DESIGN OF CASE PACKER FOR FLAT END CANS IN CAN INDUSTRY

A FINAL PROJECT REPORT
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SUBMITTED BY
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CANDIDATE'S DECLARATION

I hereby declare that the work done in this project entitled "**DESIGN OF CASE PACKER FOR FLAT END CANS IN CAN INDUSTRY**" in the partial fulfillment for the award of degree of "**MASTER OF ENGINEERING"** with specialization in "**PRODUCTION & INDUSTRIAL ENGINEERING"** submitted to **Delhi College of Engineering, University of Delhi,** is an authentic record of my own work carried out under the supervision of **PROFESSOR VIPIN**, Asst. PROFESSOR, Department of Mechanical Engineering, Delhi College of Engineering, University of Delhi. I have not submitted the matter in this dissertation for the award of any other Degree or Diploma or any other purpose whatsoever.

(S.VIJAY KUMAR)
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CERTIFICATE

This is to certify that dissertation entitled "**DESIGN OF CASE PACKER FOR FLAT END CANS IN CAN INDUSTRY**" being submitted by **S.VIJAY KUMAR** in the partial fulfillment for the award of degree of "**MASTER OF ENGINEERING"** with specialization in "**PRODUCTION & INDUSTRIAL ENGINEERING"** submitted to **Delhi College of Engineering, University of Delhi,** is a bona fide work carried out by him under my guidance and supervision.

The matter in this dissertation has not been submitted to any other university or institute for the award of any degree.

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I dedicate this project to my wife RADHIKA ,my daughter CHARISMA V KUMAR, my father Dr. S.D. SUNDARSINGH and my mother JAYA

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(S.VIJAY KUMAR)

ABSTRACT

Indian organizations are facing intense heat of global competition. Quality of products and services has now become important factors for achieving competitive advantage. This study analyzes the scope of providing better products and services through Automation Techniques.

A wide gap existing in the system of conversion of products from raw material to finished products, which results to low quality product, with higher time slots for manufacturing, mismanagement of valuable resources etc. In many occasions, the same products are available with substantially higher variability. Many of the errors are the results of human interference and interventions.

Among the most important parameter is the Cost of the product and services. In many occasions, the costs fix up the standard of the product. To organize the cost factor and to handle effectively, the automation need to be implemented.

This study reveals the areas where we need to apply more strength to establish cost effective quick packaging though Automation. Total Automation system through PLC controlled system would be a boon to Indian Industries. This is a local automation system and has the capability of integrating with the Total Factory Automation System. Indian Industry sector is expecting a growth rate of 10% during this year. This opportunity needs to be effectively utilized to sustain in the global markets.

My view to have a sustained market share in the area of packaging using tin containers in Indian Industries are in par with the world market. The ability to automate the process would have to capture market at a faster pace. The scope of further development in this area is very wide.

The volume of can produced ranges from 80 numbers to 250 numbers per minute in a normal can manufacturing machine. The recent machines are capable of making more than 600 cans per minute. Most of these systems are capable of making cans automatically from sheet to

stretch wrap package. As far as the Flat end cans are considered, this method of manufacturing is prevalent in few parts of Asia only. I have developed a Case Packer to pack the Flat End Cans using the Case Packer.

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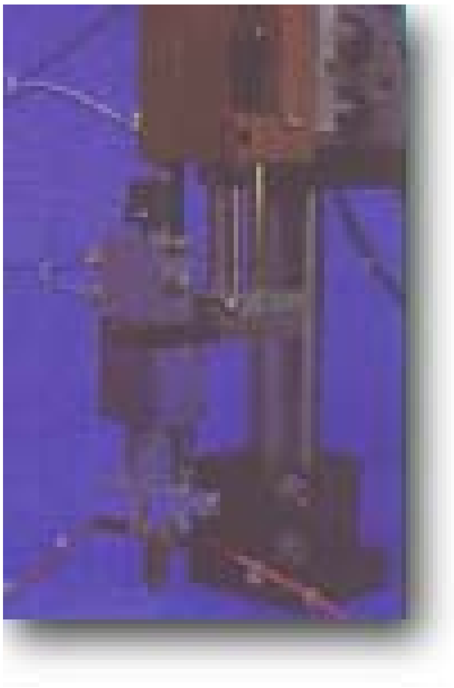
CHAPTER 1



INTRODUCTION

1.1 Introduction

To tackle the growing requirement of needs of products and services, automation has become inevitable. The scope of Automation has taken a different scenario over the last years especially in South East Asia. India and China are the prime players as the revolution in transformation is at a higher pace. It is always been believed Automation in the product manufacturing and the services will yield a better consistent quality product.

There are many areas were the research on Automation is at much faster pace than expected. A very few are listed below:

The principal areas of expertise in the centre are:

- Automated manufacturing systems.
- Programmable Logic Controller applications.
- Process control and instrumentation systems.
- Computer based monitoring systems.
- Energy management systems.

Companies can seldom arrange for their engineering or technical staff to work on development projects away from the day to day operation of the plant. Similarly, the smaller manufacturer may not have the necessary expertise in-house to undertake such projects.

In many cases the consultants provide valuable resource to the manufacturer, as they can provide a complete solution to the project in hand without tying up valuable technical staff indefinitely.

With both National and International encouragement for innovation and increased competitiveness in the manufacturing and process industries, there often exist suitable funding resources for Industrial-Academic partner projects.

In India the position of academic partner can assist in the preparation of proposals for such funding, and subsequently work towards the completion of these projects.

In the new economy, business requires their manufacturing systems to maintain low inventory levels and provide short delivery lead times. Machining systems are therefore being called upon to reliably produce products at varying production rates dependent on the products' instantaneous demand. Furthermore, decreasing product life cycle lengths has reduced the time available to develop machining systems. As a result, machining system designers need analytical models to predict system performance under various production scenarios. One of these performance measures is productivity. Traditionally, machining system productivity is estimated with consideration to both the reliability of the machining system and its processing speed.

However, system reliability and processing speed are interconnected. The parameters selected for a given machining process at a given speed influences the reliability of the machine and hence the productivity of the machine. Furthermore, the productivity of the entire system is not just dependent on the system reliability. It is also dependent on the configuration of the machining system. Therefore, the expected level of productivity for a machining system should be predicted by simultaneously considering both the machining process plan and the system design. Estimating machining system productivity typically starts by determining individual machine reliabilities. Machine reliability is typically estimated, either from experience or test, by a Mean Time To Failure (MTTF) for each machine.

1.2 What is Flexible Manufacturing System role in Automation?

In the middle of the 1960s, market competition became more intense.

During 1960 to 1970 *cost* was the primary concern. Later *quality* became a priority. As the market became more and more complex, *speed of delivery* became something customer also needed.

A new strategy was formulated: *Customizability*. The companies have to adapt to the environment in which they operate, to be more *flexible* in their operations and to satisfy different market segments (customizability).

Thus the innovation of FMS became related to the effort of gaining competitive advantage.

First of all, FMS is a manufacturing technology.

Secondly, FMS is a philosophy. "System" is the key word. Philosophically, FMS incorporates a system view of manufacturing. The buzz word for today's manufacturer is "agility". An agile manufacturer is one who is the fastest to the market, operates with the lowest total cost and has the greatest ability to "delight" its customers. FMS is simply one way that manufacturers are able to achieve this agility.

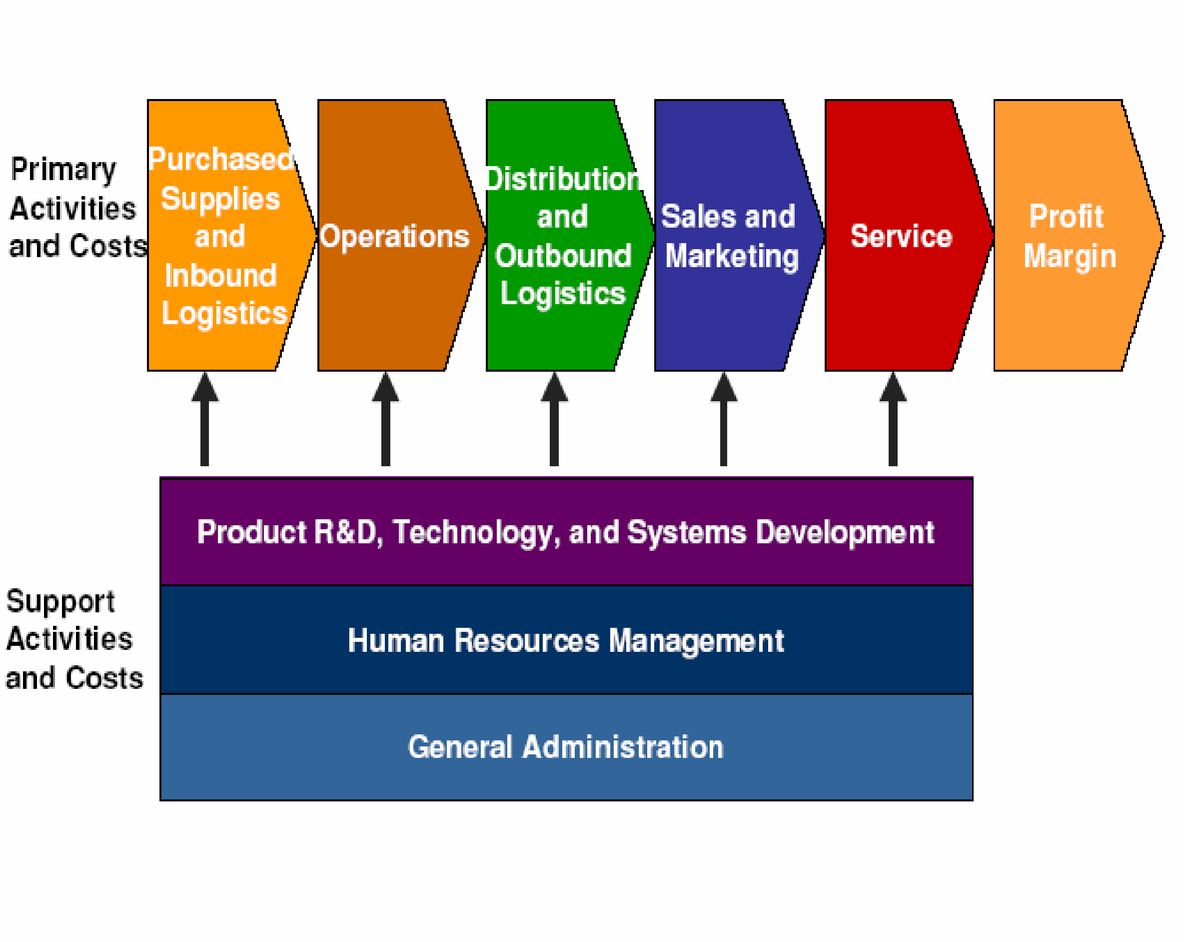
An MIT study on competitiveness pointed out that American companies spent twice as much on product innovation as they did on process innovation. Germans and Japanese did just the opposite.

