CHAPTER 8

PROJECT IMPLEMENTATION AND VALIDATION

This chapter deals with the implementation and validation of the project in a brake system manufacturing company. The proposed case study investigates the feasibility of implementation of CIM based IAS methodology to completely control the manufacturing process as well as restructuring various department of the enterprise to cope up with the new web based networking system. The entire factory is to be thrown in so many viable modules of factory operation and analysed at gross root level so that computer control may go to the roots for the envisaged standards.

8.1 THE PROFILE AND OBJECTIVES OF THE FACTORY

The company is a brake system manufacturing, medium scale company of capital investment 35 crores. Primarily the company supplies brake system and associated accessories to a few car manufacturing companies of international operational sphere so that exigency does not arise to indents by other suppliers. Fifteen major vendors supply the factory intake. At present they are third in the rank of top brake manufacturing companies in India. Intense research and developments to boost productivity and sales is on to push the company to top among Indian companies. The present vision is to export 30% of their production in all prospective buying countries of the world and increase the supplies with proportionately balanced adjustment with demands in the country and outside.
The layout of the company consists of four bays namely the Stores, Machining, Assembly and Dispatch. The working modules of the entire factory are well organized in such a manner to effectively accomplish any change in the lay out. The enterprise is a ‘QS 9000’, certified company and has own "ISO/TS 16949" certification. The company has already succeeded 100 ppm (parts per million) rejections certification. Check routines and systems are incorporated in every modularized units of the enterprise. Scientifically technological product testing facility is available in the company.

The customer is taken with sacrosanct importance and every care is taken to supply high quality products of customer specification. Quality control is kept on high alert operation all the time. To highlight the company’s business policy as regards rejections of the consignments, it aims to reduce the present 100 ppm supplies made to 50 ppm. In the factory machining line the objective is to reduce rejections to 2000 ppm and in the assembly line to 1000 ppm. All planner departments keep this vision in focus and gear their activity so that the specified target is kept year after year. Staff upgradation in skills to cope up with current standards being a priority concern, objective efforts are being made to achieve the best in class in the master booster assembly cell. The present vision is to increase the in-house production by 100% and to export 30% of their production.

8.2 GOAL OF THE CASE STUDY

The goal of the case study is to implement the CIM based IAS in the factory for comprehensive manufacturing and control. The vendor’s factory activity coordination has to be made absolutely on line. The system in operation is antiquated because of island structure and has not been integrated into an online real time control. Since communication between departments of the
factory and outside vendors has to be made online real time, the entire networking has to be done by experts to have a consistent network. Maintaining a minimum inventory to reduce inventory cost, and implementing just in time (JIT) production schedules is also one of the goals to be achieved besides ensuring quality production and reducing rejections in various cells.

Thus the case study conducted has the following goals:

- To restructure the various divisions to get geared to the developed CIM based IAS methodology to be agile and adaptive.
- To ensure computer based integrated transactions between the enterprise, vendors, customers, freighting firms, etc.
- To analyse the factory operations on modular basis and explore all possibilities of efficiency optimization in the modules and the implanting computer system and interlinking them towards IAS.
- To analyse the interdepartmental issues in the enterprise and to develop an integrated system to ensure cooperation and coordination of the various resources on on-line real time basis.
- To ensure quality production and reduce the rejections in various cells and with customer consignments.
- To increase the annual production (by 100%) and
- To develop an agile and reconfigurable manufacturing enterprise.
8.3 CURRENT SITUATION ANALYSIS

The case study analysed the factory operations on modular basis and explored all possibilities of efficiency optimization in the modules by implanting of computer system and interlinking them towards IAS.

8.3.1 Product Design and Development

The factories manufacturing schedules totally depend on the customer requirements which come into the Technical Specification Group through the administrative department. The exact mode of product design and development modularized is presented below:

The customer contacts the Chief Executive Officer of the company with their requirement of different types of product and their specification. At the desk of the Chief Executive Officer the delivery schedules are also fixed and agreed by the customer. The Technical Specification Group of the company analyses the customer order from all manufacturing angles and present their decision in abstract form to the Chief Executive Officer. After obtaining approval from the chief executive officer, the worked out design is sent to the Computer Aided Drawing division. Once the drawings are completed, fully checked by the CAD unit, the drawings are sent to the prototype fabrication department. The prototype fabrication department evolves the product sample as per the CAD specification and sends the prototypes to the Quality Evaluation Department. In the Quality Evaluation Department, all the standard testing which are statuatory in the company are done on the prototype both from theoretical and practical channels. The product prototypes are given to the customer. The customer tests the prototype on actual working systems to find
out their compatibility. Incase the prototypes are compatible, the manufacturing process will be initiated. If however they decide any alteration, the changes envisaged are brought to the notice of the Chief Executive Officer and for the particular prototype thus requiring modification, the above process loops till the customer approves the prototype.

