DEVELOPMENT OF COMPUTER INTEGRATED MANUFACTURING (CIM) FRAMEWORKS AT UMP FKM LABORATORY

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ABSTRACT

Computer Integrated Manufacturing (CIM) system is known as a system that integrate all the data and information from business, manufacturing, management information until a product distribution into one system. CIM system will offer better factory control, improved product quality and product flexibility. Nevertheless, it is still new at FKM Laboratory at UMP. Even though currently FKM still do not produce anything for market sell but is good to have such as this system for future use. So that, every details and data about production at FKM could be monitored in one system. Before manage all the information needed to develop CIM system, every company must define and determine the most important element in CIM system based on their facilities and availability. The objective of this project is to develop the framework for CIM system in FKM Laboratory. The framework will guide in the process of development CIM system for FKM Laboratory for the future use .This study also will define and determine the most important element in CIM based on FKM Laboratory. For the beginning, data and information from the making of mold for bottle plastic have been taken and used, which is as a foundation to develop CIM system. By utilizing this project, hopefully it will be as guideline for Faculty to implement the CIM system to FKM Lab furthermore to all laboratories in UMP.

ABSTRAK

System integrasi berkomputer dalam proses pembuatan adalah satu system yang menghubungkan semua informasi dan data-data daripada soal bisnes, proses pembuatan, pengurusan data hinggalah kepada soal pengedaran kepada market semuanya diselaraskan di dalam satu sistem. Sistem integrasi berkomputer ini juga menawarkan pengurusan kilang yang baik, menambah-baikkan kualiti sesuatu produk disamping memudahkan penyesuaian proses pembuatan ke atas sesuatu permintaan. Bagaimanapun, ini masih baru di Makmal FKM di UMP. Walaupun buat masa ini FKM tidak mengeluarkan sesuatu produk untuk pasaran terbuka, tetapi projek ini adalah baik untuk pembangunan masa depan FKM itu sendiri. Ini kerana, setaip perkara dan data yang ada di dalam makmal FKM dapat diselenggarakan ke dalam satu sistem. Sebelum kita boleh menguruskan semua infomasi dan data yang diperlukan untuk membangunkan sistem ini, elemen-elemen yang penting di dalam sistem ini haruslah dikenal pasti dahulu berdasarkan kemudahan yang ditawarkan di sesuatu tempat itu. Objektif projek ini adalah untuk membina rangka kerja bagi sistem ini supaya menjadi panduan dalam proses pembinaan sistem ini di Makmal FKM nanti. Projek ini juga bertujuan mengenal pasti elemen-elemen yang paling penting di dalam sistem ini berdasarkan Makmal FKM. Bagi peringkat permulaan, infromasi serta data proses pembuatan mold bagi botol plastik telah diambil dan digunakan sebagai permulaan dalam proses pembinaan system integrasi berkomputer ini.

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CHAPTER 1

INTRODUCTION

1.1 Introduction of Research

There are many types of companies across many types of industries. Most of industrial company is focus on manufacturing as their main activities. They are selling product followed by their customer demand. So, in that case they have to be alert for any situation that can make the manufacturing process slower rather than their intention or expectation. With resource including product design, equipments, database, labor and material its must be provided at the right time and to be at the right place, any problem that make the production delay may increase time and cost and it will influence the flow of overall production.

1.2 Background of the problem

The primary objective of manufacturing business is to convert raw materials into quality goods that have value in the market and that can be sold at competitive prices that to gain profit for company. Factors contributing in increasing the profits can be improved by the following aspects:

1. System efficiency and throughput
2. Product quality and reliability
3. Productivity at lower product costs
4. Efficient and effective management techniques

For effective mass production, the companies should have comprehensive approach to minimize the time and operation cost. Therefore, it is important to talk about management of product time for companies able to launch the product into the market on time.

Lead time or time to market has been generally admitted to be one of the most important keys for success in manufacturing field. All the elements in the manufacturing process should be considered as higher priority. Companies should have one system that able to access the data and monitor the flow of process. All manufacturing organizations face the same daily practical problem, customer want products to be available in a shorter time.

Companies need to control the types and quantities of materials they purchase, plan which products are to be produced and in what quantities and ensure that they are able to meet current and future customer demand, all at the lowest possible cost. Making a bad decision in any of these areas will lose the company money. This means that some level of planning is required.

To solve several problems in this field, many companies introduce and develop Computer Integrated Manufacturing framework to integrate all elements that influence and considered as important thing in flow of production process in one framework. This framework will measure and monitor includes machine, tool, work-in-progress tracking, shipping and receiving recording, inventory, material handling and so on.