In studying FMS, we need to keep in mind what Peter Drucker said: "We must become managers of technology not merely users of technology". Since FMS is a technology, well adjusted to the environmental needs, we have to manage it successfully.

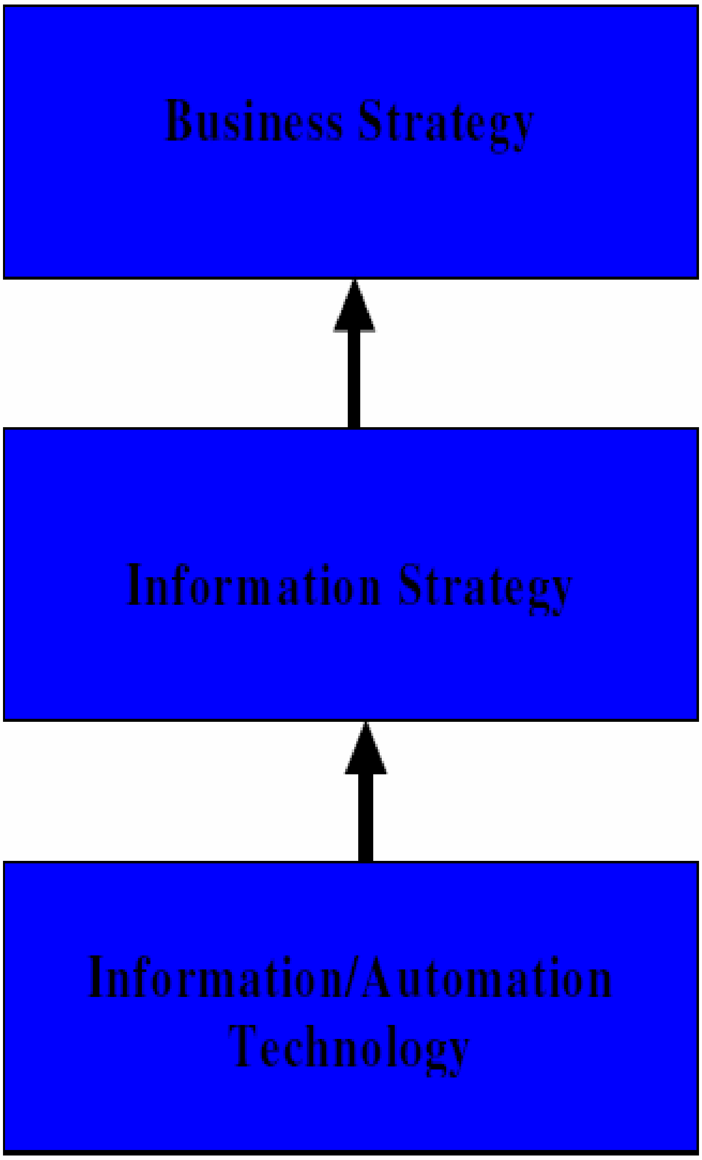
FMS gives a wide scope in organizing the products and product range and the method of achieving the product mix. Flexible manufacturing System tend to be automation intensive. Before you automate there are two principle areas that need to be examined.

1. The forces that drive the market place.
2. Differentiation with in the value chain of your organization

THE VALUE CHAIN



Technology must support the business strategy & objectives



CHAPTER 2

LITERATURE REVIEW

Consistency is very important in the production from fast food to metal moulds.

Process planning acts as a bridge between design and manufacturing by translating design specifications into manufacturing process details. Process Plan Refers to a set of instructions that are used to make a component or a part so that the design

Specifications are met. Process Plan Determines how a component will be manufactured Is major determinant of manufacturing cost and

Profitability of products

Basic Steps in Developing a Process Plan

1. Analysis of part requirements
2. Selection of raw work piece
3. Determining manufacturing operations and their sequence
4. Selection of machine tools
5. Selection of tools, work-holding devices, and inspection equipment
6. Determining machining conditions (cutting speed, feed, depth of cut) and manufacturing times (setup time, processing time, and lead times)

2.1. ANALYSIS OF PART REQUIREMENTS

.The primary purpose of process planning is to translate the design requirements for parts into manufacturing details

.What are the part design requirements?

.The part design requirements can be defined as (at the engineering design level):

.The part features are Dimensions, Tolerance specifications, Part-feature analysis (Feature Recognition) Identify “common” geometrical features such as. Plane, Cylinder, Cone, Step, Edge, and Fillet

.Common feature can be modified by the addition of Slots, Pockets, Grooves, and holes

2.2. SELECTION OF RAW WORK PIECE

Involves determining the raw work piece attributes such as:

1. Shape
2. Size (dimension, and weight)

3 Materials

4. Determining the raw work piece oversize affects dimensional
5. Accuracy as well as economics of manufacturing
6. The weight and the material of the raw work piece are dictated by the functional requirements of the parts

2.3. DETERMINING MANUFACTURING OPERATIONS AND THEIR SEQUENCE

.Determine the appropriate types of processing operations and their sequence to transform the features, dimensions, and tolerance of a part from the raw work piece to the finished state Constraints such as accessibility and setup may require that some features be machined before or after others. The types of machines and tools available as well as the batch sizes influence the process sequence. For example:

A process plan that is optimal on a three- or four-axis machine may not be optimal on a five-axis machine because of the greater flexibility of higher axis machines

The tools that are available and the tools that can be loaded onto a particular machine might change the sequence Surface finish and tolerance also influence the operation sequence. For example:

A part requiring a hole with low tolerance and surface roughness specifications would require a simple drilling operation. The same part with much finer surface roughness and closer tolerance requirements would require first a drilling operation and then boring operation Sometimes operations are dependent on one another. The holes must be drilled before milling the inclined surface because the holes cannot be drilled accurately on an inclined surface If the inclined surface has to be finished before drilling, and end mill should be used to obtain a flat surface perpendicular to the axis of the drill before drilling the hole .Cutting forces and rigidity of the work piece-tool machine tool also influence the operation sequence Hole H2 must be produced before machining the slot. If the hole is machined after finishing the slot, it may bend.

2.4 SELECTION OF MACHINE TOOLS

A large number of factors influence the selection of machine tools

1. Work piece-related attributes such as the kind of features desired, the dimensional tolerance, and the raw material form

2. Machine tool-related attributes such as process capability, size, and mode of operation (e.g. manual, semiautomatic, and automatic, numerically controlled), tooling capabilities (e.g. size and type of the tool magazine), and automatic tool-changing capabilities

3. Product volume – related information such as the production quantity and order frequency. The three basic criteria for evaluating the suitability of a machine tool to accomplish an operation are: Unit cost of production, Manufacturing lead time, and Quality.

2.5. SELECTION OF TOOLS, WORKHOLDING DEVICES, AND INSPECTION

A combination of machine tool and cutting tool is required to generate feature(s) on the work piece .Work holding devices are used to locate and hold the work pieces to help generate the features .Inspection equipment is necessary to ensure the dimensional accuracy, tolerance, and surface finish on the features (on-line and off-line inspection).

