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FROM JIT TO THE INTRODUCTION OF A CIM SUPPORTED BY HUMAN BASED SYSTEMS

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ABSTRACT

Japanese manufacturers have seen the market swing from a sellers' market to a buyers' market by dint of changes in the economic environment. Therefore, they have found the need to establish a production system in which products can be manufactured at the speed at which they are being sold and which achieve a competitive advantage.

FA activity in Japan today has begun to change from local automation to totally integrated automation.

This paper introduces a bottom to top based JIT-FA system and describes how to approach and introduce a CIM supported by human based systems. A fully automated CIM system is not only flexible but also rigid. However we can realize a flexible production line system by partially introducing human based systems including a decision support system.

1. INTRODUCTION

Improvements in computer and communication technology have been making the world smaller and smaller, and we live in an age when real time events in the U.S. and Europe come bounding into our living rooms as they happen. This is accelerating the tempo of diversification and the rise in sophistication of consumer needs. Business must create structures that can quickly cope with these types of changes.

Trade friction and the sharp rise of the yen since September, 1985 have dealt a sharp blow to the export business. As a result, manufacturers have had to advance from Factory Automation (FA) to Computer Integrated Manufacturing (CIM) in order to survive.

Because manufacturing could not cope with this change through rationalization within single factories alone, it has been necessary to push forward with rationalization and efficiency enhancement across the integrated totality of a company's dispersed factories, and further across the total business organization, including the related businesses of a group. In other words, the needs of manufacturing firms are progressing from FA and total FA to "enterprise CIM." Basic to the development of enterprise CIM is the establishment of a "just in time" system in every part of the company, including the sales, production, and research and engineering divisions.

In this article, I will discuss the introduction of the "just in time" system into manufacturing and information management systems, and the problems and prospects associated with human supported CIM.

2. MANUFACTURING BASICS

The production of goods is the basis for manufacturing. Every manufacturing company begins by making its products by hand using tools, and then, while making suitable alterations according to the orders from its customers, moves to mechanization and automation accompanied by increasing sales. In the process of developing from a small or medium sized firm into a large corporation, management techniques and system technology are learned (see Figure 1). Thus, the basis of a manufacturing business is to make a profit in the factory, and to invest that profit in a balanced way in research and development, and in sales. A manufacturing firm must take good care of its factory, in order for the factory not to produce useless products, and the other areas of the company must make the utmost effort to ensure that the factory is neither forced nor allowed to make unprofitable products. At the same time, the factory must meet the delivery schedules for the orders brought in by sales, and construct the high quality products planned by research and engineering; what is going on in the factory must be easily visible. Without such relationships of mutual trust, enterprise CIM cannot be implemented (Figure 2).

3. WHY HUMAN SUPPORTED CIM NOW?

Although there are many points at which a manufacturer must distinguish itself from its competitors, we can summarize as follows those which absolutely must be realized in the 1990's:

(1) Accelerating the pace of new product design and development;
(2) Creating flexible production lines; and,
(3) Establishing the educational capabilities required to maintain high product quality.

Since, as Figure 3 illustrates, 80% of cost responsibility is determined by the product development and production engineering groups, we can easily see why item (1) is so important (Figure 3). Although computer aided design and manufacturing systems (CAD/CAM) are already being exploited to deal with this, the pace of creative activity is being promoted even further by bringing computer aided engineering (CAE) into play.

To shorten the lead time required for design and development, "concurrent engineering" approaches are being proposed and put into practice (Figure 4). In these approaches, the steps in new product development do not proceed consecutively as in the conventional approach -- rather, this means an engineering development approach in which all groups work at the same time and in parallel.

Because the creation of the flexible production lines of (2) is fundamental to enterprise CIM, it is the most important topic in manufacturing. To accomplish it, the following requirements must be met:

(1) A flexible modification in production line layout and process design.
(2) An automated, unmanned operation and the integration on a real time basis of information systems in each process of a multiprocess system.
(3) The shortening of the setup time for die changes, etc.
(4) The construction of flexible mixed flow assembly lines.

In addition, a good working environment is important for maintaining high quality in the product, but the outlook for the 1990's in Japan is very bad. As a result, strategic investment in training is important, and it is vital for each department to create and continuously implement a training plan. These programs should include training designed to increase morale and to develop sensitivity, an understanding of high technology, creativity, and other such attributes. The best tool for addressing the needs mentioned above is CIM with an integrated human support system.