The introduction of Harrington's book refers to computer integrated manufacturing as the integration of business, engineering, manufacturing and management information that span company functions from marketing to product distribution (Harrington, 1973). Harrington could consider an integration of these activities in 1973 because their computerization was well established, it was the era of computer aided manufacturing. But refer to the objective and scope in this study is primarily concerned with the integration of manufacturing. Three main elements he considers are:

1. *Shop- floor process (particularly when computer controlled)*
2. The manufacturing engineering planning of those processes.
3. The production planning and control of both the shop-floor and the material used.

1.3 Statement of Problem

All authorities in manufacturing field seem to agree that the effective CIM system will demands change from traditional way of running a manufacturing business to the better way. Nonetheless at the moment Fakulti Kejuruteraan Mekanikal (FKM) Laboratory still do not have any CIM system applied so it will better to create this system and give exposure to another student to study advantages and importance of this system to the manufacturing field. This developing and implementing CIM at FKM laboratory will offer better factory control, improved product quality, product flexibility and increased profit. In this project later will focus only the framework in order to implement CIM. This plan may be useful to FKM laboratory if interested they might be running the business to produce a product for market sells. However to make the implementation fully successful, it require total cooperation between all functions of the enterprise, top executives, staff and all authorities.

1.4 Objective

The main objectives of this research are to develop the framework of Computer Integrated Manufacturing (CIM) at the FKM laboratory at Universiti Malaysia Pahang (UMP). Thru this project, its will give exposure and expand the knowledge about CIM. There may be many students with little experience of CIM even though they may have experience in industry. With this project also, we could determine and identify the most important elements in Computer Integrated Manufacturing framework at FKM lab. By using the Visio Software, the framework will build up properly concern to all elements that influence in CIM.

1.5 Scope

The scope for this project is including designing the framework of CIM for FKM laboratory at UMP for future used. In this project its will focus on the manufacturing process for make a mould for bottle plastic, so the framework will build up recording this process. Indeed, all elements or manufacturing level that be used will be determined and will be linked for facilities layout in the FKM laboratory.

1.6 Expected Results

This project is expected to produce a flow of production to make mold for bottle through computer integrated manufacturing framework. By utilizing this project, hopefully it will be as guideline for Faculty to implement the CIM to FKM lab furthermore to all Labs in this UMP.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Definition CIM according to the Computer and Automated Systems Association of the Society of Manufacturing Engineers:

CIM is the integration of total manufacturing enterprise by using integrated systems and data communication coupled with new managerial philosophies that improve organizational and personnel efficiency.

Basically CIM is integrating all data through all manufacturing process level. Nonetheless at the moment Fakulti Kejuruteraan Mekanikal (FKM) Laboratory still do not have any CIM system applied. The developing of CIM at FKM laboratory will offer better factory control, improved product quality and product flexibility. In this project later will focus only the framework in order to implement CIM. This plan may be useful to FKM laboratory if interested they might be running the business to produce a product for market sells.

Here are some previous researches that conducted by the other person about CIM:

a) Business Experience with CIM

This paper written based on survey that conducted by John Johansen, Uday S. Karmarkar, Dhananjay Nanda, Abraham Seidmann in 1995. This paper describes the result of recent field study of CIM adaptation strategies in US manufacturing firms.

The purpose of the study was to identify the impact of facility's process characteristic on the CIM development process and the adoption policy being followed implicitly and explicitly. The survey focused in the following aspects, which are manufacturing process characteristic, the CIM development process, the CIM architecture and perceived value and benefits. In CIM that no part or function of the company should be considered in isolation, each parts should be viewed as a part of coherent whole, including marketing, scales, design, engineering, productivity, accounting and finance. They believe that CIM would help company in declining cost of computer and communication hardware, improve productivity and reduce labor cost as well.

Nevertheless how visibility achievement in CIM, many medium size corporation buy pre-package CIM programs designed for companies the size of GM. The problem is in tailoring to fit that program to what the medium size company needs.

Other than that, the successful CIM does to a great expense not only upon to expertise in technology assessment and deployment but also on the business objectives of the firm, process characteristic, the presence of enabling technologies and the entire environment in which the firm operates. It is relying on the manager/ executive how they are good in adaptation of CIM to their environment of company's process or production.

b) Implementation of CIM: a survey of integration and adaptability issues.