2.6. DETERMINING MACHINING CONDITIONS AND MANUFACTURING TIMES

Machining conditions are the cutting speed (v), feed (f), and depth of cut (d) .There are several models for determining the optimal machining conditions, such as:

Minimum Cost per Piece Model

Maximum Production Rate Model

Manufacturing lead time

MANUALLY PREPARED PROCESS PLANNING

A skilled individual examines a part drawing to develop the necessary instructions for the process plan .Requires knowledge of the manufacturing capabilities of the factory (many times undocumented) .Machine and process capabilities, tooling, materials, standard practices, and associated costs .Widely used, time consuming, plans developed over a period of time may not be consistent nor objective .Excessive time and cost may be required to develop necessary skills for successful planners

COMPUTER APPLICATION

“Computer-aided” is a key factor in the integration of CAD and CAM. The use of computers in process planning can:

Systematically produce accurate and consistent process plans

Reduce the cost and lead time of process planning

Reduce skill requirements of process planners

Increase productivity of process planners

Interface application programs such as work standards, cost estimation, and lead time estimation consistently optimize process routings Reduce preproduction lead times Increase responsiveness

VARIANT CAPP METHODOLOGY

Recall, identify, and retrieve and existing plan for a similar part and make necessary modifications .Interactive environment between the planner and the computer .Process planning for a new part starts with coding and classifying the part into a similar family .Requires the establishment and maintaining of a database of standard process plans that contains operations, tools, notes, etc. .Requires recall and editing capability to engineering changes

VARIANT CAPP

Advantages:

.Efficient processing and evaluation of complicated activities and decisions .Standardized procedures .Lower development and hardware costs .Shorter development times

Disadvantages:

Inconsistency in editing Quality is dependent on knowledge and skill of planner. Optimization of variables such as material, geometry, size, precision, quality, alternative processing sequences, and machine loading is difficult

GENERATIVE CAPP METHODOLOGY

Process plans are automatically generated by means of decision logic, formulae, technology algorithms, and textual and geometry-based data .Truly universal system not yet developed

There are essentially two major components .Geometry-based -- define all geometric features for all process related surfaces together with feature dimensions, locations, and tolerances and the surface finish desired on the features. .Knowledge-based -- the automatic matching of part geometry requirements with the manufacturing capabilities using process knowledge in the form of decision logic and data.

SOURCES OF MFG KNOWLEDGE

Acquisition and documentation of manufacturing knowledge is not a one-time activity but a recurring process -- the backbone of process planning .Decision tables are a convenient way to document manufacturing knowledge (Boolean-type values such as true, false, do not care, etc. or continuous values) .Decision table elements include:

Conditions - state the goal to achieve Actions - state the operations to perform Rules - establish the relationship between conditions and Actions

2.7 BUILDING DECISION TABLES

A decision table is partitioned (conditions and decisions) by vertical and horizontal lines The portion of the table above the horizontal lines specifies the condition, and the portion below those lines indicates the action The portion to the left of the vertical lines contains the stub (or tag), and the portion to the right, the entries. Decision rules are identified by columns in the entry part of the decision.

TYPES OF DECISION TABLES

Limited-entry decision tables:

The condition stub/tag specifies the conditions (the value of the input variable(s)) Condition entries can be only T, F, or do not care Extended-entry decision tables: The condition stub/tag specifies the identification of the condition, but not the value. The values are specified in the condition entries Mixed-entry decision tables: Sequenced as well as un sequenced actions can be identified using mixed- entry decision tables

MAIN CONSIDERATIONS IN DECISION TABLES CONSTRUCTION

Completeness:

A decision tables must be complete, i.e. it should cover all specifications needed, and all possible course of actions. Otherwise it will lead to uncertain actions

Accuracy:

The decision table must represent the original rules that were specified

Redundancy:

Occurs when two rules have the same action(s) and their condition sets overlap

For example: Rule A and B are redundant Æ

Consistency:

Occurs when two rules lead to conflicting actions

For example: When condition 1 and 3 are true, rule A will lead to action 1 while rule C will lead to actions 2 and 3

MAIN CONSIDERATIONS IN DECISION TABLES CONSTRUCTION

Loops: When an action is used to change conditions, and recurrent calls to the table are used, an endless loop can result. The process never terminates with a conclusion from the table

For example:

The surface-condition specification of a machined hole denotes a diameter of 2 in., a surface finish of 40 µin., and a dimensional tolerance of ±0.005 in

Using the shown decision table, Rule C is first satisfied; therefore, a boring process is selected as the “final operation” and the surface finish is changed to 60 µin Rule B is then executed and the remaining process is selected Since the tolerance does not change, Rule B is always satisfied and the process never ends

MAIN CONSIDERATIONS IN DECISION TABLES CONSTRUCTION

.Size:

If a decision table requires several pages of print, it is difficult to read and interpret A “large” decision table in a computer not only requires excessive memory, but also reduces the efficiency of the decision-making process To reduce the size of the table: .Merge those rules with a common action and only one different condition. The merged rule has a “do not care” in that different condition entry

CHAPTER 3

AUTOMATION

3.1 Need for Automation:

1. Macro Programming

   – Used for doing tasks which have to be performed repeatedly in an application

2. Cross Application Programming

3. Applications expose their programmable objects using a certain protocol.

4. Increase Productivity and Improve Quality with Automation Technology & Solutions

5. It can streamline the manufacturing process, improve product quality, increase both productivity and capacity, reduce downtime, lower costs and improve time to market.

6. Automation solutions also help minimize maintenance costs and indirect costs.

3.2 Research Objectives

1. In the race to keep up with growing demand and increasing market share, profitability depends on time to market, plant efficiency, environmental compliance and controlling your overall cost.

2. Survey confirms need for automation in domestic and international supply chains

3. The long and short-term impacts of planned outages have been a problem for managers. Unplanned and random outages are much worse. Outage issues not only include manufacturing or customer outages and their various impacts, but also involve shipping and supply outages.

3.3 Scope of the Study

To take control, manufacturers are embracing global trade management platforms, and applications for inventory and shipment tracking, risk management, trade compliance, supplier collaboration, and supply chain costing. Several solutions offer collaborative portals that enable far-flung importers, exporters, and logistics suppliers to share documents and data.

For the vast majority of manufacturers, global supply chains are only half as automated as domestic supply chains, with the largest manufacturers possessing the largest gaps in automation between domestic and international.

3.4 Automation Concepts.

Use of the following items to enhance the productivity and quality.

Semiconductors

Test & Measurement

Sensors & Instrumentation

Mechanical Power Transmission

Automatic Identification & Security

Electronic Devices

Surface Mount Technologies

Smart Cards

Actually using the above items alone doesn’t fetch the system status to be an automated system, but using them intelligently to organize and control would yield good results.Simulation models have had extreme value in many companies, being used as decision making and planning tools by managers in supply chain related areas.

One method to address some of the deficiencies of the traditional system reliability approach described above is to consider machining process parameters while predicting machine reliability. This allows greater flexibility in estimating the machine reliability as the process parameters are assigned to individual machines during the evolution of the production plan.

3.5 Use of Automation in Indian Industry

Until recently, manufacturing companies in India have not fully benefited from simulation in making continuous improvements because of the time, programming expertise, and cost involved in getting useful results.

In India, Automation scope has been kept very narrow and is application was imposed on only certain areas. Reconfigurable machining systems are composed of modular machine tool components and control software that is structured in a manner to provide ease of reconfiguration.

The latest techniques for optimization include fuzzy logic, scatter search technique, genetic algorithm, Taguchi technique and response surface methodology.

CHAPTER 4

AUTOMATION SCOPE AND TECHNIQUES

4.1 Inventory reduction

Especially challenging issues in supply chain applications include capturing the behavior of continuous flow systems with stochastic conditions. Onscreen variables and output statistics modules provide guidance to make decisions on tank sizing, capacity analysis and impact of variability of supply on manufacturing units. Benefits include the ability to analyze complex systems with a holistic perspective, reducing inventory levels by modeling continuous flow systems at both manufacturing and consumer sites and determining the needs of campaigning of differing products on the same unit.

4.2 Material Handling

A very huge amount of Material handling equipments are widely used in Indian Industries for

1. The Labor cost reduction,
2. Enable to lift, move and place loads in a manner humans cannot do
3. Increases equipment Utilization
4. Repeatable handling and placement of parts
5. Can be integrated to a multitude of peripheral equipment
6. Improved Product flow.
7. Reduced WIP
8. Greater flexibility to handle wide product mix.
9. Improved ergonomics in part handling
10. Enhanced health and safety in handling operations.

4.3 Material Tracking and Value addition

Productivity is typically defined as the long run average production of a system, typically presented as a number of units produced over a given period of time. In this paper, productivity is defined as the ratio of long run average production *for a given system processing rate* to maximum theoretical throughout.

