

Analysis and Design of Computerized Production Management System for Garment Manufacturing Company

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Abstract— Work involves analysis and design of 'Production Management System' a part of ERP System for Garment Manufacturing Company. Requirement study of the system is carried out at Unitex Ltd Bangalore. The system is incorporated with three sub-systems (modules) such as (a) Product development, (b) Production, and (c) Quality management. Analysis of data flow, information flow, processing activities of the three modules are carried out using Data Flow Diagrams. Analysis identified seven processes in Product development, 14 processes in Production, and four processes in Quality Management modules. Design of the system entities, their relationship, and attributes is carried out using Entity Relationship (ER) modelling technique. Structural design of the system is carried out using Unified Modelling Language (UML) technique. Complete database of the system consisting of 21 tables is designed, and attributes of the database tables are identified with required data types and relationship keys.

Keywords— DFD, ERD, ERP, Garment, UML

I. INTRODUCTION

Enterprise resource planning (ERP) systems are computer-based information systems that enable integration of application programs for various business functions or processes such as sales, purchase, financial accounting, manufacturing, human resources etc.

Different business applications can all use a common database that serves as the integrating mechanism. Infor ERP LX, JD Edwards Enterprise One, Lawson M3 for Process Manufacturing, SAP's mySAP ERP, SSI's TROPOS are some of the generalized ERP packages.

A generalized ERP system imposes its own structure on the company, and it becomes an organizational infrastructure that affects how people work. The introduction of such ERP systems forces the firm to change or its processes, sometimes drastically. The imposition of different knowledge structure influences an organization's ability to internalize the knowledge into its business routines. Inability to manage the complex process of internalization of new knowledge has led to several instances of failures of ERP in large firms. Since Garment manufacturing firms do not normally have the resources of large firms in terms of technical expertise, financial strength, professional

management etc it is logical to assume that they would have greater problems in managing the critical success factors of implementing generalized ERP system[1,2]. In addition most Garment manufacturing firms rely on their own idiosyncratic processes that enable them to meet customer demands in a flexible manner. The structure imposed by generalized ERP threatens such idiosyncratic methods of functioning and is likely to lead to resistance and non-acceptance of the new system by the employees.

Garments Industries in our country is facing the challenge of export of their products in the world market. The market has become very competitive and it is very hard for the poor countries to survive in the quota free market. There are several RMG centers in India, of which the major ones are Mumbai, Coimbatore, Tirupur, Ahmedabad, Ludhiana, Bangalore and Indore [2].

The ERP system enables the Garment industry to enhance its databases consistently perform better by implementing in the industry so that the enterprise operation support system is maintained well for process integration with the help of latest software's which are available in the market by virtue of which there will be a dynamic change in the whole industry. A well fragmented design of such a system improves the production as well as the growth of the company in a positive manner. It was thought expedient to focus on the issues in Unitex Apparels Ltd Bangalore, which is an emerging centre that has grown at an accelerated pace over the last few years and has a dominant presence of women workers.

Most prior research on ERP implementation and success has therefore been in the context of large firms. However, now there is increased awareness of ERP in the Garment manufacturing market and ERP vendors have started paying attention to this market segment for business growth. With limited resources and more distinctive ways of functioning garment manufacturing firms are likely to face more challenge in generalized ERP implementation compared to larger firms with professional expertise. Thus the implementation and usage of ERP systems in garment manufacturing firms is worthy of investigation. To answer the above questions, we conducted an in-depth exploratory study of ERP implementation in a garment manufacturing

firm in Bangalore involved in different types of garment manufacturing. The company is representative of a typical Small and Medium Enterprise trading firm with trading operations controlled in some low cost locations [3].