This research conducted by A. Gunasekaran in 1997 about integration and adaptability issues in the implementation of CIM. He suggested for the successful implementation of CIM should include the use of computer for integrating information and material flows, small batch production with on-line production control system (e.g. FMS), and local area network (LAN) for integrating the information flow within the organization. He had found out the main issues involved in improving the integration and adaptability aspect of CIM. There are a set of major elements issues of CIM implementation that includes:

- Strategic aspect
- Organizational aspect

- Behavioral aspect
- Technological aspect
- and operational aspect

He also imagine, for the future research area of CIM are to develop suitable models for investment decision making in CIM projects and to determine the levels of skills and training required to develop and maintain a CIM system. Moreover, a system such as computer-aided tools (e.g. artificial intelligence, expert systems) should be developed for evaluating different alternative processes of CIM development from the viewpoint of integration and adaptation.

c) Roadmap for the Computer Integrated Manufacturing Application Framework

This project is join venture between the National Institute of Standards and Technology (NIST) and SEMATECH under a Cooperative Research and Development Agreement (CRADA).This project report is prepared by S.L Stewart and James A.St. Pierre. In this report includes a roadmap to adoption, use, standardization, testing, and certification of the CIM application Framework developed by SEMATECH.

The goals in this project are promote integration on the shop floor, reduce costs, and increase reuse through object-oriented technology. They also are identified a number of issues that can have important influence on the success of the CIM Framework. In some cases there are specific recommendations. There are following:

- Supplier Involvement and support
- Formal specification
- Evolution and maintenance of the specification
- Ownership of the specification
- Support from different platforms
- Integrating related effort

2.1 Definition of Computer Integrated Manufacturing

Computer-integrated manufacturing means different things to different people and different industries. However, regardless of the various definition, CIM is represents computers in manufacturing whether they be used early in the product development phase feeding production, factory floor controls, flexible manufacturing systems, and work cells, or used as an information system moving data throughout the manufacturing enterprise (Foston *et al.*, 1991)

Gabor, Kovors (Kavors and Gabor, 1986) defines CIM as the conceptual basis for integrating the applications information flow of product design, production planning, and plant operations.

CIM is concerned with the integration of :

1. Computer systems, through networks and suitable interfaces
2. Computer system software
3. Business process, activities and tasks
4. All company data and information, through database
5. Manufacturing process and activities, through network

The focus of CIM is on information as the crucial element linking all facets of the product enterprise.

CIM characteristic:

1. The complexity of the operation
2. The large amount of data involved
3. The cyclic operation
4. Uncertain or variable behavior of certain part
5. The changing nature to accommodate new market
6. Involvement of humans as part of system.

Some components of CIM are:

1. CAD (Computer aided design),
2. CAPP (Computer aided process planning),
3. CAQ (Computer aided quality assurance),
4. CAM (Computer aided manufacturing),
5. MRP (Material resource planning)
6. Material Handling

2.2 Conceptual CIM system model

A conceptual CIM framework offers more to manufacturing than simply speed and repetition and become is as guideline for build up and realize the CIM concept to reality. It is offer better factory control, improved product quality, product flexibility, and increased profits. This CIM will represent an enormous opportunity for manufacturing community to improve its productivity and maintain a competitive position in world market.

An immediate advantages of CIM is its ability to integrate such interrelated short-term functions as sales, design, materials management and handling, production, and quality assurance while providing valuable data for cost accounting and for management information system (MIS) database (Slattery and Thomas, 1985)

This system will support the complete range of business, engineering, human resources, and production activities and operations from strategic planning and customer order to the delivery of the product. The hub of the baseline model uses a common database as the central node. This node is repository for data released by engineering. Data from this node are distributed to major functional system for secondary nodes. The functional users then add values to the data at these nodes to meet their own requirements. Each function may distribute data to other subsystems for other applications.

Typical examples of the flow of product information in CIM environment as shown in Figure 2.1, all phases of the manufacturing process become computer integrated.

