed by DFD, Net work diagrams are used for showing behavioral view. As discussed earlier, it is difficult to integrate all these views. In addition, organizational theoretic of roles and responsibilities is not taken into account.

The proposed methodology offers the following advantages:

* It has only one backbone to support all views namely data view, process view and behavioral view. In addition, roles and responsibilities and cultural requirements of an event can also be defined. Interaction diagrams are actually constructed from event diagrams and therefore there is no chance of discrepancy between interaction diagrams and event diagrams. Again, interaction diagrams are constructed after data analysis for required events, and therefore they represent exactly what event has to pass on.
* Process view is available in the form of event diagrams and interaction diagrams. It offers hierarchical view of the organization. Event diagram also has behavioral attributes, through different notations provided to describe different connections on different conditions. Event notations can also represent conditions in which iterations are required.
* Base event recording for every event gives complete network of the same events to give completeness to behavioral view of the organization and thus it is fully integrated with structural and process view.
* As discussed earlier it clearly demarcates the responsibilities for different departments of an organization and helps in deciding procedures for communications.
* It can have a support from relevant information system, as the business analysis methodology is not different from system designing methodology.

**8.3 Limitation of the present work**

The present work has some limitations as listed below:

* Proposed Integrated Information Management Model lacks automation aspects.
* It is not applied to test the developed system in live conditions mainly because the proposed developed platform would need massive efforts to make it operational.
* Suitable software is not available to draw event diagrams from the data base design.
* CDBMS software is not yet commercially available with all the aspects discussed in the chapter 7.

Chapter 9

FURTHER RESEARCH

It is necessary to incorporate process automation aspects in the business analysis. Further research would be useful in this direction. Software is required to draw event diagrams and interaction diagrams from the information supplied in the designer’s screen. Such software would also take care of changes made in database design after system is implemented so as to have system documentation always in accordance with the running system. Some work could be carried out to incorporate inferences with various statistical software and program management techniques like linear programming, goal programming, transportation problem solvers etc. Such software would be a great aid in implementing six-sigma and other reengineering solutions. Further work on codeless database management system (CDBMS) is necessary to make it commercially available. There is a need to have database management system to support the design technique to reduce the programming work to minimum. The idea is to have all information stored in different tables or files and there would be a set of central programs to take care of manipulation of design details through runtime creation of commands. That is, once the design is ready, the whole system can work without any substantial development or programming efforts. System designer can then have system design combined with evolutionary prototyping capabilities. In short, system design and development itself is treated as another computerized system. It can dramatically reduce development time and would facilitate customization process since change in design is what is required to change the behavior of the system. Software can also be developed to assist business analysis exercise. A complete ERP-II system can be designed and developed using EROS principles for textile industry.

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Appendix -1

**QUESTIONNAIRE**

This questionnaire is so arranged so that it can be distributed to different departments. There is some repetition of questions, which is essential so that everyone gets complete set of questions to record the responses.

A1.1 Respondent Profile

|  |  |  |
| --- | --- | --- |
| Organization | Name |  |
| Address |  |
| Phone |  |
| Fax |  |
| Email |  |
| Web site |  |
| Name | Mr/Ms | |
| Designation |  | |
| Personal Email |  | |
| Date of Birth |  | |
| Computer Skills |  | |

EDUCATION

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Branch | Degree | University | Specialization | Year |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

EXPERIENCE

|  |  |  |  |
| --- | --- | --- | --- |
| From  To-Year | Organization | Designation | Job Description |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**A.1.2 Financial Accounting**

**Response Scale 1-5 (Tick in the appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How well is your information system in tackling problems related to finance management? |  |  |  |  |  |  |  |
| 1. How do you rate planning efficiency of information system for finance? |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent financial accounting and control? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How effective is your finance balancing system to take care of unforeseen problems? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about exact finance status of your company? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about finance status of your suppliers? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about finance status of your customers? |  |  |  |  |  |  |  |
| 1. How effective is your information system in prompting you for delayed payments? |  |  |  |  |  |  |  |
| 1. How effectively can you follow customers for non-payment of invoices after due date? |  |  |  |  |  |  |  |
| 1. How effectively can you control allocated budgets through information system? |  |  |  |  |  |  |  |
| 1. How do you rate accuracy of projected cash in flows? |  |  |  |  |  |  |  |
| 1. How do you rate accuracy of projected cash out flows? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your business? |  |  |  |  |  |  |  |

**Financial Accounting**

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

**NA: Not Applicable**

**NV: Not Available**

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | % | NA | NV |
| 1. How many bills are paid on time? (bills paid on time / total bills) |  |  |  |
| 1. How many times do you pay interest on account of delayed payment?   (Bills paid with interest / total bills) |  |  |  |
| 1. What is the extra amount do you pay on account of delayed payments?   (interest paid for delayed payments / total purchase value) |  |  |  |
| 1. How much unplanned expenditure other than purchase do you incur?   (unplanned / planned expense) |  |  |  |
| 1. How much unplanned purchases do you make?   (unplanned purchase value / planned purchase value) |  |  |  |
| 1. How much extra expenditure can be related to unplanned expenses other than purchases? (actual expense – normal if it were planned) / total expenses |  |  |  |
| 1. How much extra expenditure can be related to unplanned purchase?   (actual purchase value – normal purchase value if it were planned) / total purchase  value) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (manually created documents / total documents) |  |  |  |
| 1. How much of the business is on e-commerce if you are using it?   (business turnover through e-commerce / total turnover) |  |  |  |

**Financial Accounting**

# Response to be recorded as YES or NO

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 1. Can you see finance position of company and sister-companies as whole on-line? |  |  |
| 1. Does information system offer you advice from past record of customer? |  |  |
| 1. Can you simulate finance requirements through computer for all departments? |  |  |
| 1. Do you get purchase plan from computer? |  |  |
| 1. Can you access computer from your desk? |  |  |
| 1. Do you get costing information from computer on line? |  |  |
| 1. Do you get actual cost figures associated with products and departments? |  |  |
| 1. Do you get break up of fixed and variable costs? |  |  |
| 1. Can your computer system allocate indirect costs to different products? |  |  |
| 1. Do you get history information to compare financial status of company on-line for different periods? |  |  |
| 1. Can you view balance sheet of the company on-line? |  |  |
| 1. Can you view profit and loss account of the company on-line? |  |  |
| 1. Can you view actual cash flows of the company on-line? |  |  |
| 1. Does your system prompt you to check for payment realization on expected date? |  |  |
| 1. Are you aware of financial status of your suppliers? |  |  |
| 1. Are you aware of financial status of your customers? |  |  |
| 1. Does current system support internet transaction processing? |  |  |
| 1. Are you familiar with e-commerce? |  |  |
| 1. Are you using e-commerce? |  |  |

**Please give your brief response to the following queries in the blank papers**

**provided with the questionnaire.**

|  |
| --- |
| 1. What are the reasons for the current performance level of the computer system? |
| 1. What are main reasons for unplanned expenditure? |
| 1. Which are the departments for which finance information can not be planned in advance? What are main reasons for that? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the financial accounting and control system? What modifications do you suggest in it? |
| 1. What information do you expect from other departments for smooth and effective running of your department? Please summarise them as   Department, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. What can be done to avoid extra expenses due to incorrect co-ordination? |
| 1. What procedure do you adopt to apportion indirect costs to products? |
| 1. What problems do you face in reconciling information for presentation to government bodies? |
| 1. What do you think can be done to overcome these problems? |
| 1. How do you think computer can be useful in judging financial status of suppliers or customers? |
| 1. What are the alternative arrangements if your present computer system is not working? |
| 1. Do you think there are delays in decision making for day to day operations? What are the reasons for that? What measures do you suggest to improve day to day working of your department? |
| 1. What information about your company is available on the net? |
| 1. What information do you send and receive using internet? |

**A.1.3 Production**

**Response Scale 1-5 (Tick in the appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Please consider the performance for the financial year 1999-2000. | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How do you rate performance of computer system as far as your department is concerned? (In comparison with earlier system) |  |  |  |  |  |  |  |
| 1. How effective is raw material supply? |  |  |  |  |  |  |  |
| 1. How effectively changes in production are implemented? |  |  |  |  |  |  |  |
| 1. How do you rate production efficiency of your department? |  |  |  |  |  |  |  |
| 1. How do you rate synchronization of production rates of machines in production sequence to get balanced line? |  |  |  |  |  |  |  |
| 1. How effective is computer system in giving you indication of product efficiency to decide which product is best to run on which machine? |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent the production system? |  |  |  |  |  |  |  |
| 1. How effective is current planning module for production to get accurate production plan? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How effectively you are informed about exact production status of different sections? |  |  |  |  |  |  |  |
| 1. How effective is your rescheduling system to take care of unforeseen problems? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about production status of sub contractor’s production unit? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about shop floor production troubles? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about production troubles of subcontractor’s production unit? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your business? |  |  |  |  |  |  |  |

**Production**

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

|  |  |  |
| --- | --- | --- |
| **NA** | **Not Applicable** | **Tick in this column if the point it not relevant to your industry** |
| **NV** | **Not Available** | **Tick in this column if information related to the point is not available** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. What is the total time for which machines are stopped because of non-availability of raw material? (stopped time / planned running time) |  |  |  |
| 1. What is the total time for which machines are stopped because of inferior quality of raw material? (stopped time / planned running time) |  |  |  |
| 1. What is the overall average machine efficiency of your department?   (actual production / 100% production possible with used capacity ) |  |  |  |
| 1. What is the capacity utilisation of your department?   (100% production with used capacity / 100% production with 100% capacity) |  |  |  |
| 1. How much is unplanned production?   (unplanned production time / planned running time) |  |  |  |
| 1. What is the total time for which machines are stopped because of non-availability of material from earlier processes? (stopped time / planned running time) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (documents recompiled / total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time for recompiling / total working time) |  |  |  |
| 1. How much of your production suffers due to incorrect co-ordination of information? (stopped time / planned running time) |  |  |  |
| 1. How many times do you rework produced goods?   (Reworked production/Total production) |  |  |  |
| 1. How many of your staff can work on computer? (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (Manually created documents/ Total documents) |  |  |  |