II. NEED FOR COMPUTERIZED SYSTEM FOR GARMENT INDUSTRY

Computerization has become a prevalent corporate response to free-trade related clothing import competition as deregulation and the drying up of subsidies to support an Indian clothing industry. The garment-manufacturing industry always aims for new product development and efficiency improvement in production. In past years, advanced computer technologies already facilitate new manufacturing operation and build up management tools. Today's manufacturers are looking towards more advances and benefits with their focuses shifted to many different types of networking tools. In the globalization era, rapid data communication and sufficient information is important to make the right decision at the right time. At present, various organizations / industries in India are using paper based methods, which are time consuming. . The use of internet-based technologies to communicate information is one of the best approaches to support the informational needs of various departments of an Organization. It is extremely difficult to organize and to maintain the current and old official records manually. Most of the organizations are storing their data manually, putting their precious records at risk without any security. The search for a specific file is cumbersome process and some time they fail in their search, this leads to realization to ease their work, which is possible with computers having sophisticated and user-friendly software.

At present there are many systems to provide smooth information flow through the organization but this is too expensive to implement in the composite apparel industries. These difficulties provide the opportunities to build an effective and efficient system for the composite apparel industry from where all the information can be accessed and updated by individual department and can be retrieved when necessary. Some software companies now-a-days are making software on the basis of production information system and Human resource information system etc. They develop the software according to companies demand. Although that software is very much strong in structure but it's expensive and difficult to maintain. So, most of the apparel industries are incapable to use those software. Basically the development of the software is reflection of current production process of the apparel industry.

A. Present Status of Computerized Systems in Garment Industry

Over the last 15-20 years the apparel sector has been in a state of continuous restructuring. A combination of technological and socio-economic changes, production cost, liberalization and the emergence of important

international competitor from Asia and the Mediterranean region are influencing the apparel manufacturing sector of India[3].

Apparel manufacturers are facing increasing competition and cost pressures. Hence efficient information flows within inter department seem to be an important key factor for apparel industries in India for improving better co-ordination among them. In this report, a conceptual model related to production activity of apparel manufacturing is developed. This Model considers the specific requirements for smooth flow of information within various department of an apparel manufacturing. The production Information System will help to share information among various manufacturing activity related departments such as cutting, printing, embroidery, sewing, washing, finishing and shipping of an apparel industry.

The present status of garment industry in India is facing a very high level of competency by its neighbouring countries such as Sri Lanka, China, Bangladesh etc. Hence in order to sustainably hold a firm footing in the production of RMG it is very much essential to implement the Computerized Information System in the Garment Industry so that success will not be constrained to few levels but will be enjoyed in all the levels of the industry. Therefore it is required to implement computerized systems in garment industry to develop further and gain success more than that of its counter parts.

III. SCOPE OF WORK

Development of an ERP system or an application software for manufacturing company involves a lot of work and takes enormous time. Complete software design and development / implementation will be carried out in four stages such as (i) System requirement study , (ii) System analysis, (iii) Design of the system, and (iv) System Development and Implementation.

This task even for small and medium scale industry takes at least one to two years depending on the type and level of company. Time available for M.Tech Project for carrying out the work is about 6 to 8 months. In the present work it is decided to develop a 'Production Management System' a part of ERP System for Garment Manufacturing Company up to the design stage. Hence it is decided to take up the task of completing the first three stages of software development in the following order;

- (i) Carrying out the literature survey on ERP systems and Garment Manufacturing.
- (ii) Carry out system requirement analysis in a Company by understanding production activities, data and information requirements.
- (iii) Analyze the data and information flow requirements using Data Flow Diagram.
- (iv) Carry out the syst/em Design using Entity Relationship Modeling and Unified Modeling Language techniques, and design the database tables.

M/s Unitex Apparels Ltd Bangalore is identified as suitable company for understanding the system requirements.

IV. SYSTEM REQUIREMENT STUDY

In the production of readymade garments undertaken by Unisex group, the method employed in accomplishing the production task is Progressive Bundling Method, which gets its name from the bundles of the garment parts that are moved sequentially from operation to operation. Even though it is referred to as a traditional way of production which is been used widely by apparel manufacturers for several decades and is continued till date.