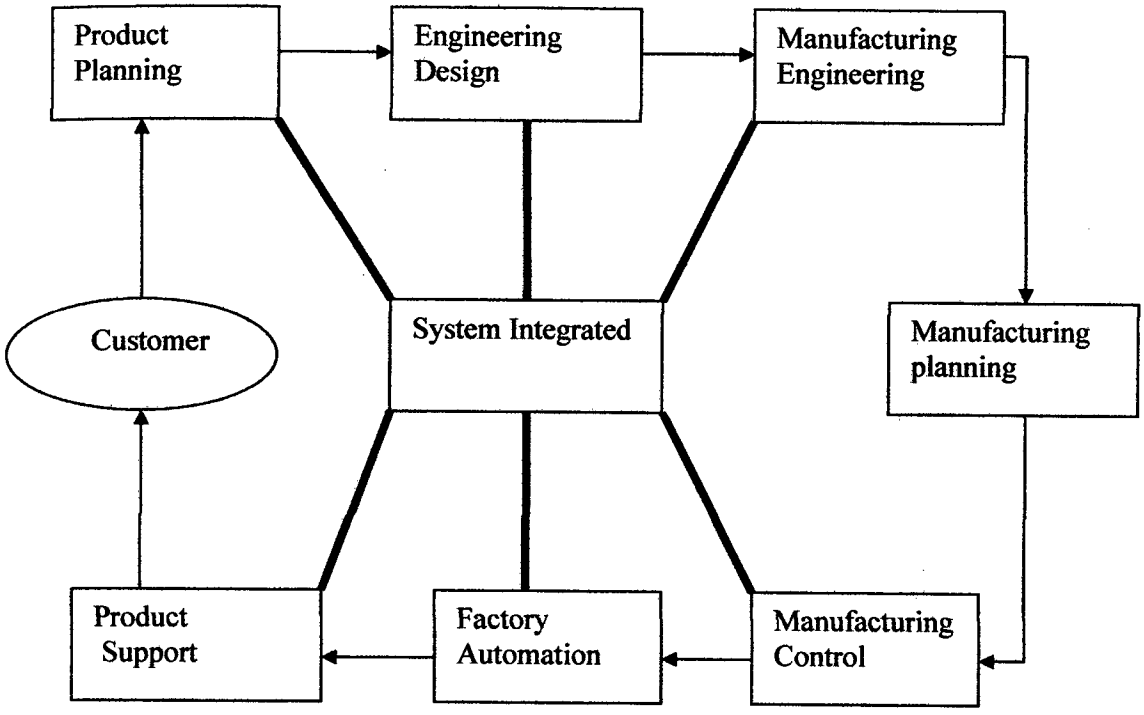

Figure 2.1: Simplified CIM cycle
(Foston *et al.*, 1991)

Developing and implementing a CIM system as illustrated in Figure 2.2 is difficult thing. A company can accept the concept of CIM without realizing the disciplines that will require achieving a CIM objective. It should be remembered that CIM is not a data processing project alone. It involves many resources, and such use must be supported by decisions and action by top management and executive.