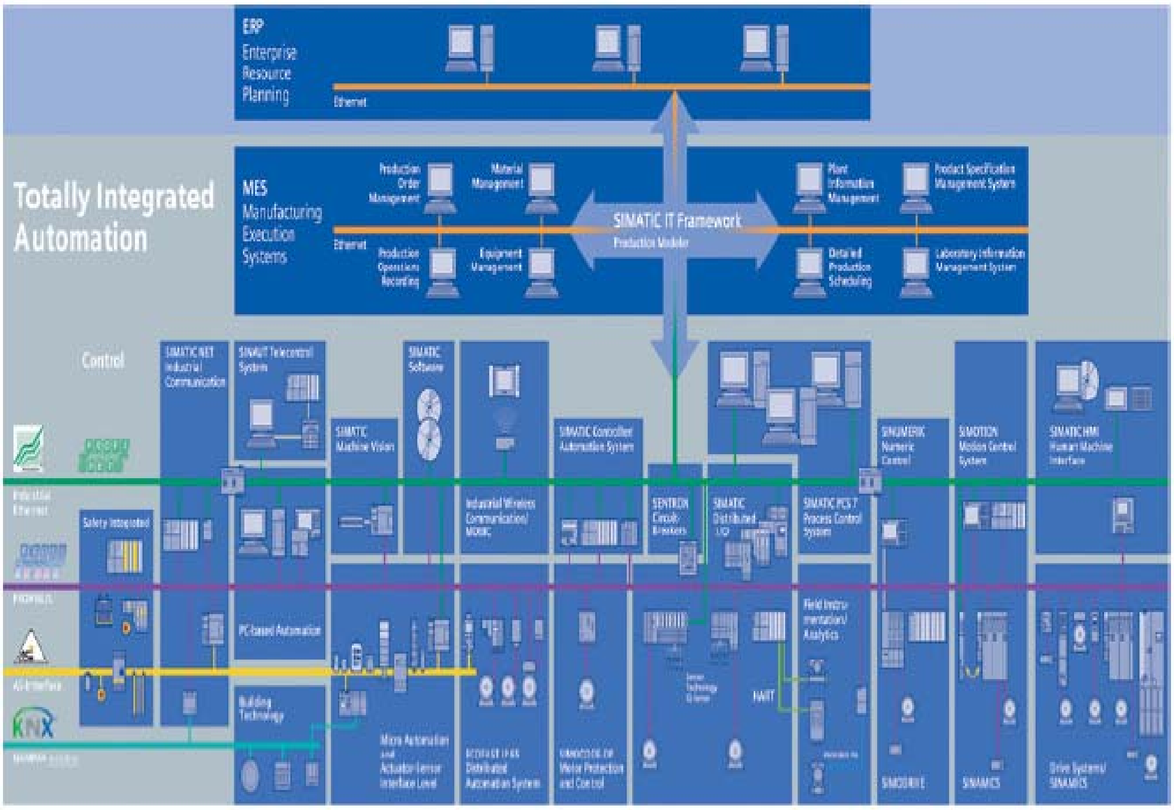
There are many parameters which come into picture apart from the core production methods. The status of the material in the industry is more or less non – traceable. Those in the work in process are highlighted and the rest is not under vision. There are many occasions, where the equivalent material are available in the store and it has been reordered due to mismatch in the nomenclature.

Scavenging of material kept are effectively used as it is highlighted while ordering equivalent material and options are given in terms of its value added cost and its usage price.

4.4 Integration Using PLC Systems

A model of total integration of industry is shown below which takes a total control of the system and it also extents its scope to supply chain also. This type of system has the capability of handle multiple tasks at a time and gives amicable solutions. Main advantages of this are that, the task centers (man or machine or process) are given selected accessibility so that they don’t get in to the preview of other system. In other words, each task centers are assigned tasks and they are supposed to perform it. Thus to provide ownership for each task.

The model below shows the proposed system for integration.



4.4 a. PLC in Design Integration:

- Piloting of Automation concepts. e.g. mechanical components through stereo – lithography, control programs using PLC-slim, 3D Solid Modelling avoid unnecessary expenses from design mistakes.
- Standardized platforms through the application of open standards e.g. PLC open , OPC provide seamless integration from field level to ERP.
- Develop your own in-house standards through the use of common traits within user requirement specification(URS)
- Coding standards e.g. results in proven functions and re-usable code.
- CAD files available from components suppliers to reduce drafting time.

- Communication technologies such as Profibus or Profinet result in reduced wiring leading to faster machine build times with lower costs.
- Production simulation tools can be employed at the product design stage to predict production equipment cycle times. These tools can greatly assist in achieving high equipment utilization and predictive identification of bottle necks.

4.4 b. PLC in maintenance Integration:

- Diagnostics resulting from inter-compatibility of hardware / software and from coding standards e.g. proven functions and re-usable code, easily understood by maintenance staff. Standardization also reduces training and spare parts costs.
- Predictive maintenance through MTBF data and maintenance trending?
- Remote access for emergency breakdown allowing specialists to work while off site.
- Wired/ wireless networking to provide access to machine manuals and schematics on the move reducing downtime. Skilled technical staff should be equipped to spend time trouble shooting, not looking for documents
- When purchasing equipment or solutions, ensure that wiring standards and comprehensive mechanical and electrical drawing and software backups in the scope of supply.
- Where a company is international or multinational or has to strategic intension to be so in the future then global support presence from suppliers is key to supporting such a transition.
- Where high availability is a requirement products / system use redundant or fast recovery technological solutions. Eg. Memory modules integrated into automation components

4.4 c. PLC in Operations:

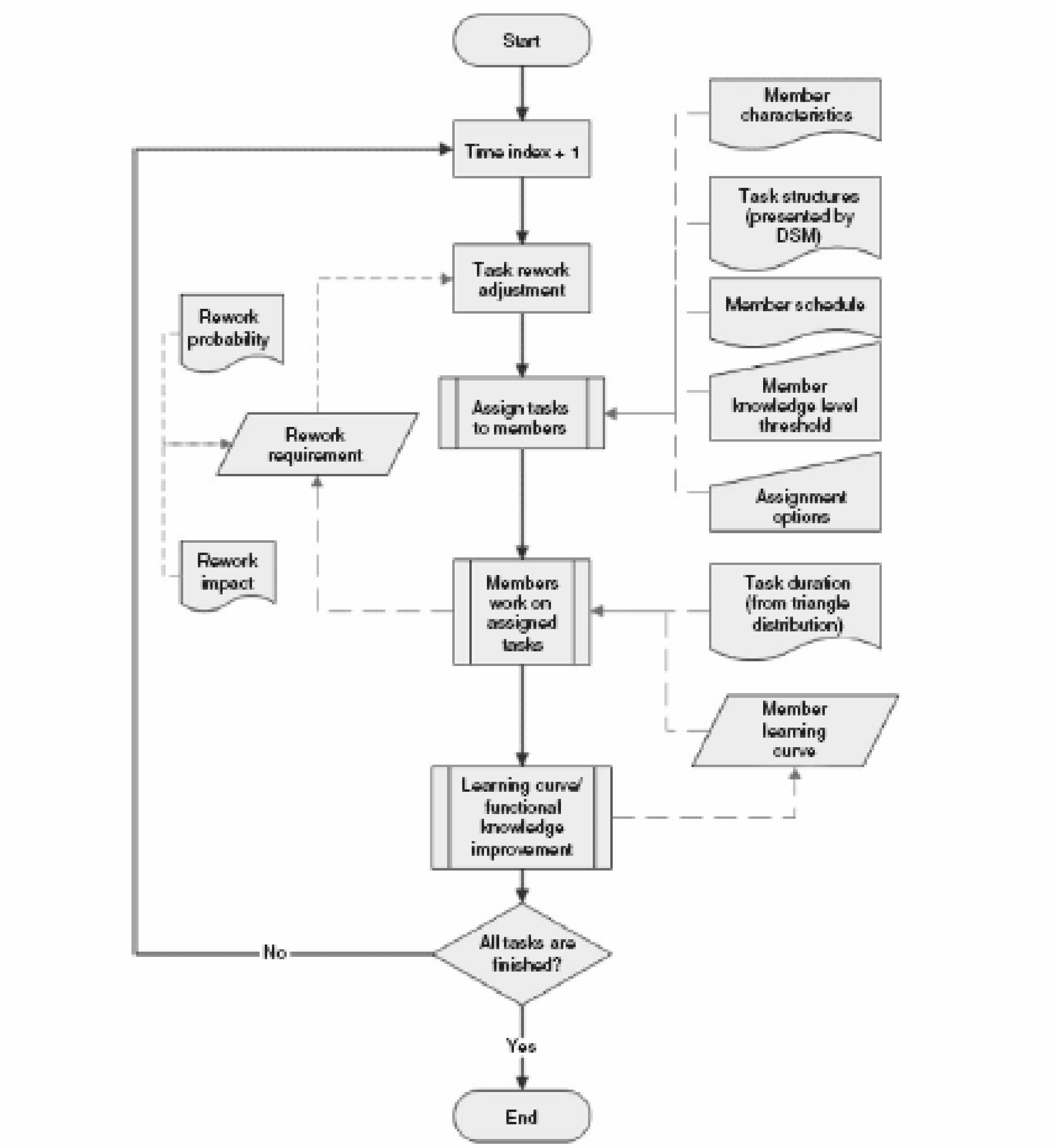
- Central data storage of components and assembly specifications (from in house drawings and supplier data sheets) ensures that master data is available and utilized by all processes.
- Modular machine design for quicker redeployment of line or cell layouts e.g. Component based Automation.
- Positive identification of production material flow and process history through the use of technologies such as RFID.
- Positive identification of production assets through RFID technology e.g. tagging of product specific test fixtures.
- Communication technologies such as Profibus or Profinet provide access to production data in real time and facilitate equipment to communicate centrally and with each other.
- Centralized Visualization of the process using SCADA system allow higher equipment utilization and allows production bottlenecks to be identified and removed.
- Use of Vision system to inspect for defects.

4.5 Perpetual and Concurrent Engineering

This system presents a parameter coordination and robust optimization approach based on knowledge network modeling. The method allows multidisciplinary designer to synthetically coordinate and optimize parameter considering multidisciplinary knowledge. First, a knowledge network model is established, including design knowledge from assembly, manufacture, performance, and simulation. Second, the parameter coordination method is presented to solve the knowledge network model, monitor the potential conflicts due to engineering changes, and obtain the consistency solution space corresponding to the given knowledge. Finally, the robust parameter optimization model is established, and genetic arithmetic is used to obtain the robust optimization parameter. A design instance is introduced to show the validity of this method.