The garment production group mainly produces products such as Jeans Pant and Jeans Jacket. The production process is same for both except the fabric material and accessories utilized. The pant has comparatively less number of parts than that of jacket. The auxiliary materials required in pant are leather patch, zip fasteners, rivets, shanks etc whereas in jacket they are buckles, straps, cuffing etc. The fabric material used in production of jacket is bit rugged and is prone to more shrinkage as compared to denim fabric which is used for production of jeans pant. The production flow process is same for both the products which are explained hereunder.

The process starts off by the buyer who sends a color visual or Original Sample to follow or a book let of their detail design to follow with the order. Factory (manufacturers) sends the price accordingly and asks for approval from the buyer. After approval, the factory develops the proto (development) sample and gets the approval. Within this period buyer sends the purchase order along with the LC (Letter of Credits). After getting the proto and LC, the factory goes for size wise fit sample (for approval of the measurement). After the approval, the factory develops the Pre-Production (PP) sample and gets these approved. Pre production sample goes with all original brandings like actual fabric in actual color, actual color print and embroidery, all actual accessories like labels, buttons, packing etc. After receiving the approval on Pre Production samples, the factory goes for final bulk production. After final production, either buyer does the inspection or the factory do the inspection on behalf of buyers and produces an inspection certificate which is a compulsory with the shipping document. The factory does the packing as per buyer's instruction. Commercial department contacts the buyer's nominated shipping agent. Thus finally finished product is forwarded for shipping along with the paper works attached on the carton box and sent to the buyer by proposed way of dispatch.

V. SYSTEM ANALYSIS

Since the work was initiated as P.G Project work due to paucity of time instead of focussing on complete ERP system it was decided to take up the system development for Production Management. This system comprises three sub-systems such as (i) Product Development, (ii) Production, and (iii) Quality Management. For proper understanding and ease of analyzing the system, the system analysis is carried out using Data Flow Diagram's (DFD) which is explained in the following section. A DFD also known as a "bubble chart," has the purpose of clarifying system requirements and identifying major transformations that will become programs in system design. Due to the space constraint the DFD's could not be posted here as it is a descriptive approach.

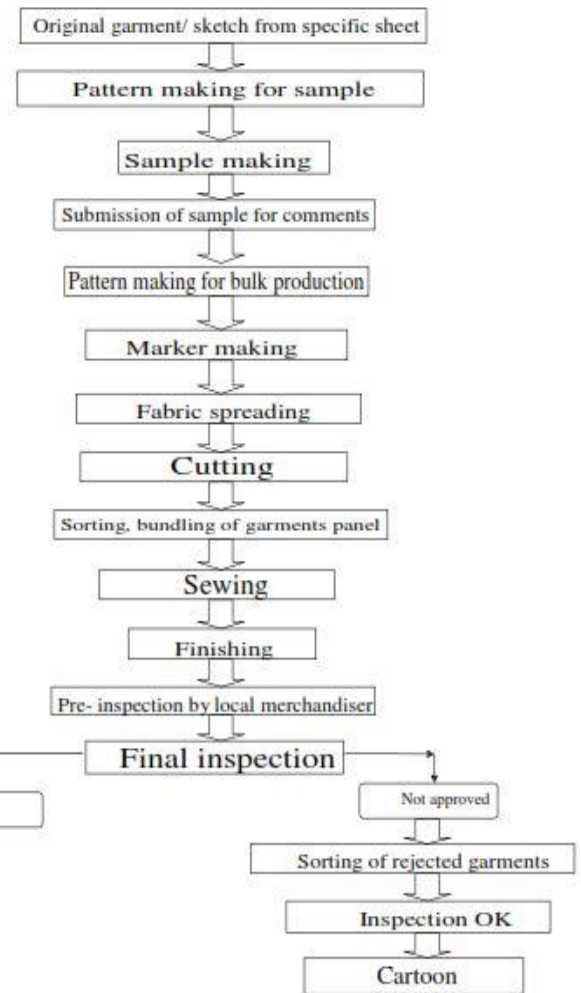


Fig 1: Flow Process of garment production.