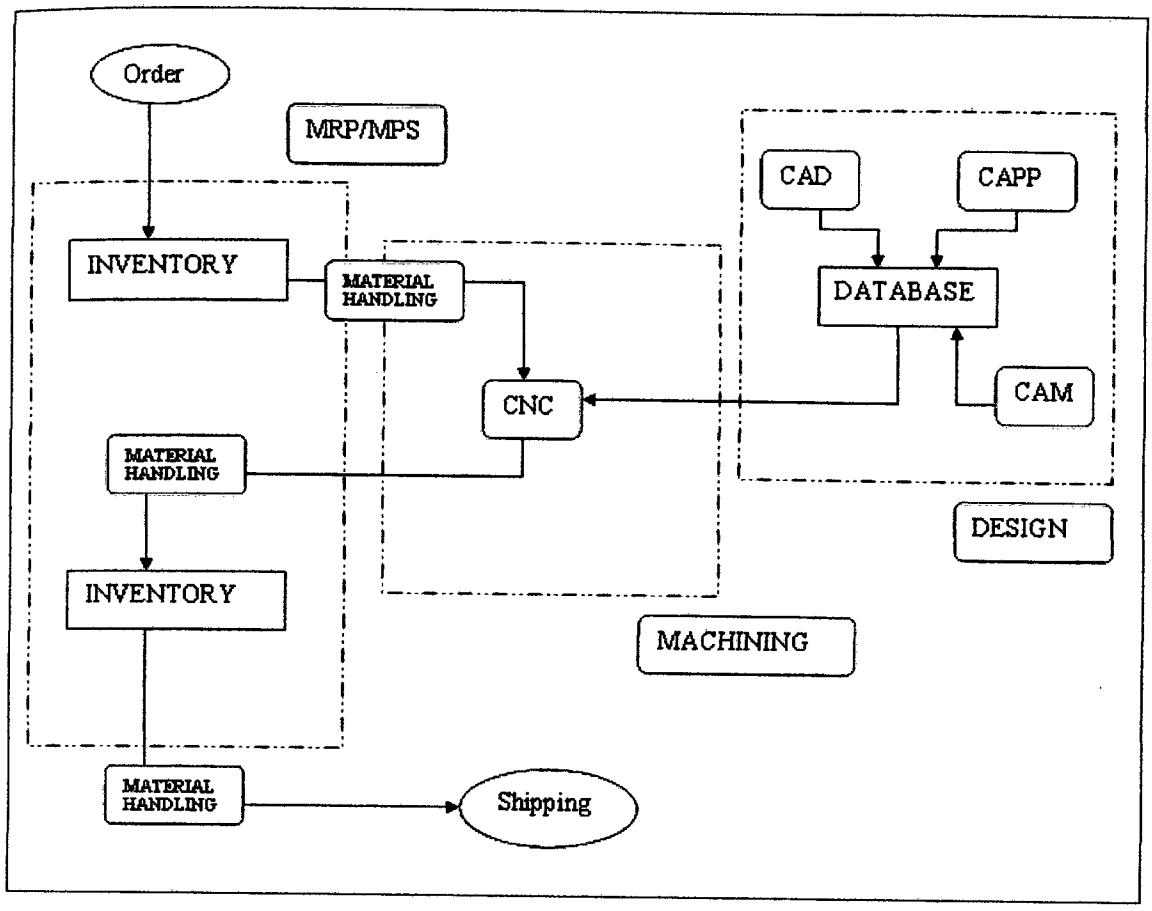

Figure 2.2: Conceptual of Computer Integrated Manufacturing

2.3 Objective of Computer Integrated Manufacturing

In the competitive business at globalization era, company should face many challenges from business world wide also competitive from other company and its business strategies as well. Therefore company should come out with a good planning and strategy. Thus, with implementating CIM system at company several things could be improved such as:

- Lead time, costs and inventory could be reduced.
- To coordinate and organize data effectively
- To eliminate paper and the costs associated with its use

- To automate communication within a factory and increases its speed
- To facilitate simultaneous engineering

2.4 Benefit of Computer Integrated Manufacturing

The integration of CIM technologies into company or industry can have a pervasive and profound effect on manufacturing organizations. Through CIM technology, data are integrated and shared by all segments of each major function: business, engineering and production.

CIM system offer many benefits (Foston *et al.*, 1991). Typical of them are the following:

i) Increased product quality

Computer-aided design enhances quality in the design itself and often provides well-done design via computer analysis, and Computer Aided-Manufacturing (CAM) assures a high level of repeatability, which further improves product quality with the aid of such systems as computer aided quality assurance (CAQ). The fast response time of computer-based systems supports total quality control (TQC) and thus the result in increased product quality for customers.

ii) Lower Product Cost

The linking of CAD/CAM systems with Computer Numerical Control(CNC) machines will increases the total system's productivity means its will lower product cost per item. This reduction cost comes from as a result of sharing and capitalizing on information from the same database system. Typical examples of lower manufacturing operating costs are in design, planning, machine tool programming, tool and fixture engineering, material handling, quality assurance, production controls, marketing and product support.

iii) Improved manufacturing planning

Planning data from every segment of manufacturing during every phase of manufacturing can be closely tracked and stored in a integrated business, engineering and production (IBEP) data system. Thus, data on each planning operation is available for use by all who need it. As a result greater predictability can be made in every phase of manufacturing because this extensive stored information on each operation in readily accessible. Also, this information gives better control over many manufacturing process, leading to higher quality product, and more effective use of manufacturing resources.

iv) Greater Market Share for Product

Manufacturing factory can target marketing with the particular needs from various customers through customization. Product could be custom tailored base on market demand. Other than that, with CIM, it can give quick response for suddenly changing of market demand.

Nevertheless, these benefits need effective planning, implementation and control process of any and all manufacturing resources of the entire company. A well-planned system comes through a willingness on the part of top management to be involved in all process.

2.5 Production Planning and control

2.5.1 MRP system

The major objective of MRP systems is to generate time-phased requirements for component or raw materials (Sipper and Buffin, 1997). In order to apply MRP in company all input must be consider and evaluate, there are following (figure 2.3):

- Master production schedule(MPS)
- Bill of material (BOM)
- Present inventory status

Some of these event may are planned or some are unplanned. So with MRP system its have capability to adopt the changes.

MPS is the main to the MRP system because the major objective of this system is to translate end-product time-phased requirement into individual component requirements. More specifically, it determines what quantities of each product will be built in each time period for which production is planned, referred to as the time bucket. The MPS begins as a trial schedule and if these schedules are feasible, they become input for the MRP system. The MPS can be updated or modified anytime a production manager wants.

The BOM is a list of all component, items, ingredients or materials- needed to produce an end item or product or one of its sub-assemblies. It lists all of the sub-assemblies, components, and raw materials that go into a parent assembly, showing the quantity of each required to make an assembly. It shows how much of materials are needed to order to manufacture a product at the right time (Khalid Sheikh, 2003).

2.5.2 Objective of MRP

The objective of the material requirement planning (MRP) is to get the right material to the right place at the right time minimizing the inventory cost (W. Plossl, 1994)