In concurrent engineering projects, tasks are usually interdependent among each other that require much iteration before completion where the critical path method/program evaluation and review technique (CPM/PERT) may not be applicable to help estimate the project duration. In addition, carrying out a large-scaled project in a dynamic environment has to deal with various factors at the same time. When estimating the project completion time, previous research often focused on one subject of interest and assumed the other factors causing little effect on the overall project duration. The objective of this article is to develop a research framework to help estimate the project completion time and analyze the major factors that affect the estimation for complex concurrent engineering projects. The framework consists of three major components: (1) data collection, where the needed data for simulation are prepared including project task structure, task relations, and quantified team member characteristics; (2) simulation, where tasks are dynamically assigned to the appropriate members/engineers according to each member’s knowledge level of the task, teamwork capability, work schedule availability, and learning curve improvement; and (3) data analysis, where significant factors to the project completion time are studied by the ANOVA analysis based on the simulation results. The effectiveness of our framework and the simulation model is totally dependent on the correct ness of the data feed.

SKEMATIC MODEL OF CONCURRENT ENGINEERING SYSTEM



4.6 SAP

The SAP FI Module has the capability of meeting all the accounting and financial needs of an organization. It is within this module that Financial Managers as well as other Managers within your business can review the financial position of the company in real time as compared to legacy systems which often times require overnight updates before financial statements can be generated and run for management review.

The real-time functionality of the SAP modules allows for better decision making and strategic planning. The FI (Financial Accounting) Module integrates with other SAP Modules such as MM (Materials Management), PP (Production Planning), SD(Sales and Distribution), PM (Plant Maintenance),and PS (Project Systems).

The FI Module also integrates with HR(Human Resources) which includes PM(Personnel Management), Time Management, Travel Management, Payroll. Document transactions occurring within the specific modules generate account postings via account determination tables.

The FI (Financial Accounting) Module components.

The FI Module comprises several sub-modules as follows:

Accounts Receivables

Accounts Payable

Asset Accounting

Bank Accounting

Consolidation

Funds Management

General Ledger

Special Purpose Ledger

Travel Management

Accounts Receivables records all account postings generated as a result of Customer sales activity.

The SAP CO (Controlling) Module provides supporting information to Management for the purpose of planning, reporting, as well as monitoring the operations of their business. Management decision-making can be achieved with the level of information provided by this module.

Some of the components of the CO(Controlling) Module are as follows:

- Cost Element Accounting
- Cost Center Accounting
- Internal Orders
- Activity-Based Costing (ABC)
- Product Cost Controlling
- Profitability Analysis
- Profit Center Accounting

The Cost Element Accounting component provides information which includes the costs and revenue for an organization. These postings are automatically updated from FI (Financial Accounting) to CO (Controlling). The cost elements are the basis for cost accounting and enable the User the ability to display costs for each of the accounts that have been assigned to the cost element. Examples of accounts that can be assigned are Cost Centers, Internal Orders, WBS(work breakdown structures).

Cost Center Accounting provides information on the costs incurred by your business. Within SAP, you have the ability to assign Cost Centers to departments and /or Managers responsible for certain areas of the business as well as functional areas within your organization. Cost Centers can be created for such functional areas as Marketing, Purchasing, Human Resources, Finance, Facilities, Information Systems, Administrative Support, Legal, Shipping/Receiving, or even Quality.

Some of the benefits of Cost Center Accounting : (1) Managers can set Budget /Cost Center targets; (2) Cost Center visibility of functional departments/areas of your business; (3) Planning ; (4) Availability of Cost allocation methods; and (5) Assessments/Distribution of costs to other cost objects.

Internal Orders provide a means of tracking costs of a specific job , service, or task. Internal Orders are used as a method to collect those costs and business transactions related to the task. This level of monitoring can be very detailed but allows management the ability to review Internal Order activity for better-decision making purposes.

Activity-Based Costing allows a better definition of the source of costs to the process driving the cost. Activity-Based Costing enhances Cost Center Accounting in that it allows for a process-oriented and cross-functional view of your cost centers. It can also be used with Product Costing and Profitability Analysis.

Product Cost Controlling allows management the ability to analyze their product costs and to make decisions on the optimal price(s) to market their products. It is within this module of CO (Controlling) that planned, actual and target values are analyzed. Sub-components of the module are:

· Product Cost Planning which includes Material Costing(Cost estimates with Quantity structure, Cost estimates without quantity structure, Master data for Mixed Cost Estimates, Production lot Cost Estimates) , Price Updates, and Reference and Simulation Costing.

· Cost Object Controlling includes Product Cost by Period, Product Cost by Order, Product Costs by Sales Orders, Intangible Goods and Services, and CRM Service Processes.

· Actual Costing/Material Ledger includes Periodic Material valuation, Actual Costing, and Price Changes.

Profitability Analysis allows Management the ability to review information with respect to the company's profit or contribution margin by business segment. Profitability Analysis can be obtained by the following methods:

- Account-Based Analysis which uses an account-based valuation approach. In this analysis, cost and revenue element accounts are used. These accounts can be reconciled with FI(Financial Accounting).

- Cost-Based Analysis uses a costing based valuation approach as defined by the User.

Profit Center Accounting provides visibility of an organization's profit and losses by profit center. The methods which can be utilized for EC-PCA (Profit Center Accounting) are period accounting or by the cost-of-sales approach. Profit Centers can be set-up to identify product lines, divisions, geographical regions, offices, production sites or by functions. Profit Centers are used for Internal Control purposes enabling management the ability to review areas of responsibility within their organization. The difference between a Cost Center and a Profit Center is that the Cost Center represents individual costs incurred during a given period and Profit Centers contain the balances of costs and revenues.

These postings are automatically updated in the General Ledger . It is within the Accounts

Receivables Module that you can monitor aging of the receivables and generate customer analysis. The Accounts Receivable Module also integrates with the General ledger, Sales and Distribution, and Cash Management Modules.

Accounts Payable records account postings generated as a result of Vendor purchasing activity. Automatic postings are generated in the General Ledger as well. Payment programs within SAP enable the payment of payable documents by check, EDI, or transfers.

Asset Accounting is utilized for managing your company's Fixed Assets. SAP allows you to categorize assets and to set values for depreciation calculations in each asset class.

Bank Accounting allows for management of bank transactions in the system including cash management.

Consolidation enables the combining of financial statements for multiple entities within an organization. These statements provide an overview of the financial position of the company as a whole.

Funds Management allows management to set budgets for revenues and expenses within your company as well as track these to the area of responsibility.

General Ledger is fully integrated with the other SAP Modules. It is within the General Ledger that all accounting postings are recorded. These postings are displayed in real-time providing up-to-date visibility of the financial accounts.

Special Purpose Ledger is used to define ledgers for reporting purposes. Data can be gathered from internal and external applications.

Travel Management provides management of all travel activities including booking trips and handling of expenses associated with travel.

4.7 Vision Inspection System

Vision systems are an electronic alternative to human or manual inspection. Vision systems allow you to monitor inspection criteria from onsite computers, remote sites, or anywhere in the world! Pricing on vision systems have dropped so dramatically in recent years that even small companies can now enjoy the benefits of vision systems integration.

Machine vision is a multi-disciplinary subject, utilizing techniques drawn from optics, electronics, mechanical engineering, computer science, and artificial intelligence.

This system uses the fundamental tools for **image acquisition**, **processing**, and **analysis**;

a range of techniques, dealing with very **simple two dimensional** systems, through more sophisticated **robust two-dimensional** approaches, to the current state of the art in **three-dimensional** robot vision. Both application areas of automated visual inspection and robot vision are addressed. Recognizing that machine vision is just a component of a larger automation system, a brief introduction to **robot programming** will be provided, together with an explanation of the mechanisms by which robot vision modules interact with the programming language.

It is important to recognize that the discipline of machine vision is presently undergoing a maturing process, with sophisticated techniques drawn from current research being exploited more and more in industrial systems. Without doubt, there is a long way to go, but the die is well cast. Acknowledging this trend, more research-orientated topics of three-dimensional image are going on understanding and early visual processing (e.g. stereopsis and visual motion). It would indeed be foolhardy to attempt an exhaustive treatment of these areas.

This system enables high-throughput inspection of many different types of implants/small parts (screws, hooks, connectors, etc) using high-performance machine vision, a high-precision, six-axis robot, and sophisticated software.

For example, if we need to check the dimensions of screws made, the parts are presented to the tool in trays of 25-100, the robot picks up the parts and positions them in front of two high-resolution cameras fitted with telecentric lenses. Using Vision tools and custom software, multiple dimensions are captured

CHAPTER 5

INTRODUCTION TO

CAN INDUSTRY

5.1 History of Can

The history of the can is literally a history of western civilization, and its innovation an engine of prosperity in the United States. Two centuries ago, the first cans were designed to sustain world powers in their quests around the globe. In boomtown America, the can was key to big business and broader frontiers. Today, can making is a major economic force; the more than 130 billion cans Americans use each year have created an eight billion dollar industry, with 200 manufacturing plants in 38 states, that employ more than 35 thousand employees.

The can has moved as fast as consumer demand has grown; always adapting, innovating and satisfying while preserving the qualities that provide its inherent value—protection and strength. From the original, crude tinplate canisters shaped by hand to the lightweight, completely recyclable containers produced mechanically today, the can preserves and endures like no other package available.