**Production: Response to be recorded as YES or NO (Tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 1. Can you simulate capacity requirement through computer? |  |  |
| 1. Do you get material and labor plan from computer? |  |  |
| 1. Can you know how efficiently an individual worker works? |  |  |
| 1. Do you get efficiency loss analysis attributable to specific reasons from computer? |  |  |
| 1. Does your computer system render you accurate capacity utilization figure? |  |  |
| 1. Does current computer system render you accurate machine, labor and product efficiency figures? |  |  |
| 1. Can you access computer from your desk? |  |  |
| 1. Do you get information about process parameters related to particular product from computer?   (For example Draft, Humidity, Twist, Spindle Speed, Pressure etc) |  |  |
| 1. Do you get trouble shooting information from computer? |  |  |
| 1. Can you plan maintenance schedule changes to optimize production time loss and loss due to bad product quality or wear and tear of machine? |  |  |
| 1. Do you get history information of efficiency and production figures for last two years? |  |  |
| 1. Can you plan labor requirement effectively? |  |  |
| 1. Can you visualize capacity problems of subcontractor? |  |  |
| 1. Can you plan for capacity and materials for sub contractor's production unit? |  |  |
| 1. Are your sub contractors paid on time? |  |  |
| 1. Does current planning system give allowance for reworking of produced goods? |  |  |
| 1. Does current trouble shooting system offer you advice on problems because of which reworking is necessary? |  |  |
| 1. Can you send and receive information related to production orders through internet to and from other units? |  |  |

**Please give your brief response to the following questions**

|  |
| --- |
| 1. What are the reasons for the current performance level of the computer system? |
| 1. What are the alternative arrangements if your present computer system is not working? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the production system? What modifications do you suggest in it? |
| 1. What information do you get about process parameters related to a particular product from computer? |
| 1. What information do you expect from other departments for smooth and effective running of your department? Please summarise them as   Department, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. How do you think co-ordination between departments can be improved? |
| 1. How do you think production planning decisions for the factory can be improved? |
| 1. How do you think planning decisions for sub contracting can be improved? |
| 1. What are the main reasons for rejected products? What measures do you suggest to reduce rejections? |
| 1. What are the problems or bottle necks in production process? |
| 1. How do you think they can be rectified? |
| 1. Do you think there are delays in decision making for day to day operations? What are the reasons for that? What measures do you suggest to improve day to day working of your department? |
| 1. What method do you adopt to evaluate performance of individual worker or to calculate efficiency of individual worker? |
| 1. What information do you send and receive using internet? |

**A1.4 Purchase and Supplier Management**

**Response Scale 1-5 (Tick in appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How effective is raw material supply? |  |  |  |  |  |  |  |
| 1. How effectively supply of material can adopt to changes in production planning? |  |  |  |  |  |  |  |
| 1. How effective is your information system in tackling problems related to supply management? |  |  |  |  |  |  |  |
| 1. How effective is your planning for capacity and materials for your supplier? |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent the supplier management system? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How effective is your supplier selection system to take care of unforeseen problem? |  |  |  |  |  |  |  |
| 1. How effectively you are informed about exact production status of supplier's production unit? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about supply problems of your supplier? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about processing problems at supplier’s production unit? |  |  |  |  |  |  |  |
| 1. How does your supplier rate you compared to his other customers? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your business? |  |  |  |  |  |  |  |

**Purchase and Supplier management**

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

**NA : Not Applicable**

**NV : Not Available**

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. What is the total time for which machines are stopped because of non-availability of raw material? (stopped time / planned running time) |  |  |  |
| 1. What is the total time for which machines are stopped because of inferior quality of raw material? (stopped time / planned running time) |  |  |  |
| 1. How many times do you place orders with supplier of lower preference or orders at higher prices due to incorrect coordination of information? (purchase value for such purchases / total purchase value) |  |  |  |
| 1. How much is probable loss because of such orders?   (Actual expense – Normal if it were planned) / total expenses) |  |  |  |
| 1. How many times do you place orders with supplier of lower preference or orders at higher prices because of urgent need?   (purchase value for such purchases / total purchase value) |  |  |  |
| 1. How much is probable loss because of such orders?   (Actual expense – Normal if it were planned) / total expenses) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How many times supply and therefore production suffer due to incorrect co-ordination of information? (stopped time / planned running time) |  |  |  |
| 1. How many visits on an average a supplier has to make to get his payment?   (total visits for getting payments / total bills) |  |  |  |
| 1. How many times do you reorder supplied goods?   (rejection value / total purchase value) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually? 2. (manually created documents / total documents) |  |  |  |
| 1. How much of your business is carried through e-commerce in case you are making use of it? (purchase value through e-commerce / total purchase value) |  |  |  |

**Purchase and Supplier Management**

**Tick the appropriate column**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 1. Does current information system help in selection of supplier? |  |  |
| 1. Do you get material purchase plan from computer? |  |  |
| 1. Do you get material, capacity and labor plan for supplier's factory from computer? |  |  |
| 1. Can you access computer from your desk? |  |  |
| 1. Do you get history information to compare efficiency and production figures? |  |  |
| 1. Can you visualize capacity problems of supplier? |  |  |
| 1. Can you foresee delays in supply of material? |  |  |
| 1. Are your suppliers paid on time? |  |  |
| 1. Does current system support internet transaction processing? |  |  |
| 1. Does your supplier complain about treatment at your office? |  |  |
| 1. Are you aware of supply markets of your supplier? |  |  |
| 1. Are you aware of complete backward chain up to the last supplier? (Suppliers of supplier...) |  |  |
| 1. Are you familiar with e-commerce? |  |  |
| 1. Are you using e-commerce? |  |  |

**Purchase and Supplier Management:**

**Please give your brief response to the following queries in the blank papers**

**Supplied with the questionnaire**

|  |
| --- |
| 1. What is your complete backward chain of suppliers of supplier up to the raw market? |
| 1. What are the processing facilities at every supplier in the supplier chain? |
| 1. What are the reasons for the current performance level of computer system? |
| 1. What are alternative arrangements if your current computer system is not working? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the supplier management system? What modifications do you suggest in it? |
| 1. What information do you expect from other departments for smooth and effective running of supplier management function? Please summarise them as   Department, Site, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. What arrangements can you make if one supplier fails to deliver on time? |
| 1. How do you think co-ordination with supplier can be improved? |
| 1. How do you think production planning decisions for supplier’s production unit can be improved? |
| 1. What are the problems that you face while dealing with suppliers? |
| 1. What do you think can be done to overcome these problems? |
| 1. What are the main reasons for disturbances in raw material supply? What measures do you suggest to avoid them? |
| 1. What information would like to include in supplier database? |
| 1. What information of your business do you think is necessary to be given to supplier? |
| 1. What are the alternative arrangements if your present computer system is not working? |
| 1. Do you think there are delays in decision making for day to day operations? What are the reasons for that? What measures do you suggest to improve day to day working of your department? |
| 1. What method do you adopt to evaluate performance of individual purchaser? |
| 1. What are the factors that your information system takes into account to select supplier? Are they sufficient? What are other factors that you would like to include? |
| 1. What is the procedure to register supplier's complaints, solve them and to reply back? |
| 1. How do you think computer can be useful in improving dialog with supplier? |
| 1. What are the factors, which supplier takes into account to treat you as his customer? |
| 1. What are possible problems in supply markets of suppliers? |
| 1. What suggestions can you make to expand supply base of supplier? |
| 1. Who are your business partners? What products do you need from them to provide a complete solution? |

**A1.5 Inventory**

**Response scale (Tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How do you rate performance of computer system as far as your department is concerned? (In comparison with earlier system) |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent the inventory system? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your activities? |  |  |  |  |  |  |  |
| 1. How effectively can you manage your spares inventory? |  |  |  |  |  |  |  |
| 1. How effectively can you manage your tooling inventory? |  |  |  |  |  |  |  |

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. What is the total time for which machines are stopped for non-issue of available material? (stopped time / planned running time) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How many of your staff can work on computer? (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually? (manually created documents / total documents) |  |  |  |
| 1. On how many occasions does the production suffer due to non-availability of material in the stores? (stopped time / planned running time) |  |  |  |
| 1. How many times actual consumption is less than expected consumption?   (months with surplus stock / 12) |  |  |  |
| 1. How many times actual consumption is more than expected consumption?   (unfulfilled requisitions / total requisitions) |  |  |  |
| 1. What is the percentage of adjustments that are necessary to tally the physical and book stock? (physical value / book value) |  |  |  |
| 1. How much money is blocked in slow moving items? (value of slow moving items / total stock value) |  |  |  |
| 1. How much money is blocked in dead items? (value of non-moving items / total stock value) |  |  |  |

**Inventory**

**Response to be recorded as YES or NO (Tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 1. Can you co-relate purchases to a particular requisition or department? |  |  |
| 1. Can you see status of any requisition on-line? |  |  |
| 1. Can you allocate material to specific shop order? |  |  |
| 1. Does your system prompt you if material is falling below re-order stock? |  |  |
| 1. Is there any automated link to supplier giving him indication of your requirements? |  |  |
| 1. Does your computer supply you consumption analysis to show seasonal effects? |  |  |
| 1. Can you access computer from your desk? |  |  |
| 1. Do you get actual cost figures related to departments and products? |  |  |
| 1. Does your information system prompt you for physical stocktaking? |  |  |
| 1. Do you get all inventory control reports including ABC analysis from computer? |  |  |
| 1. Does your current system support internet transaction processing? |  |  |