A. Product Development Sub-system:

There are eight processes in this module which are briefly explained hereunder.

Garment Selection: The garment selection process does the selection of source of fabric that is required in manufacturing the product. The source of fabric is selected based on the buyer requirement which is specified.

Feasibility Check: The local and foreign fabric source information is collected and stored in the respective data stores, upon which a feasibility check is made by this process so as to decide on which fabric source is selected.

Fetch CAD Model: This process fetches the CAD model details of the product that is to be produced, further based on the details in the data store and relevant modification information are updated.

Sample Pattern Preparation: In this process sample pattern information is prepared for a sample product, it will be done based on the information obtained by the buyer in the form of Proto samples.

Sample Product Preparation: This process uses sample pattern information to create details of sample product.

The product details and characteristics of the product are utilized to produce the sample product.

Sample Verification: This process sends sample product information to the buyer for verification, based on the buyer's approval information it updates all the details of the sample product.

Costing Approval: The cost of all the raw materials used, machinery used, labour wages, transportation charges, manufacturing cost etc. required to produce the product in bulk production, all these information are updated by this process and generates approval report.

Purchase Order: Purchase order details received from the customer is updated by this process.

B. Production Sub-System:

This module is identified with twelve processes which are briefly explained here below.

Pre-Production Activity: The pre-production activity information details such as procurement of purchase order, raw material procurement, machine availability, and man power allocation etc. which are carried out prior to bulk production all these information are updated by this process.

Assessment of Material: The details regarding assessing of the material for defects, shrinkage, shortage and decision on material procurement is made and updated in this process.

Material Procurement: The material source selection information and details of material procured is updated in this process.

Prepare Bulk Production Pattern: The bulk production pattern preparation information details are obtained from approved sample product pattern. Bulk production pattern is prepared based on the information of sample pattern and all the information details are updated in this process.

Production Route based on Product Style: The production route is decided based on the information for each style of the product, all these details are updated in this process.

Marker Sheet Laying: Marker sheet laying information for individual product style is based on the details of product styles. The marker sheet laying details are stored in this process.

Marking Dimensions: The information details regarding marking the dimensions based on size for each style and the dimensions are marked, details of marking the dimensions are provided in this process.

Production Details: The details required in order to produce a product such as cutting information, code generation information and laying information are processed here. All the details of information required in production are updated in this process.

Sorting & Bundling of cut pieces: The sorting and bundling of cut piece is done in this process and details of sorting and bundling are updated in this process.

Sewing Work Update: The sewing of cut parts is the activity in this process, upon completion of sewing work the details of sewing is updated in this process.

Finishing: The finishing operations such as attaching batch setting, embroidery work etc. Details of finishing are stored thereafter in this process.

Washing: Washing details and information regarding washing process given by the buyer is followed and washing is carried out, all the washing details are updated in this process.

C. Quality Management Sub-System:

There are four processes in this module which are explained here below.

Joint Pre-Inspection: The joint pre-inspection carried out by both the local merchandiser and buyer's merchandiser, the information on their comments on the inspected product, are updated in this process.

Finishing Works: The finishing works such as dummy trims replaced by the original trims, the approved finished product details etc. all these information's are updated in this process.

Sorting Out Defective Products: The defective products are sorted based on the information from the standard requirements, all this information is processed and updated in this process.

Packing And Forwarding To Shipment: The information details regarding the finished products after getting the approval is packed and forwarded to shipment, all these information of the product are updated in this process.

VI. METHODOLOGY

We chose the case study method because our aim was to explore 'what' problems are crucial in a Garment manufacturing firm's endeavour to implement an ERP package and 'how' they address them. Case studies are appropriate when little is known about the phenomenon as well as when the investigation entails a 'how' aspect, signifying a process orientation (as opposed to factor orientation [5,6].