8.3.2 Production Planning and Control

Orders to be processed are sent to the production control executive in the factory premises from the administrative department. The production control executive at phase-I schedules the stores, machining department and assembly department so that proper production is achieved as per the schedules demanded by the administrative department. All finished products are routed through the quality control department with proper certification reach the dispatch block. The control executive in the dispatch updates the order indent and works out the shipping schedule to the customers and supplies necessary information to the administrative department to raise the bills against the supply.

For the coordination of the vendors with the factory there are appropriate liaison officials attached to administrative department and production department. Since some of the vendors are from overseas, coordinated operation is usually complex under certain condition so the production controller is ultra careful in the maxima and minima and the lead time checks on the raw material and other parts availability in the stores so that factory operation is uninterrupted. For ensuring quality, the company quality inspection consists of incoming products inspection of zero defect, in-process
inspection and final inspection of finished products. Durability tests, leak-proof tests are done for maintaining the quality of the product.

8.3.3 The Manufacturing System

The factory operation incorporates "TOYOTO production system", incorporating 14 elements of lean manufacturing. Broadly there are four blocks of manufacturing, namely material storage and inspection, Machining, Assembly and dispatch, all systematically linked to optimized quality production. The Machining process makes use of cellular manufacturing and is decentralized to make the manufacturing process extremely fast. Once the machining processes are over, the finished machined products are conveyed to the assembly division. The various machined product go to appropriate locations and the products get assembled in the assembly line according to the customer specification. The products are tested fragmentarily in bottom up mode sub-units as well as in the final customer specified assembled status and then sent to the dispatch department which is the fourth block attached to the manufacturing system. The Dispatch Division does cross checking the products against order forms from the customer, get them packed according to standard norms and ship them by freighting contractors.

8.3.4 Organisational Communication and IT Analysis

The industry has Local Area Network (LAN) connecting various departments of the enterprise. Mostly, the communication between the various departments was done through telephonic links and personal discussions. The installed networking system should be optimally utilized between various departments of the industry for the inter-departmental communication.
The enterprise has been using ERP with three modules namely the Enterprise module (common module, which deals with the company, finance, customer, supplier etc), Distribution module (which deals with purchase order, inventory, invoicing, receipt, excise, supplier and customer schedules) and Manufacturing module (which deals with materials requirements planning, bill of materials, lead time, manufacturing standards and production schedules).

The enterprise has other custom-made software also for production planning control for generating production reports (using Visual basic as front end and Access as backend). In the stores also custom-made software has been used for invoicing, receipt, vendor performance rating reports, warranty reports. For inter-departmental communication Rainmail is being also used.

With the customer, the enterprise utilize Electronic Wide Area Network (EWAN) of the customer also for facilitating on-line information of purchase order, customer on-line production status, customer production plan (daily and monthly), invoice status, payment status and material status (WIP). E-mail facilitates communication regarding any change in the plan.

8.3.5 Bottleneck Situations

The following section highlights the bottlenecks in the enterprise:

- As there is no network connectivity with data sharing between the departments results in a bottleneck for information flow. Hence the departments immediately could not access the real-time information. To access information from other departments for production, production staff has to go directly to obtain the
information that results in loss of time and proper information cannot be abstracted.

- There is no link between CAD and CAM operations resulting loss of productivity if varieties of products are manufactured.
- The enterprise has not yet established real time links with vendors, which results in loss of productivity.
- Although vendor store relationship has been structured according to principles of inventory management, there are minor interruptions intercepts the company operation at times.
- Failure of a cell results in total production loss and
- The ERP and custom-made software are as islands with out integration and data sharing.