**Please give your brief response to the following queries in the blank papers**

**provided with the questionnaire.**

|  |
| --- |
| 1. What are the alternative arrangements if your present computer system is not working? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the inventory system? What modifications do you suggest in it? |
| 1. What information do you expect from other departments for smooth and effective running of inventory function? Please summarise them as   Department, Site, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. How do you think co-ordination between departments can be improved? |
| 1. Can you manage your tooling inventory properly? Why? |
| 1. What methods do you use to arrive at minimum and maximum stock levels? |
| 1. What are the reasons for difference in expected and actual consumption? |
| 1. What are the reasons for passing adjustments in book stock to match it with actual stock? |
| 1. What are the reasons attributable to stocked slow moving and dead items? |
| 1. How do you arrive at required finished goods inventory and raw material inventory? |
| 1. How much finished goods inventory do you stock? For what duration? |
| 1. How many raw material inventories do you stock? For what duration? |
| 1. What are the problems in managing tooling inventory? |
| 1. What information do you send and receive using internet? |

**A1.6 Customer Management**

**Response Scale 1-5 (Tick in appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How effective is your information system in tackling problems related to customer management? |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent the customer management system? |  |  |  |  |  |  |  |
| 1. How effective is your planning for capacity and materials for supplier? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How effective is your customer manipulation system to take care of unforeseen problems? |  |  |  |  |  |  |  |
| 1. How effectively you are informed about exact production status of customers' factory? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about market problems of your customer? |  |  |  |  |  |  |  |
| 1. How effectively are you informed about processing problems of customer’s production unit? |  |  |  |  |  |  |  |
| 1. How does your customer rate you compared to his other supplier? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your business? |  |  |  |  |  |  |  |

**Customer Management**

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

|  |  |  |
| --- | --- | --- |
| **NA** | **Not Applicable** | **Tick in this column if the point it not relevant to your industry** |
| **NV** | **Not Available** | **Tick in this column if information related to the point is not available** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. What is the total time for which machines are stopped because of non-availability of customer? (stopped time / planned running time) |  |  |  |
| 1. How many times do you face problems because of not delivering the order as planned? (orders delayed / orders delivered on time) |  |  |  |
| 1. What is the number of orders sold with discount due to incorrect coordination of information? (discounted orders / total orders) |  |  |  |
| 1. How much is probable loss because of price cuts? (discount value / planned sales value) |  |  |  |
| 1. What is the number of orders sold with discount because of surplus production? (discounted orders / total orders) |  |  |  |
| 1. How much is probable loss because of such price cuts? (discount value / planned sales value) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How much time is wasted in doing adjustments in production changes due to unplanned orders? (Extra setting and cleaning time / total production time) |  |  |  |
| 1. How many visits on an average a customer has to make to get his complaint sorted? (customer visits related to complaints / total complaints) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (manually created documents / total documents) |  |  |  |
| 1. How much of your business is carried through e-commerce in case you are making use of it? (sales value through e-commerce / total sales value) |  |  |  |

**Customer Management Please tick the appropriate column**

|  |  |  |
| --- | --- | --- |
| 1. Does current information system help in deciding on customer? | **Yes** | **No** |
| 1. Do you get product sales plan from computer? |  |  |
| 1. Do you get material, capacity and labor plan for customers' production unit from computer? |  |  |
| 1. Can you access computer from your desk? |  |  |
| 1. Can you visualize capacity problems of your customer? |  |  |
| 1. Can you foresee delays in proposed sales orders because of trouble in markets of customer? |  |  |
| 1. Are your customers given deliveries on time? |  |  |
| 1. Does current system support internet transaction processing? |  |  |
| 1. Can you make re-arrangements if any customer fails to stick to his promise of buying? |  |  |
| 1. Does your customer complain about treatment at your office? |  |  |
| 1. Are you aware of sales market of your customer? |  |  |
| 1. Is there any automated link to customer to get indication of requirement? |  |  |
| 1. Are you aware of complete forward chain up to the end user? |  |  |
| 1. Are you familiar with e-commerce? |  |  |
| 1. Are you using e-commerce? |  |  |

**Please give your brief response to the following queries**

|  |
| --- |
| 1. What is your complete forward chain of customers of customers up to the end user? |
| 1. What are the processing facilities at every customer in the customer chain? |
| 1. What are the reasons for the current performance level of the computer system? |
| 1. What are alternative arrangements if your current computer system is not working? |
| 1. How do you rate the event diagram supplied by us to represent the customer management system? Can you supply all the information asked in it? What modifications do you suggest? |
| 1. What information do you expect from other departments for smooth and effective running of customer management function? Please summarise them as   Department, Site, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. How do you think co-ordination with customer can be improved? |
| 1. How do you think planning decisions for customer’s production unit can be improved? |
| 1. What are the problems that you face while dealing with customers? |
| 1. What do you think can be done to overcome these problems? |
| 1. What are the main reasons for disturbances in getting continuous orders? What measures do you suggest to avoid them? |
| 1. What information would you like to include in customer database? |
| 1. What information do you think is necessary to be given to customer? |
| 1. What are the alternative arrangements if your present system is not working? |
| 1. Do you think there are delays in decision making for day to day operations? What are the reasons for that? What measures do you suggest for improvement? |
| 1. What method do you adopt to evaluate performance of individual sales person? |
| 1. What are the factors that your information system takes into account to decide on a customer? Are they sufficient? What are other factors that you would like to include? |
| 1. What is the procedure to register customers' complaints, solve them and to reply? |
| 1. How do you think computer can be useful in improving dialog with customer? |
| 1. What are the factors, which customer takes into account to treat you as his supplier? |
| 1. What are possible problems in sales markets of customers? |
| 1. What suggestions can you make to expand markets of your customer? |
| 1. Who are your business partners? For what products and where the supply is used? |
| 1. What information do you send and receive using internet? |

**A1.7 Marketing**

**Response Scale 1-5 (Tick appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable | Information not relevant to your industry |
| NV | Not Available | Information not available |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How effective is your information system in tackling problems related to marketing? |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent marketing management system? |  |  |  |  |  |  |  |

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. How many inquiries are converted into orders? (inquiries converted into orders / total inquiries received) |  |  |  |
| 1. How much expenses (in terms of lost orders or orders at reduced price) can be related to incorrect coordination of information? ((order value lost + discount value) / total sales value) |  |  |  |
| 1. What is the percentage of rejection from customer? (expenses related to rejected goods / total sales value) |  |  |  |
| 1. How much do you spend on product promotion schemes? (promotion expenses / sales value) |  |  |  |
| 1. How much do you earn on extra sale due to such schemes? (sales with promotion - sales without promotion) / total sales value) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How many times does order delivery suffers due to incorrect co-ordination of information? (delayed orders / orders delivered on time) |  |  |  |
| 1. How much time is wasted in doing adjustments in production changes due to unplanned orders? (Extra setting and cleaning time / total production time) |  |  |  |
| 1. How many calls s on an average a customer has to make to get his complaint sorted? (customer calls related to complaints / total complaints) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (manually created documents / total documents) |  |  |  |
| 1. How much of your business is carried through e-commerce in case you are making use of it? (sales value through e-commerce / total sales value) |  |  |  |
| 1. How many of your customers place repeat orders on you? (repeat orders / one time orders) |  |  |  |

**Marketing**

**Response to be recorded as YES or NO (Please tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| Can you access computer from your desk? |  |  |
| Can your information system deliver you the ratio of inquiries to finalized orders? |  |  |
| Can your information system deliver you ratio of value of the rejected material to the total order value? |  |  |
| Does your computer system give you analysis of sales and profitability for different channels? |  |  |
| Does your computer system give you analysis of sales and profitability for different products? |  |  |
| Do you get historical sales analysis figures from computer? |  |  |
| Can you forecast customer demand using changing customer needs, future trend and past sales analysis? |  |  |
| Does your information system help you in storing forecasting information and arrive at forecasts? |  |  |
| Does current system support internet transaction processing? |  |  |
| Does your computer system give you analysis of change in market share for different products? |  |  |
| Do you get assistance from the information system on comparisons of your product and other competing products? |  |  |
| Do you get assistance from your information system on analysis of promotion schemes? |  |  |
| Are you familiar with e-commerce? |  |  |
| Do you use e-commerce? |  |  |

**Marketing**

**Please give your brief response to the following queries in the blank papers provided with the questionnaire.**

|  |
| --- |
| What are the reasons for losing customers? What is the most important one? |
| 1. What can be done to avoid losing orders due to incorrect coordination of information? |
| 1. What are the reasons for the current performance level of computer system? |
| 1. What are alternative arrangements if your current computer system is not working? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the marketing system? What modifications do you suggest in it? |
| 1. What information do you expect from other departments for smooth and effective running of marketing function? Please summarise them as   Department, Site, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. What are the main reasons for rejection? |
| 1. Are you aware of all possible markets of your products? Which are those markets? |
| 1. Do you know which markets are more profitable? Why? |
| 1. Which are the markets that are inaccessible? Why? |
| 1. What is your strategy to deal with all different markets of your product? |
| 1. What are different channels that you use for marketing? |
| 1. What are the main reasons for disturbances in getting continuous orders? What measures do you suggest to avoid them? |
| 1. Which channel gives you maximum sales? Why? |
| 1. Which channel gives you maximum profit? Why? |
| 1. Which channel gives you maximum profit per unit sale? Why? |
| 1. Which products give you maximum sales? Why? |
| 1. Which product gives you maximum profit? Why? |
| 1. Which product gives you maximum profit per unit? Why? |
| 1. How do you foresee change in needs of future customer? |
| 1. What method do you use to arrive at forecast figures? |
| 1. How many customers prefer your product in all possible markets of your products? What is the reason for this % of acceptance by customers? |
| 1. What was the trend of market share (% of customers) for your products in last five years? And Why? |
| 1. How does your product compare with competitors' in quality, price and attributes? |
| 1. What are your product promotion schemes? |
| 1. Who are your emerging competitors? How do you plan to tackle them? |
| 1. Do you think market share of your product will increase or remain constant in next 5 years? |
| 1. If not, have you thought of any alternative product range? And what reasons support the choice of alternative product? |
| 1. Does your computer system assist you in analyzing information related to diversification? How? |
| 1. What are the reasons of retaining the customer? |
| 1. What customer interaction programs do you arrange? |
| 1. How many sales point (points where product is exchanged for money) do you have for each product? |
| 1. How many sales points have computer terminals? |
| 1. How do you get sales data from all these points at center place? |
| 1. How many marketing offices do you have? Are all of them are connected to head office through communication links? If not, do you propose to have such link in future? |
| 1. What information do you send and receive using internet? |