4. PROCEDURES FOR INTRODUCING HUMAN SUPPORTED CIM

4.1 Introduction Concepts

(1) Clarify which products are strategic, and, concentrating on those products, decide which departments should introduce CIM and within what scope.
(2) Even if the areas in which CIM should be introduced have already been automated and set up for unmanned production, aggressively review the fabrication, material flow, and information management systems from a JIT viewpoint, and eliminate all wasteful aspects before introducing CIM.

4.2 Introduction Procedures

After the concepts behind the introduction of CIM have been checked, the introduction itself must be studied concretely. When undertaking a study of the introduction, a vision should first be conceived based on the business strategy. Then, plans and targets should be set, and these should be affirmed by all members before beginning the introduction of CIM.

Step 1

(1) As shown in Figure 5, field work is improved, and material flow is improved and simplified with JIT as the basis. This is a step to develop a new production line, even with a multiprocess system. It is aimed at averaging the production flow, providing an "assembly line in the flow system," and standardizing the working conditions as well as changing from a single setup time to a "one touch" setup time. Thus, it realizes automated, unmanned operations to save labor costs. ... In other words, this is the evolution of the manufacturing system.
(2) Information flow is simplified and standardized to establish management by direct contact with machine, material flow, delivery, quality, and personnel information, etc. ... In other words, this is the evolution of an information management system.

Because any area that requires quick decision making is a potential bottleneck in mixed flow single product manufacturing, introducing a human based system into such areas should be actively considered. More precisely, information that is required for personnel to make decisions must be put into an easily understandable format. A decision support system that can enable visual management of machinery/equipment and line statuses, product quality data, part supplies, and stock must be tied into human based systems.

Step 2

(1) Establish a manufacturing information management system based on automation in single cell or multi cell (FMC) units.
(2) Implement a vertically integrated system linking the above decentralized systems in real time with sales and engineering information systems.

Using the FS (Feasibility Study) approach developed by our company enables this work to progress smoothly. This achieves synchronization of both materials and information.

Step 3

(1) The systems established by steps (1) and (2) develop in parallel, and integration is achieved across all production line, sales, and design sections.

The expression of the procedures above with a production line block diagram yields something like Figure 6. A completely unmanned system has problems with flexible adaptation. Therefore, a human based system is incorporated in the final decision section, enabling a flexible production line to be constructed economically by creating a total line by linking small scale unmanned systems by means of human based systems. That is to say, at this time it is best to aim for CIM that incorporates a human support system.

4.3 Aspects of the Construction of Systems Evolved in Parallel for a Serially Decentralized System

The approach discussed in Section 4.2 for building a CIM system has a variety of advantages, the most important of which are as follows:

(1) Reduction of initial and total investments;
(2) Shortening of construction time;
(3) Simplification of maintenance and standardization of application software;
(4) Easier horizontal development of the same software; and,
(5) Less danger from a complete stop on the line, and an easier restart at a local stop.

5. PROBLEMS IN HUMAN SUPPORTED CIM

There are many problems that need to be solved in future considerations of CIM, but the following points summarize prospects for future development:

(1) The reconsideration of automation at the cell level, and integration methods. (Determine the range that can be covered by one person.)
(2) The reestablishment of intelligent machine synchronized production.
(3) The use of "kanban" for feed forward as well as feedback information.
(4) The establishment of mixed flow single product manufacturing methods.
(5) The balancing of unmanned and human based systems.
(6) The database integration that permits independent decentralization.
(7) The establishment and utilization of business communication networks.
(8) The development of upper and middle management personnel able to think creatively.

6. CONCLUSION

This article has discussed how important it is for CIM implementation to start with a flexible, waste free factory as the base, and to construct advanced information management systems on that base. At current technology levels, it is not possible from a budgetary viewpoint to replace human recognition, judgment, and creativity with machines and computers. In the factory of the 1990's, it will at last be possible to achieve flexible production lines through balanced system structures that make the most of both human abilities and current automated machinery/equipment, computers, and communication technology.