8.4 DESIGN AND IMPLEMENTATION OF INTEGRATED AUTOMATION SYSTEM

In this section, the design of the IAS is discussed and the company's business, manufacturing strategies, benefits of IAS implementation, network architecture and design organisational interfaces are discussed. The following business and manufacturing objectives should be considered in the design of the CIM based IA system:

1. To design communication network with web connectivity and data sharing.
2. To maintain the consistency of the quality of product in various cells.
3. To deliver products on time and increase productivity.
4. To offer variety of products to customers.
5. To design and produce products according to customer/market requirements.
6. To design devices which can be used on the shopfloor for increasing production and quality.
7. To design an agile and re-configurable manufacturing system with optimum production efficiency.

8.4.1 The Aims and Benefits of the Implementation of CIM

1. To integrate the business information and manufacturing planning. As said earlier, it is often found that information in the company network does not reflect reality. For this reason, it is essential to link various departments and product specification database to provide a more realistic manufacturing plan and hence increase flexibility in production.

2. To increase the amount of data input and data collection into and from the network. Similarly, CAD and computer aided modelling software are only available to authorized staff. In order to use the network, CAD files and modelling files should be made readily available to any other staff on a Read Only Memory (ROM) basis from the network to reduce the complications of communication.

3. To reduce Work In Progress (WIP). As mentioned earlier, there is a missing link between CAD and CAM. If a variety of products with 3-D machining are to be manufactured, a
A machining technician has to spend 60% of his time interpreting the NC code. If software is linked between CAD and CAM to convert NC coding, this 60% of labour time could be reduced greatly. It will also reduce human error, making communication easier for achieving and assuring product quality.

4. To increase the use of bar-coding at the production stage. Currently, manual markings are made on the parts in the shop floor. Information in the route cards consists only of product delivery time, and the quantities and the quality specifications and work schedules. However, random events may occur on the shop floor, such as failure of machine tools, shortage of supplies and absence of workers. These random events force changes in the schedules. Implementing a bar-coding system for WIP and distribution tracking would maintain efficient shop-floor control.

8.4.2 Design and Implementation of Organisational Interfaces for Network Architecture

As a summary a new CIM model is designed for the implementation of IAS as shown in Figure 8.1. Taking the proposals for solutions contained in the above sections, as a starting point, CIM sub-functions are defined as shown in the model. This is a tailor-made CIM model, showing the CIM building blocks. This is an integration path the company should follow, integrating the product specifications database with sales, marketing forecast, production planning and control (PPC), etc.
The CIM model consists of different departments as modular units and are connected by the information system irrespective of its functions. The different modules are the marketing department, purchasing department, administrative department, CAD, CAPP, CAM, Computer Aided Quality control (CAQ), SFC, warehouse and sales department. The information flow between various modules is governed by the company goals and policies. The Knowledge Based System governs the goals and policies, which control the information flow and assist in decision-making.

For the above CIM model, an integrating infrastructure has been developed to integrate the islands of applications of the enterprise. The details of the architecture, Application integration, and technology are explained in chapter 6 and 7. This is a Client/Server structured, Object-Oriented platform with high degree of flexibility. The primary functionality of the architecture is
the integration of applications in a heterogeneous distributed computing environment with various operating systems, networking protocols and database management systems.

Under the integrated automation system envisaged the entire factory floor has been restructured through computer networking system providing on-line real-time information about product data, inventory, production schedules, work in progress, finished product, dispatch status etc. Since all orders are registered on the computer system, production planning and control is fully automatic, the compatibility of the inventory in the store cater to the scheduled production with out any interruption. All documents required with in the company including dispatches are generated on-line real time by computers situated at different places.

Integrated Automation system design will connect the entire factory in a client/server networking system with tagged access with the internet. The officers of the various modular factory operation are to be given powers to access vendors through the networking system as well as through other channels, so that any requirement on approved production schedule within the ambit of their operation, the concerned officer with out checking the administrative department will carryout himself.

Each unit of product manufactured in different units will involve different types of data to be transferred to further units of manufacturing. Hence the computer network must have exhaustive software to check and highlight all possible errors in data entries incorporating logical rules and knowledge based systems.
8.5 IMPACT STATISTICS OF IAS ON THE ENTERPRISE

Integration of the islands of application of the enterprise predicts optimized production efficiency and predicted standards. The factory production effectiveness is measured by the factors Total Productivity Maintenance (TPM), which is also called as cell efficiency and Lead Indicators (LI). TPM has four sub-factors, they are Rate of Availability, Rate of Production and Rate of Quality. Lead indicators are Profit on sales, Return on Investment and Return on net asset.