**A1.8 Product Development**

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

|  |  |  |
| --- | --- | --- |
| **NA** | **Not Applicable** | **Tick in this column if the point it not relevant to your industry** |
| **NV** | **Not Available** | **Tick in this column if information related to the point is not available** |

|  |  |  |  |
| --- | --- | --- | --- |
| Please consider the performance for the financial year 1999-2000. | **%** | **NA** | **NV** |
| How many of customer complaints related to product attributes are taken care of through design changes? (design changes / total complaints) |  |  |  |
| How many of future needs are taken care of through product changes? (design changes from forecasted needs / total expected changes) |  |  |  |
| 1. How much of your staff is dedicated to product design? ( design staff / total staff of the company) |  |  |  |
| 1. How much of company's expenditure is spent on product development?   (expense related to research and development / company's total expenditure) |  |  |  |
| How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| How much of department's time is wasted in such activities? (time spent on recompiling / total working time) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (manually created documents / total documents) |  |  |  |

**Product Development**

**Response to be recorded as YES or NO (Please tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| Can you record customer complaints related to product attributes in terms of product design change? |  |  |
| 1. Can you record trend in customer demand in terms of product design change? |  |  |
| 1. Can you foresee trend in technology changes related to your business? |  |  |
| 1. Does your computer assist in calculating impact of these changes on your business? |  |  |
| 1. Does your information system help you in arriving at expenses in making modified or a new product? |  |  |
| 1. Does your information system gives you information about increased sales because of such modifications? |  |  |
| 1. Do you know what characteristics are superfluous in your products? |  |  |
| 1. Can you store cost figures related to such attributes on your computer? |  |  |
| 1. Do you know what are shortcomings of your product? |  |  |
| 1. Can you store cost figures to incorporate these shortcomings? |  |  |
| 1. Can you arrive at time frame for incorporating desired changes in the product or to manufacture a new product? |  |  |
| 1. Can you know if those changes are relevant after that time period? |  |  |
| 1. Does your current system support internet transaction processing? |  |  |
| 1. Do you have competent personnel to incorporate necessary changes? Or to produce new product? |  |  |
| 1. Can you arrive at possible life of new product? |  |  |
| 1. Can your system arrive at payback period, break even sales and possible earnings till the product is expected to be obsolete? |  |  |
| 1. Do you have QA system to check product quality at design stage? |  |  |

**Please give your brief response to the following queries in the blank papers provided with the questionnaire.**

|  |
| --- |
| How do you decide relevance of changes? |
| 1. What is the necessary technology to incorporate changes? Is it available with you? What is its cost? |
| 1. What can be other additional expenses to develop the product and to produce it? |
| 1. What are alternative arrangements if your current computer system is not working? |
| 1. How do you rate the event diagram supplied by us to represent the product development system? Can you supply all the information asked in it? What modifications do you suggest in it? |
| 1. What information do you expect from other departments for smooth and effective running of product development function? Please summarise them as   Department, Site, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. Does your computer system assist you in analyzing information related to diversification? If yes in what way? |
| 1. What QA checks do you carry out to ensure product quality at design stage? |

**A1.9** **Manpower**

**Response Scale 1-5 (Tick in the appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How do you rate performance of computer system as far as your department is concerned? (In comparison with earlier system) |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent the manpower system? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your activities? |  |  |  |  |  |  |  |

**Response to be recorded in Percentage.**

**(Calculate the ratio for the specific reason and multiply with 100)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (manually created documents / total documents) |  |  |  |

**Manpower**

**Response to be recorded as YES or NO (Tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 1. Can you access computer from your desk? |  |  |
| 1. Does your current system support internet transaction processing? |  |  |
| 1. Are responsibilities for every designation available on computer? |  |  |
| 1. Are preparation and circulation of reports and other information clearly defined? |  |  |
| 1. Are the facilities, salary structures and other benefits given to employees available on computer? |  |  |
| 1. Can you generate monthly payroll information without any problem? |  |  |
| 1. Do you have well defined promotion and assessment policy? |  |  |
| 1. Does existing information system help you in decision making regarding promotion? |  |  |
| 1. Can you relate production and therefore profit to a particular employee if he is a direct labor? |  |  |
| 1. Is there any system to record employee expectations? |  |  |
| 1. Is there any system to record expected troubling situations? |  |  |
| 1. Is there any system to record and answer employees' queries? |  |  |
| 1. Is there any system to address employee grievances? |  |  |
| 1. Do you conduct regular programs to improve labor-management relations? |  |  |
| 1. Do you record employees' views regarding their superiors? |  |  |
| 1. Do you encourage employees to express their opinion on improving current management practices? |  |  |
| 1. Do you encourage employees to express their opinion on improving current production practices? |  |  |
| 1. Do you reward workers for average, good and exceptional performance? |  |  |
| 1. Do you reward workers for excellent suggestions? |  |  |
| 1. Do managers have technical competence? |  |  |
| 1. Are your managers technically qualified? |  |  |
| 1. Are your supervisors technically qualified? |  |  |
| 1. Do your managers and supervisors think workers as a valuable resource? |  |  |
| 1. Do they think workers are of not much importance because plenty of them are available? |  |  |
| 1. Do workers think that they are well treated in the company? |  |  |
| 1. Are workers happy with the working conditions? |  |  |
| 1. Is there any possibility of improving working conditions? |  |  |
| 1. Are recreation facilities available for workers and managers? |  |  |
| 1. Do you have proper insurance and medical schemes for managers? |  |  |
| 1. Do you have proper insurance and medical schemes for workers? |  |  |
| 1. Do you have proper training scheme for workers? |  |  |
| 1. Do you have proper training scheme for managers? |  |  |
| 1. Do you have proper recruitment procedure? |  |  |
| 1. Do you use consultant for recruitment? |  |  |
| 1. Do you collect feed back from new entrant regarding his view of your company? |  |  |
| 1. Do you have labor law specialist to advice you on legal matters? |  |  |

**Manpower**

**Please give your brief response to the following queries in the blank papers provided with the questionnaire.**

|  |
| --- |
| 1. What are the alternative arrangements if your present computer system is not working? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the manpower system? What modifications do you suggest in it? |
| 1. What information do you expect from other departments for smooth and effective running of manpower function? Please summarise them as   Department, Site ,Information Document and its contents, Frequency like daily, monthly etc. |
| 1. How do you think co-ordination between departments can be improved? |
| 1. What recruitment procedure do you follow? |
| 1. Do workers and managers mix up regularly to know each other through some cultural program to improve inter personal relations? If yes please describe the frequency and the nature of such program. |
| 1. Are your employees well paid in comparison with your competitors? What is the % difference compared with worst paid companies and excellent paid companies? |
| 1. Do your employees feel that it is their company? What are reasons for that? |
| 1. What information do you send and receive using internet? |

**A1.10 Quality Control**

**Response Scale 1-5 (Tick in the appropriate column)**

|  |  |  |
| --- | --- | --- |
| 1 | Unsatisfactory | Up to 20% |
| 2 | Satisfactory | 20% to 40% |
| 3 | Average | 40% to 60% |
| 4 | Good | 60% to 80% |
| 5 | Excellent | 80% to 100% |
| NA | Not Applicable |  |
| NV | Not Available |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **1** | **2** | **3** | **4** | **5** | **NA** | **NV** |
| 1. How do you rate performance of computer system as far as your department is concerned? (In comparison with earlier system) |  |  |  |  |  |  |  |
| 1. How do you rate event diagram, which is supplied by us to represent the quality assurance system? |  |  |  |  |  |  |  |
| 1. How much are you dependent on information from other departments? |  |  |  |  |  |  |  |
| 1. How much are you dependent on computer for your information needs? |  |  |  |  |  |  |  |
| 1. How much are you dependent on internet for your activities? |  |  |  |  |  |  |  |

**Response to be recorded in Percentage.**

**Calculate the ratio for the specific reason and multiply with 100)**.

|  |  |  |  |
| --- | --- | --- | --- |
| **Please consider the performance for the financial year 1999-2000.** | **%** | **NA** | **NV** |
| 1. What is the total time for which machines are stopped for quality checks? (stopped time / planned running time) |  |  |  |
| 1. How much material is wasted at different stages for quality checks? (sample value / total sales value) |  |  |  |
| 1. How many times do you recompile information from other departments by using your own staff? (recompiled documents/total documents from other departments) |  |  |  |
| 1. How much of department's time is wasted in such activities?   (time spent on recompiling / total working time) |  |  |  |
| 1. How many of your staff can work on computer?   (computer literate workers / total workers) |  |  |  |
| 1. How much of your work is still carried out manually?   (manually created documents / total documents) |  |  |  |

**Quality Control**

**Response to be recorded as YES or NO (Tick the appropriate column)**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 1. Do you have procedures manual that covers all business procedures? |  |  |
| 1. Is it available on computer? |  |  |
| 1. Do you have well defined inspection procedures? |  |  |
| 1. Do you have proper documentation of tests to be conducted for different products, raw materials? |  |  |
| 1. Does your system assist you making such documentation? |  |  |
| 1. Can you access computer from your desk? |  |  |
| 1. Do you get quality reports from computer? |  |  |
| 1. Does your system prompt for inspection check wherever it is needed? |  |  |
| 1. Does your system give you details if such checks are not carried out at required stages? |  |  |
| 1. Do you get product quality analysis from computer? |  |  |
| 1. Is there any computer system that tells you how to improve on quality? |  |  |
| 1. Do you have trouble shooting system on computer? |  |  |
| 1. Can trouble shooting system tell you cause of defect in product? |  |  |
| 1. Can you build your own analysis scheme on computer? |  |  |
| 1. Can you assess loss due to defects in the final product? |  |  |
| 1. Do you have maintenance system on computer? |  |  |
| 1. Does your system generate planned maintenance orders? |  |  |
| 1. Does production planning system take into account future maintenance orders? |  |  |
| 1. Do the system list out material and other requirement for QA check in advance? |  |  |
| 1. Do you get exact status of maintenance operation from computer? |  |  |
| 1. Can you assess if maintenance operation was effectively carried out? |  |  |
| 1. Do you get advice on procurement or deterioration of tools? |  |  |
| 1. Do you get production loss figures due to break down maintenance from computer system? |  |  |
| 1. Do you get analysis of reasons for break down maintenance from computer system? |  |  |