What's more, the can brings products into our hands and into our homes, allowing us to enjoy things made at another time in another place which we otherwise would never experience. Exotic foods and out-of-season produce are merely the beginning of what is now within reach. Food supplies aid third-world countries, blood plasma rescues wounded soldiers, and a vast array of household products are kept safely in the home, thanks to the utility of the can.

Because we have come to rely so much on the convenience and easy familiarity of canned products, almost imperceptibly present in every part of life, we are the "tin can civilization." Without fanfare, the can has played an essential role in the standard of living we enjoy by making the products we want cheaper, safer, easier, more readily available and reliable. Our health and long life expectancy have benefited from nutritious canned foods; our wealth and productivity have increased as cans made their products more cost-effective and accessible; and the innovation and improvement of canned products has left more time for life and leisure.

Research and continual improvements guarantee that the can will consistently and faithfully remain the necessary-but-unnoticed, unsung hero of contemporary living.

By the time of the great world wars, cans were an integral part of American life. If the French and English armies had originally benefited from the convenience and portability of canned provisions, American troops fighting in Europe and Asia depended on them even more. Soldiers went into battle with a can opener hanging around their neck along side their dog tags. It was a vital tool for survival. The government allocated scarce metal for can production because nearly two-thirds of the Allies' food supply was in cans. For example, the U.S. War Department bought 75 percent of all available canned salmon and 40 percent of canned tomatoes during war time. And, as had been the case with the Civil War, the soldier's trust of canned foods returned home with him after the war.

Norton Brothers merged with 60 other firms, with 123 factories, to form the American Can Company in 1901. Edwin Norton became president of the new conglomerate and kept his headquarters at the original Norton plant in Illinois. Forbes magazine would, in 1941, call American Can a corporation that "shaped the daily lives of man in the United States." In 1904, Norton left American Can to form the Continental Can Company. That same year, the Sanitary Can Company was formed from three New York can companies and began production of the sanitary—or open top—can which, since the lid was crimped on after filling, required no soldering. By the 1920's, the hole and cap model can was history.

As production increased, so did the number of things you could purchase in cans. The investment canners had made in their production lines required that they find new foods to can and keep their businesses running year round. Campbell's condensed soups were introduced nationally in 1899 and sold for a dime. The red and white labels were inspired by Cornell University's football jerseys and the gold medallion at center represented a gold medal the soup won at the 1900 World's Fair in Paris. Tuna fish was first canned in 1909 when one processor ran out of the sardines he usually canned. By then, 63 different kinds of meat were available in cans. Citrus fruits and tomato juice first appeared in cans around 1920.

Industry's inventions brought greater success, new capabilities, and more competition to the canning market. The railroad transferred goods across the country. A new type of labor force emerged to work the production lines. Conveyor belts and automatic machinery such as washers and fillers moved the products through at astonishing rates. Still more machines shucked corn and peas, trimmed kernels off corncobs, pitted cherries, even peeled and sliced fruit. Factories hummed and Americans bought more and more quantities and varieties of canned goods. The onset of winter previously had meant that households had to put up provisions—dried meats and fruits, potatoes stored in root cellars, and vegetables canned at home. Now an endless variety of foods were available year round. Some were so exotic and foreign that they were being tried by American consumers for the first time.

The photograph of the fully formed tin can is shown below:

Canned products had appealed to homemakers for decades (canned baby food, for instance, appeared in the 1920s), but never before had the housewife been in command of such a disposable income or so jealously courted by makers of household goods. What is more, the convenience and familiarity of canned products had created a near revolution in the way women did their shopping in the previous years, culminating in the prevalence of the chain grocery store.

The pre-packaging and labeling of products, enabled by the can and other containers, had fundamentally changed the relationship between the consumer and the shopping experience. Whereas previously a clerk stood behind a counter and between the consumer and the goods—setting prices, measuring out parcels, recommending brands—the availability of packaged items allowed the shopper to see and choose goods for themselves. Shelves lined with cans depicting bright illustrations of tender peas, glistening pears, golden pastures and healthy babies allowed everyone the democratized shopping opportunity of choosing among a rainbow of enticing goodies. Their labels educated shoppers about the products inside and allowed consumers to form brand loyalty to favorites.

The can's distinguished history began in 1795 when the French government offered a prize of 12,000 francs to anyone who could invent a method of preserving food. Napoleon's troops were being decimated more by hunger and scurvy than by combat. As his soldiers resorted to foraging for food on their own, Napoleon famously noted that an army "travels on its stomach." Military prowess and colonial expansion required that a way of keeping food unspoiled over distance and time be discovered.

A Parisian named Nicholas Appert came up with the idea. A jack of all trades, Appert used his experience as a former candy maker, vintner, chef, brewer and pickle maker to perfect his technique. After experimenting for 15 years, Appert successfully preserved food by partially cooking it, sealing it in bottles with cork stoppers and immersing the bottles in boiling water. His theory of canning was all his own—Pasteur's discoveries regarding bacteria were still almost a half-century away. But Appert assumed that, as with wine, exposure to air spoiled food. So food in an airtight container, with the air expelled through the boiling process, would stay fresh. It worked.

Samples of Appert's preserved food were sent to sea with Napoleon's troops for a little over four months. Partridges, vegetables, and gravy were among 18 different items sealed in glass containers. All retained their freshness. "Not a single substance had undergone the least change at sea," Appert wrote of the trial. He was awarded the prize in 1810 by the Emperor himself. Like all good national heroes, Appert soon wrote a book called The Book of All Households: or The Art of Preserving Animal and Vegetable Substances for Many Years. It described in detail the process for canning more than 50 foods and was widely relied

5.2 INTRODUCTION TO FLAT END CAN

Tin sheets are slit to size and it is rounded and seam welded. After Seam welding, the can attains a shape of a hallow cylinder. The circular pieces are cut in presses and it is formed to make a shape of the *closed end.* Generally one end is seamed at the factory end and other end is kept open. It is supplied to the filling stations, where the cans are filled with appropriate powder or liquid and the other end is seamed at the filling station site.

There is huge transportation involved as the filling stations are far away from the canning factory. And the cost involved in transportation is also huge. To optimize the cost in transportation, there are few techniques involved. One such technique is to flatten the can and transport to the filling stations. At filling station, before filling, it is re- rounded and then seamed at the bottom. Now the can is ready for filling the liquid or powder. After filling , as usual it is seamed at the top .

The model of the seamed can is shown below:

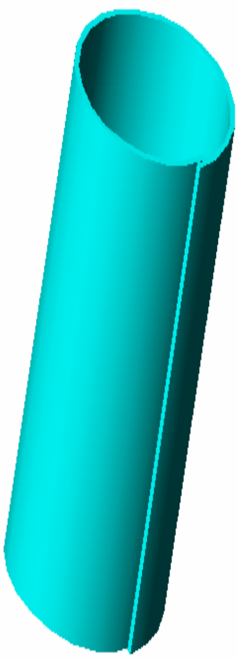


FIG. 1 SEAMED CAN.

The model of the flattened can is shown below:

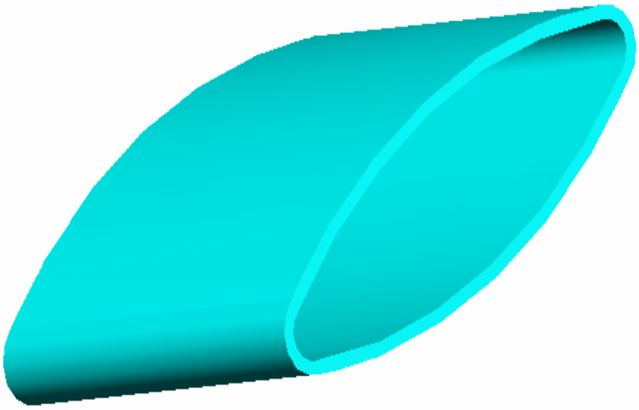


FIG. 2 FLATTENED CAN

The model of the end cover of can is shown below:

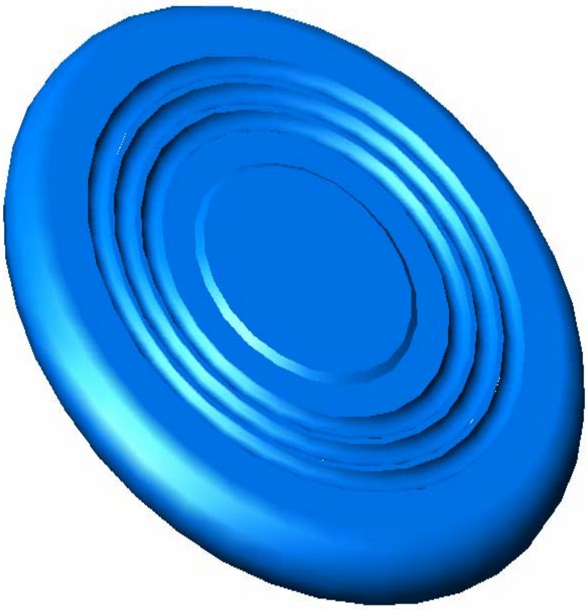


FIG. 3. TIN COVERS (ENDS)

5.3 NEED FOR CASE PACKER FOR FLATTENED CANS

The quantity of seamed cans produced from the sonchronic or Mechelonic machine ranges between 250 numbers to 400 numbers per minute. There fore packing through manual methods are impossible. Also the cans are sensitive and thus preferable , if it is not touched by hands.