The analysis is to determine if the problem or the subject due for development warrants further analysis. It also refines the problem statement and creates a preliminary plan for an in- depth analysis of the problem. The analysis of the system is carried out using Data Flow Diagram's (DFD) for proper understanding and ease of analysing the system. The software applications success is one of the most enduring research topics in the field of information Prior researches have addressed the definition and measurement of success as a thorny matter in information system implementation. The definition of success depends on the point of view of the person who defines it. It became clear early on in the research that people often mean different things when talking about information systems or ERP success. The design of database for the proposed production management system is carried out with the help of ERD and UML diagrams which clearly picturize the data flow in the system[4,8]. The use of ERD gives a rough idea about the system and the activities taking place in it. Further with the help of UML diagrams a clear

and more detailed, structured and well organized design can be obtained to generate the database for the system. The ERD of the system is shown in figure.

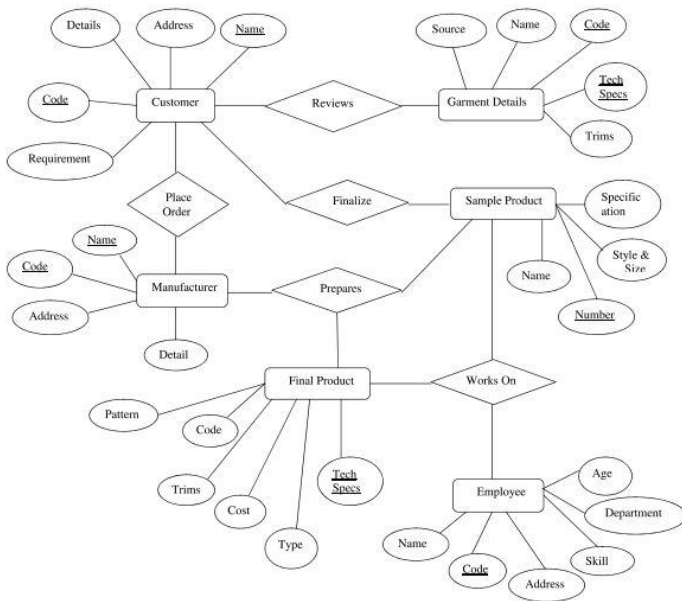


Fig 2: ERD for the Production Sub-System

Our investigation is therefore informed by prior research that provides a framework for the analysis as well as our analysis of the perceptions of the problems and the constraints faced in addressing the challenges. Hence a deductive as well as inductive element in our analytical approach is used here. Initial coding of the case narrative was done with collated segments of data were collected, the possible explanations/causes were developed.

VII. DESIGN OF THE SYSTEM

The Product Development database keeps track of the employees, customer, manufacturer, garment detail, sample product and final product. The Product development gives description of the parts of database represented. According to the requirements we identify six entity types one corresponding to each other. The Product is developed based on customer requirement, the customer has a unique name, a unique code, and details pertaining to them as the attributes. It keeps track of the details of the customer so as to know whether the customer had any previous transaction with the firm or not and the order placed by him is transacted. The manufacturer also has a unique name, a unique code, and details pertaining to the firm. The code is key attribute here for customer and manufacturer. In the same manner ERD for other Sub-Systems are also prepared. The group as a whole did not have a policy for implementing computer systems at its unit. As a result, each of the departments developed their own systems. It catered to merchandising. After some usage, these systems were abandoned and work was done manually. Again it had developed software for sales and merchandising. In addition, a common stand-alone

accounting package was used by all subsidiary units. The management at each of the subsidiary units relied more on gut feel and out of date manual Excel reports rather than information from computer systems to control and manage the operations. The group as a whole derived little benefit from disparate systems in terms of an overall understanding of the cash flow, production costs etc. Management at the group level felt the need to streamline the computer operations for the subsidiaries and improve information management and dissemination.

VIII. NORMALISATION OF DATABASE TABLES

Normalization is a technique for designing relational database tables to minimize duplication of information and, in so doing, to safeguard the database against certain types of logical or structural problems like data anomalies.