**Quality Control**

**Please give your brief response to the following queries in the blank**

**papers provided with the questionnaire.**

|  |
| --- |
| 1. What are the contents of various quality reports? |
| 1. What are the alternative arrangements if your present computer system is not working? |
| 1. Can you supply all the information asked in the event diagram supplied by us to represent the QA system? What modifications do you suggest in it? |
| 1. Do workers possess quality consciousness? What are the reasons for that? How do you know that workers possess or do not possess quality consciousness? |
| 1. What information do you expect from other departments for smooth and effective running of quality assurance function? Please summarise them as   Department, Site, Information Document and its contents, Frequency like daily, monthly etc. |
| 1. How do you think co-ordination between departments can be improved? |
| 1. Can you manage your tooling inventory properly? Why? |
| 1. What quality awareness programs do you conduct to improve quality consciousness? |
| 1. What is the cost of quality? And how does it reflect in improved sales? |
| 1. How many times do you skip quality checks? Why? |
| 1. Do you think some more quality checks are necessary? Why? |
| 1. What QA system do you have to ensure quality at product designing stage? |
| 1. What problems does the maintenance department have in managing tooling inventory? |
| 1. What information do you send and receive using internet? |

**Appendix 2**

**TOOLS FOR CONCEPTUAL MODELING**

This complete Appendix is taken from the internet and is compiled by **Dehne, Wieringa & Henk, (2000) unless specific mention is made to any other author.**

**A2.1 Data Flow Diagram (DFD)**

**The figure A2.1 shows symbols used in DFD and the figure A2.2 shows the connection, which are prohibited while drawing DFD.**



L

Data Process

Data Store

External Entity

Split Merge Node

Unidirectional Data flow

Bi-directional Data flow

**Figure A2.1 Symbols used in DFD**

L



**Figure A2.2 Connections that are not allowed**

**Explanation:**

* Circles represent processes, also called data transformations or  functions. A process is some computation by a software system. There are two kinds of processes: Data processes and control processes.
* Squares represent external entities; these are entities with  which the software system must interact.
* Two parallel lines represent a data store, which is a piece of  software memory (e.g. a file or a variable).

The directed edges represent data flows between these nodes. In the figure A2.3, there are three processes, *Confirm Registration*, *Check Request* and *Register students*. When the external entity *STUDENT* sends a message *test\_request*, which is a request to participate in a test, then the process *Check Request* retrieves the identifier of the test from the data store *TESTS* and the student identifier from the *STUDENTS* data store (the data stores are most likely implemented as files or in a database). If the test and student exist, and the student is allowed to participate in the test, then process *Register students* stores this fact in the *TEST\_REGISTRATIONS* data store and *Confirm Registration* confirms this to the external entity. To make the DFD in the figure A2.3 more precise, this model must be supplemented with precise process specifications, and a specification of the structure of the data stores and data flows. DFDs can be hierarchical. This means that a process can be specified by means of another DFD, which has the same external interface as the process being specified. Such a process is called a compound process.   A process specified in another way (e.g. by means of a piece of text) is called primitive.  This can be indicated by the letter *P* in the node that represents the process.

**DEHNE F.,** Faculty of Mathematics and Computer Science, Vrije Universiteit, De Boelelaan 1081a, 1081 HV Amsterdam and WIERINGA R. J., HENK R. Z., Department of Computer Science University of Twente, P.O. Box 217, 7500 AE Enschede, Netherlands, 1998,[http://wwwhome.cs.utwente.nl/~tcm/usersguide/user.html](http://wwwhome.cs.utwente.nl/~tcm/usersguide/User.html)

Compound processes give rise to a tree of DFDs. Processes in this tree are labelled by means of a Dewey numbering  system that indicates the location of the process in the tree. For example, process 1.2 is the process with label 2 in the DFD that specifies the compound process with label 1.



**Figure A2.3 DFD for Student Registration Process**

Data processes that are not decomposed are called **primitive data processes**  and should be specified by a so-called **minispec** in the form of an arbitrary piece of text. Figure A2.4 shows splitting and merging of data flows.

**A3.2 Event and Data Flow Diagram (EDFD)**

EDFD has data processes and **control processes**, represented by a solid and a dashed circle, respectively. EDFD has two types of flows: **time discrete flows** and **time continuous flows**. EDFD has **event flows** that are represented by dashed arrows. When an event flow has as label `T', it is a **trigger** and when it has as label `E' or `E/D', it is a **prompt**. Event flows have a time discrete variant and a time continuous variant too, represented by a dashed single headed arrow respectively by

a dashed double headed arrow. Figure A2.5 shows symbols used in EDFD



Figure A2.4 Splitting and merging of Data Flows

L

Data Process

Data Store

External Entity

Split Merge Node

Discrete Data flow

Bi-directional Data flow

Event Process

Event Store

L

Continuous Data flow

Discrete Event flow

Continuous Event flow

L

L

L

Figure A2.5 Symbols used in EDFD

Event flows

Event flows are represented by dashed arrows. An event flow can carry a signal without any data contents. The precise meaning depends upon the method that uses this technique.

Time-Discrete and time-continuous flows

A time-discrete flow carries a value that changes in discrete steps; a time-continuous flow carries a value that changes in a continuous way. Time-discrete flows are represented by arrows with a single arrowhead; time-continuous flows are represented by arrows with a double arrowhead. Again, the precise meaning depends upon the method used. Figure A2.6 sows permitted connections in EDFD. Figure A2.7 shows EDFD for the robot control process and f**igure A2.8 shows** State Transition Diagram (STD) for the robot control process.



Figure A2.6 Permitted Connections in EDFD



Figure A2.7 An EDFD for a robot control process.

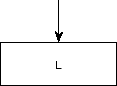


**Figure A2.8:** STD for the robot control process of figure A2.7

**A3.3 State Transition diagrams (STD)**

 Nodes and Connections

Figure A2.9 shows symbols used in state Transition diagram



Initial State

State

Decision Point

Transition

5.1.2 States

Figure A2.9 Symbols used in State Transition Diagram

**States**

There are tree kinds of nodes: **initial states**, (normal) **states** and **decision points**. All nodes should have mutually unique names. Nameless states, also called **transitory states**, are not permitted. **Non-deterministic** state transition diagrams are permitted.

An initial state can have one or more initialisation actions. You can add an action by selecting the initial state, and click on or near the arrow on top of the box. When an edit cursor appears at the right side of the arrow, you can type in the actions. Each line of text will be considered as a separate action. If you stop editing, the actions will be placed at the right side of the arrow and the texts become left aligned. The arrow will be resized to accommodate the height of the texts and on top of the actions a horizontal separator line will be drawn. Only when the initial state has actions then the separator line is drawn. Note that these actions are in this notational convention part of the initial state *node*, whereas the other actions (and events) of a diagram are as a notational convention part of an *edge*.

Transitions, Events and Actions

Transitions are drawn as arrows. They do not have a single editable name label like most of the other line or arrow types in TCM. Instead they have a distinct event label and an arbitrary number of action labels. The action labels each occupy exactly one line of text; the event label can contain multiple lines. The event and the actions are separated by a horizontal **separator line**. When a transition is created, a separator line will also be created and it will be positioned near where a name label would normally be positioned. When the transition line segment near the separator is drawn vertically, the separator is by default connected to the right side of that line segment. When the segment is drawn horizontally, the separator is by default positioned somewhat above the line. See figure A2.10 for the two default positions.

States are named, and are represented by rectangles.  State transitions are represented by arrows and are labelled by *event [guard] / action* pairs.    The event is the trigger   of the transition and can be viewed as the occurrence of an input. The guard is a condition.  The precise meaning of the guard depends upon the method in which the notation is used. A minimalistic interpretation is that if the guard is false, an occurrence of the event will not trigger the transition. A more closed interpretation is that additionally, if the guard is true, an occurrence of the event will trigger the transition. The action part of the transition label is the output action generated by the transition. Each STD must have an initial state, pointed at by an arrow that  leaves from no node, and that can be labelled by an initialisation action.

TCM also has decision points, which are intermediary states that the machine may have between system transactions. Decision points are represented by a hexagon.   
Figure A2.10 shows a STD for a simple coffee machine in which at two points, an external process is triggered (the actions that start with *T:*) that must send the Machine an answer. While waiting for an answer, the machine is in the decision point.



<DIV align=center>

**event**

**action**

# State3

**Figure A2.10:** State Transition Diagram for A Coffee Making Machine.

A3.4<DIV align=center> The Activity Diagram (AT)

An activity diagram is a special case of a state diagram in which most states are action states or sub-activity states, and most transitions are completion transitions. The purpose of an activity diagram is to focus on flows driven by internal processing (as opposed to external events). Figure A2.11 shows symbols used in the activity diagram and figure A2.12 shows activity diagram for coffee making machine.

Activity

Activities are represented by two parallel lines connected by semicircles. The name of the activity can be entered in the shape.

Transition

Transitions are represented by unlabeled arrows. A transition represents the completion of the activity from which it departs.

Choice nodes

A choice node is represented by a diamond. A transition that emanates from a diamond can be labelled by a *[condition]* that tells us when this branch is taken. A choice point is not a state of the system.

Fork and join nodes

Fork and join nodes are represented by fat horizontal or vertical lines. If more than one arrow leaves the node, it is a fork node and there must be exactly one arrow entering it. A join node represents the start of two or more parallel processes.