This necessarily needs to develop the case packer for packing of flattened cans. This system of flattening the can and reforming is not prevalent in other countries except few countries in Asia. And India is one of the strongest players.

5.4 FLAT END CANS REFORMER.

The flattened cans are transported to the destination and where initially it is reformed. The construction of flat end can reformer consists of roller with taper entry. This main roller is powered with ½ hp motor. There is a floating PU dummy roller, which acts as a support for the reformer. The flat end can is inserted into the main roller and the lever is used to press the dummy roller over the upper surface of the flat end can. Due to the revolution of the main and the dummy rollers, the cans get reformed.

CHAPTER 6:

CASE PACKER DESIGN

AND FUNCTIONS

6.1 Model of Case Packer

The model of the case packer is given in separate sheets.

6.2 Elements of Case Packer and Functions

(a) FLATTENER

(B) CONVEYOR AND TRACKING SYSTEM

(C) DIVERTER

(D) MAGNETIC CONVEYOR IN EACH TRACK

(E) STACK HANDLER IN EACH TRACK

(F) STAND FOR CARTONS

(G) COUNTERS.

(a) FLATTENER : The construction of the flattener consists of two steel polished functional rollers with cushioned by polyurethane sheets. One roller is fixed and driven by 1 HP induction motor. The other roller is free floating and not power driven. There are two feeding rollers, which functions as the entrance for the un deformed cans.

The can is ejected out from the welding machine and it travels in a track of ss rods. The cans are feed inside the dummy rollers and it is passed through the flattening rollers. Actually the can are made to press fully, but after ejection from the rollers, it spring back to form as shown in the model figure 2.

(B) CONVEYOR AND TRACKING SYSTEM: The Flattened cans is carried to the next destination by a auto conveyor. This conveyor is powered by the signal from the sensor at the exit point of the flattener. This flat auto conveyor has a Photoelectric cell, which is used as a counter. Whenever the number touches 80 (the counter can be reset to any value ranging from 50 to 150 numbers), the diverter is activated.

(C) DIVERTER: The signal from the photoelectric counter activates the diverter. The function of the diverter is to track the cans in batches of 80 numbers. This is to accommodate 80 cans in one rows. The diverter is powered by a pneumatic cylinder kept at 3 bar pressure. The diverter toggles between both the tracks. The arm fitted to the diverter tracks the can and it feeds the slanting magnetic conveyor.

(D) MAGNETIC CONVEYOR IN EACH TRACK: There are two identical magnetic conveyors kept side by side and mounted to single base. The construction of the magnetic conveyor consists of a slanting platform, in which the magnets are pasted firmly using glue and over which the end-less belt travel. The conveyor is powered by 1 HP motor with reduction gear each. The conveyor takes the flattened can from the diverter track and it moves forward till stack handler.

(E) STACK HANDLER IN EACH TRACK: The flattened cans from the first track come one by one and fall in the stack handler. As programmed earlier, 80 cans falls inside the stack handler and it is compressed by a means of pneumatic cylinder at the top. Once the compressing is complete, the stack handler moves radial down till it reaches the carton box. The front door opens and the cylinder from the back pushed the cans and it guides the cans to slide to the carton.

(G) COUNTERS.: The counters are used to count the number of cartons filled. It is kept below the rollers . Once the cartoon moves from its destination, it activates the counter.

6.3 Conditions for Case Packer.

The following conditions need to be fulfilled for a effective working of the case packer.

1. All the motors are integrated with a gear box for a controlled constant speed. This should be ensured at all times.

2. This case packer is designed for a carton which has 2 rows and 2 columns with 80 numbers each.

3. This case packer can operate with a range of 80 cans per minute to 180 cans per minute.

4. This carton in the case packer should be perfect and out of flaws with regard of its shape and dimensions. The carton should be of 4 ply minimum with good quality paper.

5. Safety switches are not provided as this is still in the design state.

6.4 Conclusion of Case Packer.

Consumer demand for on-the-go convenience and easy-to-use products is sparking a packaging revolution. In this revolution, consumers are clearly winning.

While food and beverage containers utilizing such new concepts as plastic pouches and "Tetrapaks," small glass jugs, plastic bottles and cans with straws are populating grocery shelves, consumers say they prefer traditional packaging in metal, glass and plastic.1 They just want packaging that helps them do things faster and easier, and cans are rising to the challenge with new-age options for today's busy consumers.

"Innovations in the metal packaging sector are revolutionizing the packaging industry, from an array of easy-to-use and convenient containers with twist-tops, resealable metal lids, easy-open cans with pull-tab lids and rectangular cans with a convenient peelable opening system," In this competitive industry, satisfying customer in all aspect including price is very essential. There fore automation is essential. Also the indirect cost is a essential factor, where the scope of cost reduction is more. This is one such vital area where the cost could be easily reducible.

CHAPTER 7:

OBSERVATIONS AND RESULTS

7.1 Effect of Automation on Quality

Automation results in a consistency in the quality of products and services as repeatability is involved. However the quality directly relates with the cost and thus affects the total profile of the company.

There are few cost which are closely associated with automation and have a direct impact on it.

COST OF COMPLIANCE:

(a) Prevention costs: Quality training, Supplier reviews, Quality engineering and Preventative maintenance.

(b) Appraisal costs: Inspection of incoming material , WIP, & finished goods. Cost of test equipment and quality audits.

COST OF NON- COMPLIANCE:

(a) Internal failure costs: Scrap, rework quality related downtime and re-testing training

(b) External failure costs: Returns recalls, warranty repairs and handling of customer complaints.

7.2 Effect of Automation on Cost

The effect of Automation on the cost of the product and services as well as the status of the industry in total can be said as TOTAL COST OWNERSHIP (TCO)

The total cost ownership (TCO) measures the following costs.

1. Original cost of the Automation system

2. Hardware and software upgrades

3. Maintenance / Warranty / Support

4. Power consumption

5. Consumables

7. Training

RETURN ON INVESTMENT (ROI)

A return on investment (roi) calculation results in a value that represents the benefits received from a project against the total costs of the projects.

$$\text{ROI (\%)} = \frac{\text{Total benefits} - \text{Total costs}}{\text{Total costs}} \times 100$$

If the return is over several years, then the mean of the total cost / benefits is used

7.3 Effect of Automation on Logistics:

Logistic Automation means the monitoring and controlling the movement of finished goods and raw materials. The scope of this system also controls the minimum quantity to be shipped for an optimized margin.

Indirectly we are approaching in optimizing the cost involved in the transportation. Generally cost in transportation should be as minimum. In reality the cost in packaging and transportation accounts to a appreciable value.

As far as empty cans are considered, the economy in transportation becomes a vital factor. To make it more effective in handling, compact packaging system is essential. And this technique is not very popular as there are few drawbacks in this system.

Overall this system may be used primarily in non-food industry very comfortably

7.4: Results:

The projected cost of this project is around 2.75 lakh rupees. In terms of the money return, the pay back period is much less than one year. Also the method of handling the cans, which is coming at a very high speed, is very difficult. More over when it is atomized, the chances of hands being touched are directly avoided.

This case packer is capable of pack 80 cans to 180 cans per minute. Over and above, because of auto counting, we can be 1005 sure of delivering correct quantity.

In future this system can be integrated with the database net work to account for the total quantity made, packed and thus the handling of the data becomes easy.

. Food can makers foresee significant technological advances ahead, which will make the can even more attractive. Grocery shoppers will be able to select from an array of easy-to-use and convenient metal packages, including:

- Containers with twist-top resealable lids
- Easy-open cans with pull-tab lids made with steel, aluminum or plastic
- Distinctive easy-to-grasp metal cans shaped like bowls, kettles and even squares
- Self-heating and self-cooling cans to deliver a piping hot can of coffee or a cold drink
- Microwaveable cans

CHAPTER 8

SUMMARY AND CONCLUSION

8.1 Summary and Conclusion

- Define a 3-5 year horizon plan in line with the company's strategic objectives to facilitate the implementation of flexible manufacturing.
- Be aware that the market is dynamic so contingencies need to be developed to ensure that deviations can be facilitated.
- A comprehensive study of work practices should be conducted to identify work processes and procedures impacted by the proposed changes.
- This in turn may provide an opportunity to facilitate Business Process Re-engineering (BPR) to streamline operations. All Processes should be customer oriented.
- Where a company wishes to implement a staged migration from legacy processes and systems, attention must be paid to the impart of each staged implementation while paying attention to the final result.
- Where the competencies do not exist in-house avail of consultants and supplier expertise etc.,

8.2 Scope for Future Research

Due to the increase in the free international marketing, the products needs to be with high quality, consistent, cost economic and timely availability.

These can be achieved by use of the automated integrated system, which would generate the demand by global forecasting techniques (data received from global source and auto analysis to find the nearest demand) and would prepare a list of material procurements along with the recommendation of the vendor. The purchase order is automatically sent to the vendor .The vendors are automatically and periodically rated and accordingly selected for the corresponding jobs.

The materials reach to the assembly line by the automated conveyor system, which controls the mix between the vendor items and stock items along with auto inspection using different inspection systems.