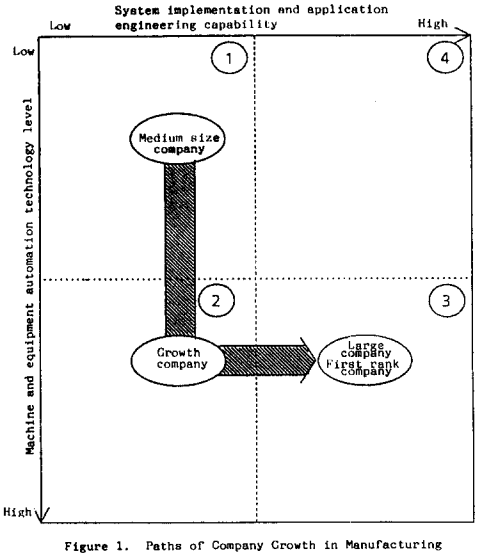

Figure 1. Paths of Company Growth in Manufacturing

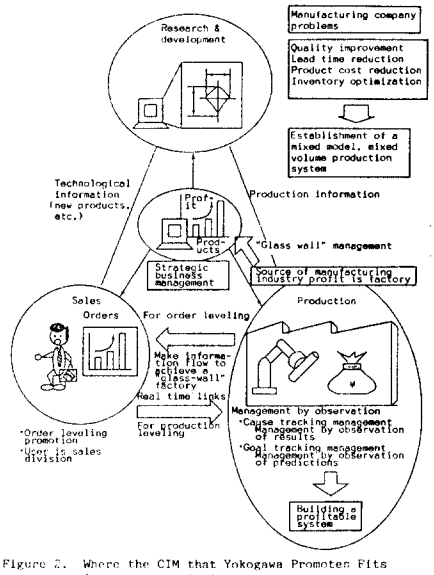

Figure 2. Where the CIM that Yokogawa Promotes Fits into the Overall Picture

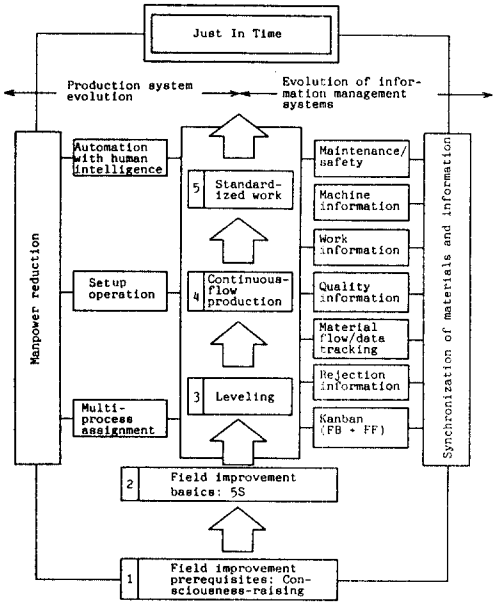

Figure 5. Procedure for Introducing JIT Production Systems

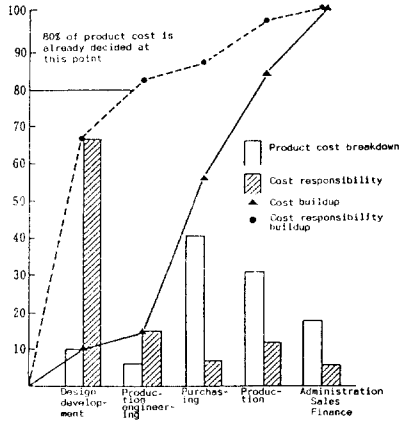

Figure 3. Cost Responsibility in Design Development

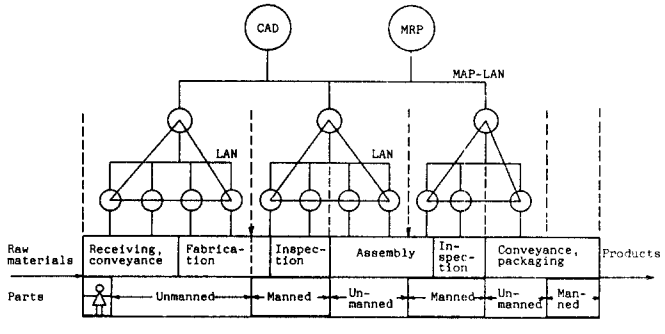

Figure 6. Parallel Evolution of a Serially Decentralized System

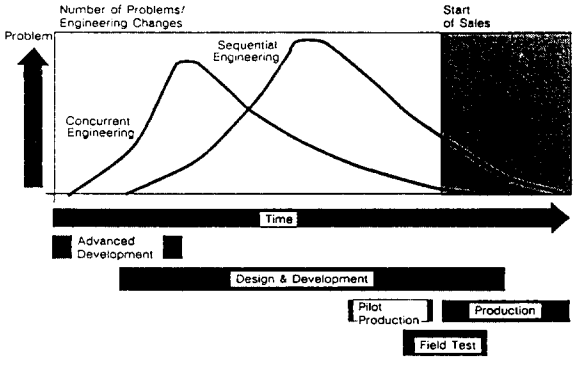

Figure 4. Concurrent and Sequential Engineering