If more than one arrow terminates at the node, it is a join node and there must be exactly one arrow that departs from it. A join node represents the merging of two or more parallel process into one process.

Initial and final state

The start of an activity diagram is represented by a bullet. There must be exactly one bullet in a completed diagram.

A final state of an activity is represented by a bull's eye. There must be at least one final state in an activity completed diagram.



Action state

Waiting state

Start state

End state

Decision

Control Flow

Horizontal Synchronisation bar

Vertical Synchronisation bar

Figure A2.11 Symbols used in the activity diagram

A2.5 Process Structure Diagram (PSD)

Nodes and Edges

Figure A2.13 shows the symbols used in the PSD has just one special type of node, called Process and one type of edge called Empty edge. The process node is represented by a box. In the top right corner of the process node box, a process operator can be specified.

The Process Tree

PSD has to make sure that there is always a one-one relationship between each node instance and its representing shape instance.

In PSD, the highest box in the drawing area represents the root of the tree, which is called the **main root**. This is the process node whose representing box has the smallest y-coordinate. The **main tree** is the tree that is connected to the main root.

Each process node has a set of children that is ordered from left to right. The ordering of the children is determined by the position of the shapes in the drawing area. **Actions** are the leaf nodes of the tree, excluding the ``quit'' boxes. See figure A2.14 for a PSD with numbered actions. Each parent receives a sequence number that is one higher than the highest number amongst its children.

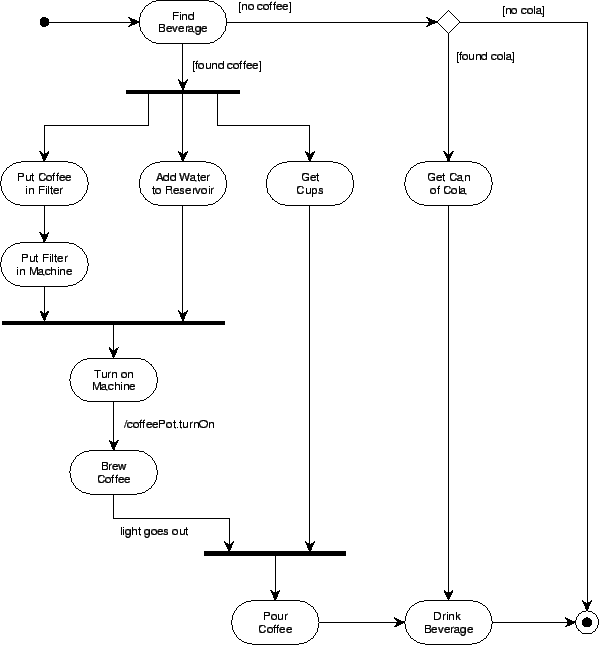
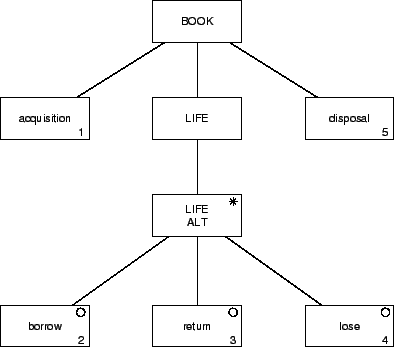


Fig A2.12 An Activity Diagram For Coffee Machine



\*

O

!

Process

Iteration

Choice

Premature Completion

Connector

Fig A2.14 Process Structure Diagram: Library Book Service

Fig A2.13 Symbols used in PSD

A2.6 Function Refinement Trees (TFRT)

A function refinement tree is a tree in which the root represents the entire system mission and the leaves represent system functions. The hierarchy of nodes represents the refinement of functions into subfunctions. All nodes in the tree represent external functions.

A FRT can be used in combination with a hierarchical DFD to represent the hierarchy of DFDs. It is used in information engineering to represent external functions of an information system . Of course, a tree can be used to represent any hierarchical decomposition. See figure A2.15.

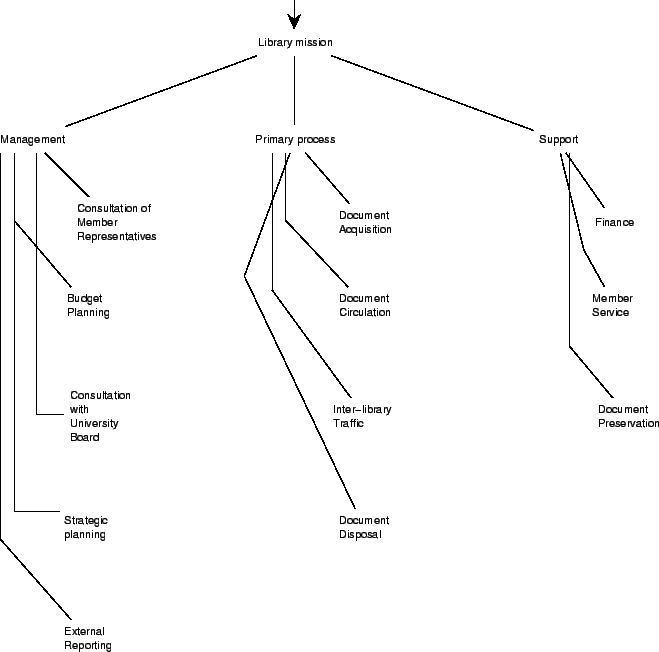


Fig A2.15 Function Refinement Tree

**A2.7 Process Network Diagrams or System Network (SN) Diagram**

Figure A2.16 shows symbols used in process network diagram.

Connection

End

System

Network

Process

Data Stream

Controlled Data Stream

Connection

Start

State Vector

Figure A2.16 Symbols used in process net work diagrams

In order to be able to edit a system network diagram as a graph, a system network connection is a compound connection consisting of three parts: one node and two edges. The node is one of State vector, Data stream or Controlled data stream.    The two edges are a Connection start edge and a Connection end edge. These two types of edges do not have a name label but they can both have a cardinality constraint label. See figure A2.17for the permitted connections (immediately enforced).



Figure A2.17 Permitted connections in Process Net Work Diagram

Compound connections connect system network processes (abbreviated to SN processes).  For an example system network diagram, see figure A2.18



Figure A2.18 Net Work Diagram for Tests and Results

A2.8 Recursive Process Graph

Process graph roots have their name label written on top of a downwards pointing arrow. In general the process graph roots are named after the process graph document, but in upper case letters. By default a process graph is named UNTITLED. Process graph nodes have two node shape representations. They can be small unnamed circles or larger rounded boxes which can contain a name label. Process graph nodes are connected by event edges. Figure A2.19 shows the symbols used in the process recursive graph and figure A2.20 shows an example of process recursive graph.



Process graph root



Process graph node



Event

Figure A2.19 Symbols used in Recursive Process Graph

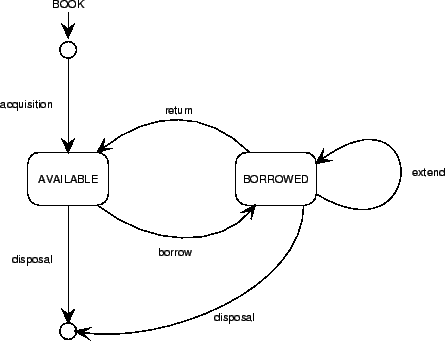


Fig A2.20 Recursive Process Graph: Library Book Issue

**A2.9 Entity Relationship Diagram**

The following figure shows the symbols used in entity relationship diagram.

System Network Process

Value

Figure A2.21 Symbols used Entity Relationship Diagram

Relationship

Taxonomy Junction

Binary Relationship

Function

Binary Relationship

Is a

One to One Function

There are many other conventions

to represent binary relationships.

Figure A2.22 shows different ways of

representing the following constraints:

* Each existing *E1* is related to at

least one existing *E2* and

* Each existing *E2* is related to

exactly one existing *E1*.

* Each existing *E1* is related to at any

number (including 0) existing *E2*

and each existing *E2* is related to

exactly one existing *E1*.

Figure A2.22 Different ways of

representing the same constraints

Cardinality properties are represented by annotations placed at the end points of these lines. (Cardinality properties are also called ``cardinality constraints'' by many authors.)   
<DIV align=center>

**Figure A2.23** The placement of Cardinality constraints.

</DIV>  
For example, in figure A2.23 each business has an employment relationship to more than zero persons and each person has 0 or 1 employment relationships to a business. The end points of the line can also be annotated with the role that the entity at that end of the line plays in the relationship. Figure A2.24 gives an example.

<DIV align=center>

**Figure A2.24** The placement of role names.

****

**Figure A2.25** The meaning of cardinality properties

</DIV>In general, a cardinality property is represented by a set of natural numbers. For example, if *c* is a set of natural numbers, the property in figure A2.25 is that each instance of *E1* is related to *n* instances of *E2*, where *c*. (More precisely, each existing instance of *E1* is related to *n* existing instances of *E2*.) If no cardinality property is shown, the convention is that *c* is the entire set of natural numbers. For example, in figure A2.25, each instance of *E2* is related to any number instances of *E1*. This includes the case that it is related to 0 instances of *E1*.

<DIV align=center>

Note that there is no natural reading direction for a relationship name in figure A2.23. If there is a reading direction, one can adorn the relationship name with a small arrow that indicates this. See figure A2.26.

****  
<DIV align=center>

**Figure A2.26** Reading direction of a relationship name.



<DIV align=center>

**Figure A2.27** The diamond representation for relationships.

</DIV>  
A relationship is a Cartesian product of two or more entity types, called its components. (To be more precise, it is a labelled Cartesian product.)   Relationships can always be represented by a diamond, connected by lines to the boxes that represent its components. For example, figure A2.27 contains exactly the same information as figure A2.23. Relationships with arity higher than 2 cannot be represented by a line. They can only be represented by a diamond. Figure A2.28 gives an example.

  
<DIV align=center>

**Figure A2.28** A ternary relationship with a cardinality property.

The figure also illustrates the notation for a cardinality property of a relationship with arity higher than 2. A cardinality property is expressed by an expression *c* written at the end of a line, close to an entity type box. It represents the number of instances of that entity that participate in the relationship simultaneously. The property in figure A2.28 says that each transport company participates in at least one delivery. (This is not very realistic but is does illustrate the convention.)