The Rate of Availability (ROA) is the ratio of actual time utilized and the total time available. The Rate of Production (ROP) is the ratio of Total quantity produced multiplied by time and Actual time utilized multiplied by per component time. Rate of Quality (ROQ) is the ratio of total number of components accepted and total production. Total Productivity Maintenance (TPM) is obtained by multiplying ROA, ROP and ROQ. Prior to the implementation of CIM based IAS, the performance measures for the factors ROA, ROP, ROQ and TPM are 80%, 90%, 94% and 67% respectively. After the implementation of IAS the measured values of ROA, ROP, ROQ and TPM are 90%, 95%, 99% and 85% respectively. Comparison of the performance measures is shown in Figure 8.2.

Work in progress (WIP) turn ratio (the ratio of turn over and inventory) has been optimised from 10 to 16. The factory utilization factor has been optimised from 80% to 90%, Return on Net Asset has been optimised from 17% to 25%, and Return on investment has been optimized from 2.5 years to less than 2 years. By maintaining high production efficiency and production standards, the enterprise could export now 10% of its total production. The
optimised performances motivated the enterprise to meet the market demand by increasing its production by 60% by the end of December 2003 and 100% by the end of April 2004. The expected productivity improvement is shown in Figure 8.3. Thus it has been proved that IAS has the capability to create confidence and ensure the ways and means to align with the market/customer demand.

Figure 8.2 Comparison of performance measures

Figure 8.3 Expected productivity improvement
8.6 FINDINGS AND RECOMMENDATIONS

The following are some of the findings and recommendations in the design and implementation of IAS in a manufacturing enterprise.

Since Integrated Automation is totally controlled by networking system, with practically no manual controls, the entire working personal of the factory are integrated with the computers of the network. This would give an atmosphere of a highly mechanized system where all operating personal also get metamorphosed in the total structuring of the machinery as machinery themselves. This way the entire factory is brought under the network as integrated modular units. Thus Integrated Automation System brings the following benefits:

- The use of IT standards simplifies creation of a truly interactive system, which enables manufacturing functions to communicate easily with other relevant functional units.
- Accurate data transferability among the manufacturing plant or subcontracting facilities at in-plant or diverse locations.
- Faster responses to data-changes for manufacturing flexibility.
- Increased flexibility towards introduction of new products.
- Improved accuracy and quality in the manufacturing process.
- Improved quality of the products.
- Control of data-flow among various units and maintenance of user-library for system-wide data.
- Reduction of lead times which generates a competitive advantage.
- Streamlined manufacturing flow from order to delivery.
- Easier training and re-training facilities.
• Faster plant commissioning, because the individual machine units or modules are tested and commissioned in advance.
• User software is easy to reuse.
• Standardization of machines/plants, because the customer-specific machine/plant can be configured quickly from different standard modules.
• Plant expansions can readily be integrated into the existing data processing environment.

The implemented integrated automation system must be validated with all types of production processes (with variable process parameters and different operating conditions) in the manufacturing enterprise. It should be stressed here that all the factory engineers must be very closely involved in the maintenance of the Integrated Automation System. An excellent training must be given with extensive technical manual, so that they will be able to handle the hardware and software of the system with absolute knowledge of what is happening at the apex level. All facilities should be kept open for open training so that the necessary new equipments needed for any task will be open for implementing engineers. Since certain conditions can occur upsetting the whole process, the entire IAS must be strictly maintained as modular units and each module must be completely documented to ensure proper maintenance.

8.7 SUMMARY

The methodology for the implementation of IAS presented above has been implemented in the factory and the results show that the factory production has indeed optimized to predicted standards. The most important change brought in the factory is delegated management. The networking
systems which controls the whole factory and connects operation with open world like vendors, customers, etc. with data checks and transfers have made the implanted IAS the absolute monarch of the show. All kinds of interlinking in the operational schedules proved absolutely successful according to expected standards. The developed CIM model for the implementation of IAS seems to be generic and can be used as a model for any type of industry. The comparative statistics particularly certifies the supreme addition brought in by CIM based IAS.