- First Normal Form (1NF): Eliminate Repeating Groups – Make a separate table for each set of related attributes, and give each table a primary key.
- Second Normal Form (2NF): Eliminate Redundant Data – If an attribute depends on only part of a multi-valued key, remove it to a separate table.
- Third Normal Form (3NF): Eliminate Columns Not Dependent on Key – If attributes do not contribute to a description of the key, remove them to a separate table.
- Boyce-Codd Normal Form (BCNF): The remaining anomalies from functional dependencies are removed.

IX. CONCLUSION

Our findings indicate that lack of adequate financial, technical and management resources constrained the firm's ability to effectively manage the problems and that these resource constraints had different impacts at different stages of the ERP implementation life-cycle.

- Thorough requirement study of the system was carried out which has resulted in identifying important activities in Garment manufacturing, related data and information flows.

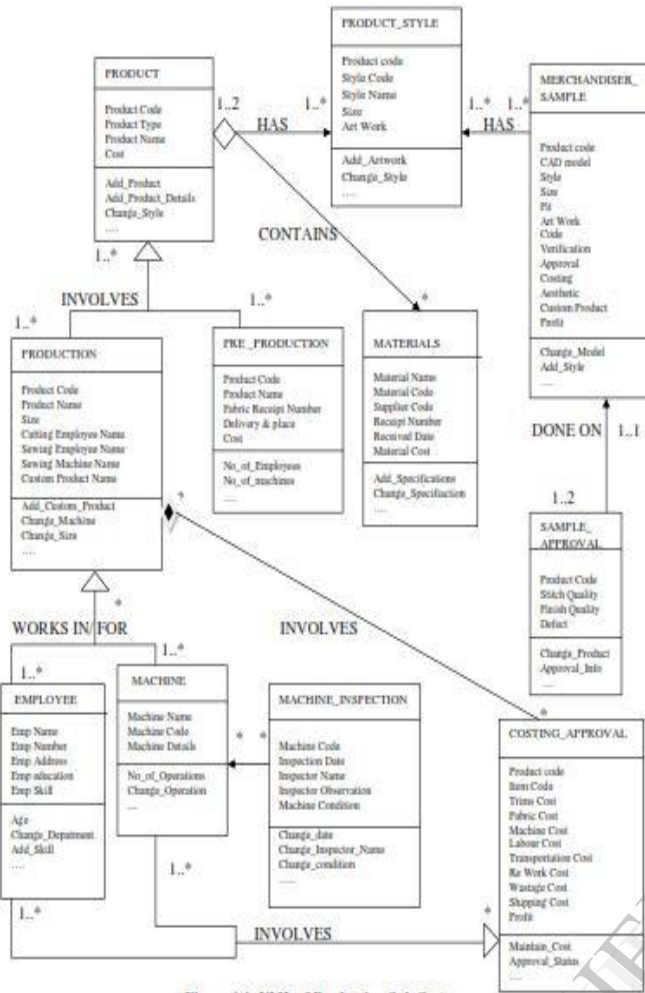


Fig 3: UML for the Production Sub-System

- (ii) After the system analysis it was identified that ‘Production Management System’ of Garment Manufacturing Company will comprise three sub-systems (modules) such as (a) Product development, (b) Production, and (c) Quality management.
- (iii) Analysis of Data flow, information flow, processing activities of the three modules are carried out using Data Flow Diagrams. Analysis identified seven processes in Product development, 14 processes in Production, and four processes in Quality Management

modules.

- (iv) Preliminary design of the system using entities, their relationship and attributes relevant to the entities is carried out using Entity Relationship (ER) modeling technique. Design of Product development has three relationships, Production has five relationships and Quality Management has two relationships between the entities in the system.
- (v) Structural final design of the system is carried out using Unified Modeling Language (UML). The clarity on design of the system is obtained based on UML design, the database tables are designed showing the cardinality of each table with the other in a systematic manner.
- (vi) With the help of ER models and UML complete database of the system is designed which consists of 21 tables. Based on the data and information relationships requirement attributes of the database tables are identified with data types and relationship keys.

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