Figure A2.29 shows attribute representation diagram.



.

**Figure A2.29** Representation of attributes

</DIV>Entity attributes are represented by listing them in a separate compartment below the entity type name. Representation of entity attributes is optional.

If a relationship itself has attributes, it is represented by an entity box that contains the relationship name and the attribute declarations, connected to the relationship line or relationship diamond with a dashed line. See figures A2.30 and A2.31 for illustrations.

****   
<DIV align=center>

</DIV>  
  
<DIV align=center>

**Fig A2.30 Line Representation Fig A2.31 Diamond Representation**

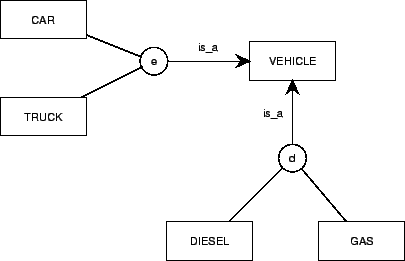
Is-a relationships

Figure A2.32 shows is\_a relationship and figure A2.33 shows how taxonomy can be represented by ERD.



Is\_a

<DIV align=center>   **Figure A2.32** The representation of is-a relationships.



**Figure A2.33** ERD Example taxonomic structure.

</DIV>An is-a relationship is a binary relationship that is an inclusion function. For example, figure A2.32 shows that each *CAR* instance is also a *VEHICLE* instance. Extensionally, the set of all possible cars is a subset of the set of all possible vehicles. Intentionally, the set of properties shared by all cars includes the set of properties shared by all vehicles. *CAR* is called a specialization of *VEHICLE* and *VEHICLE* is called a generalization of *CAR*.

If there is more than one specialization of an entity type, then these must be grouped into specialization groups.  This is represented by connecting the rectangles representing the specializations to a small circle  called the taxonomy junction or generalization node and connecting this with an *is-a* arrow to the rectangle representing the generalization. The generalization node must be annotated as follows:

* A ``*d*'' means that the specializations are mutually disjoint.
* An ``*c*'' means that the specializations jointly covers the generalization.
* A ``*dc*'' means the conjunction of ``*d*'' and ``*c*'', i.e. the specializations partitions the generalization.

  A generalization can be specialized by any number of specialization groups. For example, figure A2.33 means the following:

* Cars are vehicles and trucks are vehicles.
* The union of the set of all cars and all trucks equals the set of all vehicles. So vehicles are trucks or cars (or both).
* Diesel vehicles are vehicles and gas vehicles are vehicles.
* There is no vehicle both a diesel and a gas vehicle.
* There may be vehicles that are neither diesel nor gas vehicles.

A2.10 Transaction-Use Tables (TUT)

A transaction-use table is a simple way to discover entity types from required system transactions. The leftmost column lists external system functions and the top row lists the basic Create, Read, Update and Delete actions. The entries list the entity types or relationships that are created, read, updated or deleted during the function. (Figure A2.34)

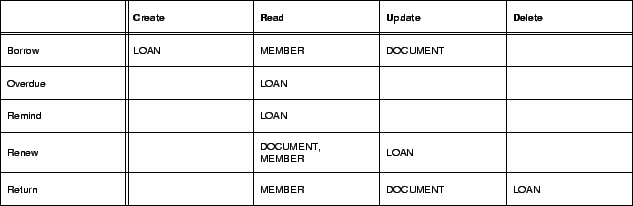


    Figure A2.34 Transaction use table

Function-Entity Type Tables (TFET)

The top row of a function-entity table lists system functions and the leftmost column represents, for example, entity types. The entries contain C, R, U or D, to indicate that this function Creates, Reads, Updates or Deletes entities of this type. Instead of entity types, the leftmost column may list relationships, or subject areas, or data stores in a DFD, with corresponding changes in the meaning of the CRUD entries.

A function-entity type table is a kind of traceability table. It is almost the same as a transaction decomposition table. Function-entity types are used in Information Engineering to find subsystems. These are identified by clustering subject areas and functions in such a way to minimize data flows between the clusters. (Figure A2.35)

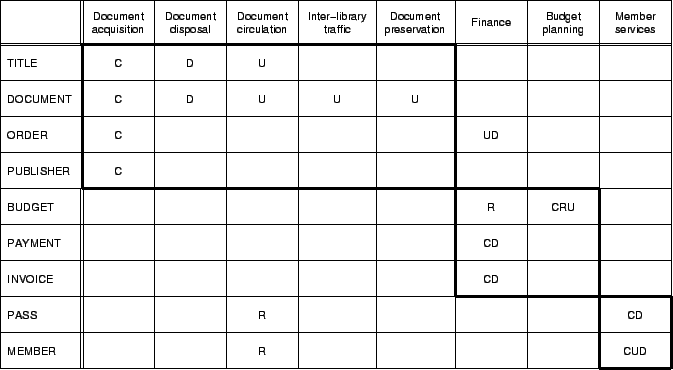


Figure A2.35 Example function-entity type table partitioned into business areas

Appendix - 3

**EVENT DIAGRAM FOR TEXTILE PROCESSES**

**100 Opening & Cleaning**

**(1,M)**

***Lap, Open Tufts***

**110 Carding**

**(2,M)**

***Carded Sliver***

**120 Combing**

**(3,O)**

***Combed Sliver***

**140 Roving**

**(5,O)**

***Roving Bobbin***

**130 Drawing**

**(4,M)**

***Drawn Sliver***

**150 Spinning**

**(1,M)**

***Yarn Bobbin,***

***Cheese***

**180 Winding**

**(1,O)**

***Cone, Cheese,***

***Pirn***

**190 Warping**

**(2,M)**

***Warper Beam***

**210 Drawing In**

**(4,M)**

***Drawn Beam***

**200 Sizing**

**(3,M)**

***Sized Beam***

**Yarn**

**220 Weaving**

**(1,O)**

***Fabric***

**M: Compulsory event O: Optional event Italic: Out put of each process 1,2,3 : Sequence of events within another event 10,20,30 : Sequence of events within the same hierarchy (Output of earlier process is input to the next process.)**

**Fabric**

**40 Spinning**

**Preparatory**

**(1,M)**

**50 Yarn**

**Production**

**(2,M)**

**70 Weaving**

**Preparatory**

**(1,M)**

**80 Fabric**

**Production**

**(2,M)**

**160 Doubling**

**(2,O)**

***Yarn Bobbin,***

***Cheese***

**Sub-Department**

**(Hierarchy-2 event)**

**Process**

**(Hierarchy-3 event)**

**Legend**

**Spinning**

**(2,O) M(1.2.2, N1)**

**N(1.3,1.2.3)**

**Fabric Production**

**(2,M)**

**Department**

**(Hierarchy-1 event)**

**Yarn**

**Manmade Fibre**

**Production**

**(1,M)**

**10 Polymer**

**Formation**

**(1,M)**

**20 Yarn / Fiber**

**Production**

**(2,M)**

**10 Nylon**

**(1,O)**

***Polymer***

**20 Polyester**

**(2,O)**

***Polymer***

**30 Acrylic**

**(3,O)**

***Polymer***

**40 Cellulosic**

**(4,O) E(1,2,3,4)**

***Polymer***

**50 Spinning**

**(1,M)**

***Filament***

**60Staple Fiber**

**Cutting**

**(2,O)**

**Staple Fiber**

**30 Texturing**

**(3,O) N(2.2)**

**Chemicals**

**Chips**

**Filament**

**Fibre**

**Sliver**

**Roving**

**60 Yarn Dyeing**

**(3,O)**

**Yarn**

**Yarn**

**Fibre**

**Yarn**

**Beam**

**H-1**

**H-2**

**H-3**

**170 Singeing**

**(2,O)**

***Yarn Bobbin,***

***Cheese***

**230 Knitting**

**(2,O)**

***Fabric***

240 Non woven

(3,O) E(1,2,3)

*Fabric*

**Fabric**

**60**

**Yarn Production**

**(2,O) *Yarn***

***E(2,3)N(2)***

Fig A3.1 Textile Processes-I

Fig A3.2 Textile Processes-II

M: Compulsory event O: Optional event Italic: Out put of each process 1,2,3 : Sequence of events within another event 10,20,30 : Sequence of events within the same hierarchy (Output of earlier process is input to the next process.)

Sub-Department

(Hierarchy-2 event)

Process

(Hierarchy-3 event)

Legend

Department

(Hierarchy-1 event)

**Fabric**

**H-1**

**H-2**

**H-3**

510 Sewing

(1,O)

*Garment*

520 Bonding

(2,O)

*Garment*

**150 Component**

**Assembly**

**(4,M)**

**160 Garment**

**Finishing**

**(5,M)**

**Garment**

**Manufacturing**

**(5,M)**

**Garment**

**140**

**Component**

**Manufacturing**

**(3,M)**

**130 Findings**

**Production**

**(2,M)**

430 Pattern

Making (1,O)

*Design Patterns*

440 Marker

Making(2,O)

*Pattern*

*Markers*

450 Spreading

(3,O)

*Marked*

*Fabric*

480 Sewing

(6,O)

*Components*

460 Cutting

(4,O)

*Cut Parts*

390

Interlining

(1,O)

*Interlinings*

400 Linings

(2,O)

*Linings*

410 Closures

(3,M)

*Closures*

420 Trims

(4,O)

*Trims*

**Components**

350 Over

Printing

(1,O)

*Fabric*

360

Discharge

Printing

(2,O) *Fabric*

370 Resist

Printing

(3,O)

*Fabric*

380 Discharge

Resist (4,O)

E(1,2,3,4)

*Fabric*

**110 Printing**

**(3,O)**

**Fabric Processing**

**(4,O)**

**Fabric**

**90 Finishing**

**(1,O)**

**100 Dyeing**

**(2,O)**

250 Desizing

(1,O)

*Fabric*

260 Scouring

(2,O)

*Fabric*

270

Bleaching

(3,O)

*Fabric*

290 Anti shrink

And

Other Finishes

(5,O) *Fabric*

280

Mercerizing

(4,O))

*Fabric*

300 Direct

Dyeing

(1,O)

*Fabric*

310 Reactive

Dyeing (2,O)

*Fabric*

320 Vat

Dyeing

(3,O)

*Fabric*

340 Pigment And

Other Dyeing

(5,O)

E(1,2,3,4,5)

*Fabric*

330 Disperse

Dyeing (4,O)

*Fabric*

490 Bonding

(7,O)

E(6,7)

*Components*

500 In Process

Press (8,O)

*Components*

530 Wet

Processing

(1,O)

*Garment*

540 Garment

Dyeing

(2,O)

*Garment*

560 Durable

Press (5,O)

*Garment*

580 Retail

Presentation

(7,M)

*Garment*

570

Final (Off)

Press (M,6)

*Garment*

**120 Fabric**

**Embroidery**

**(1,O)**

550

Embroidery

(4,O)

*Garment*

470 Embroidery

(5,O) *Cut part*

**Findings**

**Fabric**

**Fabric**

**Fabric**

**Fabric**

**Garment**

**Garment**

**Fabric**

Appendix 4 attached separately **Appendix 5**

# INFORMATION ELEMENTS FOR THE PROPOSED MODEL

This appendix gives various information groups and information elements associated with the event diagrams given in the section 6.2 of this thesis. Each box represents one information group. Title of the information group is given in bold. The event number with which the group is associated is put at the start. There can be more than one information group associated with one event, all such groups are represented in decimal form. For example, if there are two information groups associated with event number 10, then both of them will carry the event number 10 and decimal 1 and 2 for their distinct identity in the system. One group will have number 10.1 and another will carry the number 10.2. When event has origin in some other module, abbreviation of the module and information group number of that module is mentioned at the beginning of the group name and in the end of the group name event number of the current module is written in the bracket. Abbreviations used for modules are supplied in the list of abbreviations given at the beginning of the thesis. Few more abbreviations are used to get the compact representation of information elements. Following table gives the list of abbreviations used.

Table A5.1 List of abbreviation used

|  |  |  |  |
| --- | --- | --- | --- |
| Advt | Advertising | Ref | reference |
| Avg | Average | Rej | Rejection |
| Bal | Balance Sheet | Reqd | Required |
| BOM | Bill of Material | Seq | Sequence |
| Cust | Customer | Sgrp | Sub group |
| Desc | Description | Spl | Special |
| Eff | Efficiency | Tran | Transaction |
| FOH | Fixed Overheads | VOH | Variable Overheads |
| Grp | Group | Vol | Volume |
| Insp | Inspection | Yrs | Years |
| Inst | Institute |  |  |
| Inst | Institute |  |  |
| Maint | Maintenance |  |  |
| Mc | Machine |  |  |
| No | Number |  |  |
| Opr | Operator |  |  |
| Ord | Order |  |  |
| Para | Parameter |  |  |
| PL | Profit and Loss Account |  |  |
| PO | Purchase Order |  |  |
| Prod | Production |  |  |

Appendix 6

GLOSSARY

|  |
| --- |
| **Agent Relation Morphism Analysis**  Business process reengineering methodology, based on object oriented analysis and design principles, suggested by Valiris and Glykas Application Shortest possible sequence of steps describing the business. Application can also be termed as event of first hierarchy.  **Business Process Reengineering**  Critical analysis of business processes to increase its competitiveness and profitability by quantum jumps.  **Capacity Requirement Planning**  Planning of availability of different machinery according production plan.  **Codeless Database Management System**  Database Management System that runs on the information stored in various files, which are manipulated by programmer in stead of writing code for program.  **Computer Aided Design**  A software that allows to make designs on computer.  **Computer Aided Manufacturing**  Use of software controlled machines in production or manufacturing.  **Computer Integrated Manufacturing**  Manufacturing practice in which data related to manufacturing is fed to the computer and manufacturing activities are subjected to analysis obtained from the computer.  **Conceptual Modeling Tool**  Diagram aids provided to conceptualize working of business.  **Customer Relationship Management**  Managing the customer requirements with assisting software so as to achieve customer satisfaction  **Data Mining**  Process of examining data to find out useful association in various operations to arrive at rules of governance  **Data Warehouse**  Central collection of data which can be available to all to derive necessary information from it.  **Database Management System**  Software that allows user programs to create and manipulate data in the system.  **Decision Support System**  Information system, which can be used to assist making decisions.  **Electronic Commerce**  Business which is carried out over network of computer including monetary payment  **Electronic Data Interchange**  Electronic transfer (Transfer through computer network) of business related data between companies.  **Enterprise Resource Planning**  Information system that takes care of information needs of entire enterprise  **Enterprise Resource Planning – II**  ERP system with added capabilities of electronic business. |

|  |
| --- |
| **Event**  Activity associated with single business transaction. These are fourth hierarchy events.  **Event diagram**  Diagram showing logical arrangement of events  **Event Related Open Systems**  System designing methodology which relies on breaking of events into number of hierarchical events.  **Executive Information System**  Information system, which assists high level executives with latest current information from markets to make strategic decisions.  **Information Element**  The smallest element of information which cannot be split up further.  **Information Groups**  Grouping of information associated with business transactions.  **Information System**  Computerized system to collect and process data so as to derive meaningful information which can be used to guide business establishment  **Interaction diagram**  Diagram used to show interaction of an event with other events in the system  **Knowledge management**  Information system that processes information and derives laws of business governance  **Major Event**  Sequence of activities describing module. Major events are events of third hierarchy.  **Manufacturing Resource Planning**  Information system which assists production planning and control function  **Master Production Schedule**  Production targets for individual end products of the company  **Material Requirement Planning**  Information system that assists in procurement and management of raw material  **Module**  Sequence of activities describing an application. Modules are events of second hierarchy.  **On Line Transaction Processing**  A transaction processing method in which all related data is updated in related tables soon after data entry in one table.  **Professional Service Application**  Information system for complete business planning for service industry  **Project management**  Managing of projects with the assistance of suitable software.  **Relational Database Management System**  Database Management System that arranges data in logical format of rows and columns.  **Sub Module**  Sequence of activities describing module. Sub modules are events of third hierarchy.  **Supply Chain Management**  Managing the complete chain of input-process-output from basic raw material to the delivery of the final end product to the customer.  **System**  A set of related events or activities. |

RESEARCH PUBLICATIONS BASED ON

THE PRESENT RESEARCH WORK

**1.**

**Title: Development of an Integrated Information Management Model: A Case of Textile Industry**

**Journal: Production Planning and Control: UK**

**Authors: Chandrashekhar Chiplunkar, R. Chattopadhyay and S. G. Deshmukh**

# Status: Forthcoming

Abstract: For past two decades many organizations have tried to implement integrated information management systems for better production management based on coordination of information and therefore activities of different departments. Although Enterprise Resource Planning systems are in the market for the past decade, many industries find it difficult to implement such systems due to amount of work involved in streamlining the documentation, customization and of high costs reported in implementation. An attempt is made through this paper to propose an integrated model, which can be easily understood by production personnel, with specific emphasis on the textile sector.

**2.**

**Title: Some Observations on Indian Textile Industry**

**Journal: Productivity: INDIA**

**Authors: Chandrashekhar Chiplunkar, R. Chattopadhyay and S. G. Deshmukh**

**Status: Forthcoming**

Abstract:

Today’s changing world requires assessment of direction in which business is heading. The correct speculation of future trends and developments definitely leads to better decision making and it is essential for survival of the textile industry, which is one of the important source of foreign exchange and employment. This article takes a general view of Textile Industry and discusses possible strategy to deal with international competition.

**3.**

**Title: Production Planning and Control Systems for Textiles**

**Journal: Indian Textile Journal: INDIA**

**Authors: Chandrashekhar Chiplunkar, R. Chattopadhyay and S. G. Deshmukh**

**Status: Communicated**

Abstract:

Although Information Technology is around the corner quite some time and India is leading solution provider, textile industry is not exploiting IT to its fullest potential. IT is an essential and most vital to achieve competitive edge in the global market. IT allows fast and accurate flow of information along the complete supply chain and help companies in cycle time reduction, cost savings, sales volume, customer satisfaction, machine up-time and employee satisfaction

**4.**

**Title: Application of Principles of Event Related Open Systems to Business Process Reengineering**

**Journal: Computers and Industrial Engineering: USA**

**Authors: Chandrashekhar Chiplunkar, R. Chattopadhyay and S. G. Deshmukh**

**Status: Communicated**

Abstract:

This paper is focused on analyzing the complete business environment with the help of information technology. It takes into account various interactions between different business processes while conducting BPR exercise. It also provides a framework based on Event Diagram to record logical flow and other relevant details, which can be used for design of information system coupled with business process reengineering. Each event can be analyzed for requirement of data, operations and resources. Interactions between various forces, events, modules, applications can be shown through interaction diagrams. In addition, this paper lists out the driving forces for BPR and their contents. Suggested event diagrams are useful for intelligent information system design. This methodology can also be used to develop a system for system design.

**5.**

**Title: Codeless Database Management System: EASY Program**

**Journal: Computers and Industrial Engineering: USA**

**Authors: Chandrashekhar Chiplunkar, R. Chattopadhyay and S. G. Deshmukh**

**Status: Communicated**

Abstract:

Database Management Systems have been always progressing towards making programming as easy and as simple as possible. Although Relational Database Management System (RDBMS) has succeeded to a great extent in achieving this aim, it is still complicated enough for users to write their own queries, to create their own screens or to generate their own reports. Through this paper an attempt is made to throw some light on potential of file based or codeless DBMS (CDBMS), which essentially stores programs, reports, queries as file records. The term codeless implies that programmer is not expected to write any hard coded program for creating or manipulating database information. He or she is supposed to change the information in system database just as any user of commercial information system manipulates information from different files or tables.