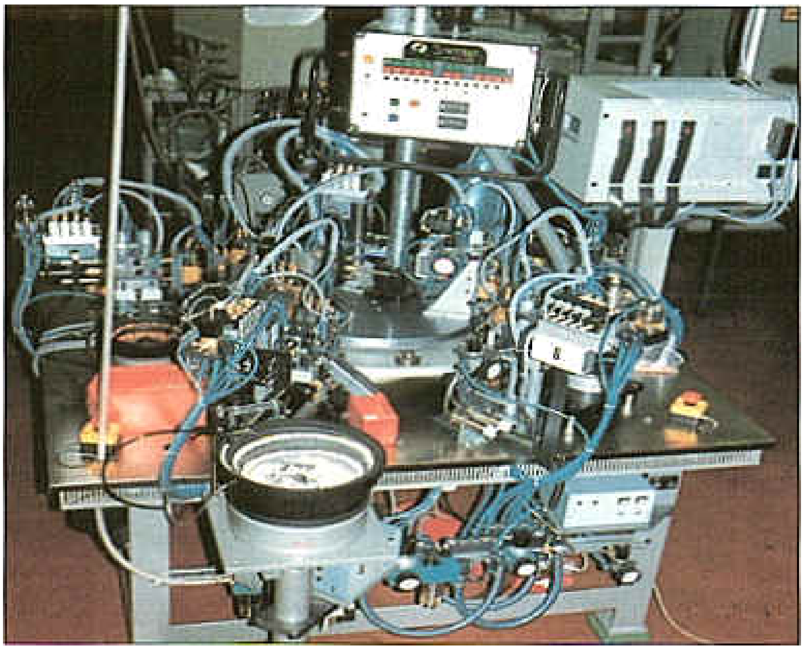
Assembly is done with robots and automated fixtures which handles the assembly line. Finished goods are inspected for its aesthetic and performance and prepare a confirmation report to standards.

Finished goods are handled and loaded by the material handling system and given advice / instruction for its destination and duration.

Any variation in the system is viewed as a single system flaw and tries to rectify or neutralize to achieve the targets.

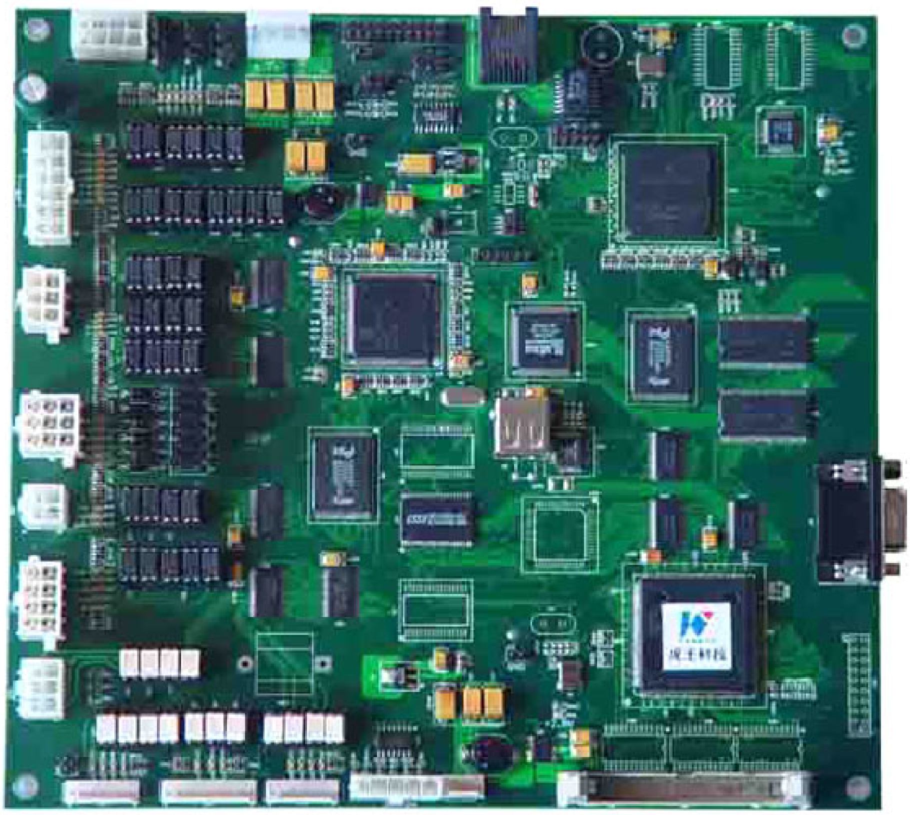
CASE STUDY

Automated Assembly of thermostats



Function: Electro pneumatic system for assembly of small thermostats. The following components in that order make up the thermostat. 1) Housing,2) Spring, 3) bimetal disk 4) cover, at a rate of one unit every two seconds.

Industrial automation and control system



Industry uses a Integrated Automation and control system to monitor and control the flow of materials and usage of resources. This system has proven to be more effective in Inventory management System and capable of controlling the wastages.

A huge amount of manual errors are eliminated and relatively it follows a pre-defined path, which gives a good planning in the dispatch of goods on the target dates. In the mean time the asset value of the IAC System are relatively high and less popular. In a medium scale industry , the pay back period is around 3 years

In the recent years, the so-called special purpose automatic machine has been listed under conventional machines. Though the pace of growth in Europe and America was more in the last decade, the results are prone to happen now.

However India is projected to achieve a relatively higher growth rate in Industry sectors. The following little automation is very popular in the recent days.

- Ultra High-Speed continuous motion assembly of nails and washers
- Ultra High-Speed continuous motion assembly of bolts and "O-ring.
- High speed rotary crimp press assembly of automotive water pumps seals.
- High speed rotary press automated assembly and ultra-sonic welding of plastic pipettes.
- A multi station in-line transfer assembly machine for the assembly and ultra-sonic welding of plastic smoke detector cover.
- A nine station test and assembly of automotive lip seals.
- A robotic cell created to assemble, test and palletize automotive water pump seals.
- A semi-automatic assembly machine for the attaching of latches, hinges and labels to plastic tackle boxes and cosmetic cases.
- A drill and drive assembly for the attachment of explosion-proof electrical fittings.
- A customized assembly presses for articulated truck components.
- A semi-automatic machine designed for the ultra-sonic welding of plastic spray nozzles.
- Automatic machine for tapping of conduit mounting clips.
- A semi-automatic reaming, facing and chamfering machine for conduit fittings.
- A semi-automatic machine designed to feed and place micro pins in terminals.
- A drilling and tapping machine for cylinder heads and caps.
- A CNC drilling and tapping machine for pneumatic cylinders.
- Automatic feeder of blanks into a deep draw press for cookware covers.

- A semi-automatic pantograph router for custom stair components.
- The ultrasonic degrading of surgical stapler driver components.
- The high-speed punching and trimming of hypodermic needle tips.
- A multi-station machine for the drilling, tapping and welding of rotary seal components used in oil refining operations.
- A high-speed universal bar finishing machine designed to automatically saw and chamfer bar ends unfed from the metal forming machine.
- An automatic high-pressure water jet deburring machine for fuel injection components.

REFERENCES

References:

1. Boothroyd, G., Dewhurst, P., Knight, W., (1996), “Product Design for Manufacture and Assembly”,
2. Bush, S.A. and Sheldon, D.F. (1995), ``Whole life costing: a business approach to product design''.
3. Butterworth-Heinemann, Ostwald, P.F., (2001) “Engineering Cost Estimating”, Prentice Hall, 1992.
4. Chalos, P., (1992.) “Managing Costs in Today’s Manufacturing Environment,” Prentice Hall,
5. Chun Du and Jim Lee, **“**Development of a shop floor performance evaluation system”, University of Louisiana at Lafayette
6. E Hundal, M.S. (1997), ``Product costing: a comparison of conventional and activity-based costing methods'', Journal of Engineering Design.
7. Enzhen Huang and Shi-Jie (Gary) Chen “Estimation of Project Completion Time and Factors Analysis for Concurrent Engineering Project Management: A Simulation Approach “
8. Fendrock, J.J. (1992), Proceedings of International conference ``Product costing for contract manufacturing''.
9. French, M.J. (1990), ``Function costing: a potential aid to designers'', Journal of Engineering Design.
10. Fritz, R.D. and Kimbler, D.L. (1996), ``Traditional product cost estimation: problems and alternative'', Proceedings of the 5th Industrial Engineering Research Conference, Norcross,
11. Harrell C. R. (1990). Trends in Manufacturing Simulation. In Proceeding of Autofact Conference,. Detroit, Michigan.

12. Innes, J. and Mitchell, F. (1990), ``Activity based costing research'', Management Accounting,

13. Jelen, F.C., Black, J.H., (1983) "Cost and Optimization Engineering", McGraw-Hill.

14. Journal on " Automation and Funding" from Automation Research Center, University of Limerick, Ireland.

15. Journal of "Can Manufacturers Institute (CMI)" Omnibus study, July 2005.

16. Kyle Bauer "Modern Casting; Jun 2004;" ProQuest Science Journal on "Digging Deeper Into Automation, Robotics"

17. Marcel Dekker, Poli, C., (1994) "Design for Manufacturing: A Structured approach",

18. Mueller, Friedberg ,Strasse , Brismson, J.A. (1986), ``How advanced manufacturing technologies are reshaping cost management'', Management Accounting,

19. Ostwald, P.F. (1992), Engineering Cost Estimating, Prentice-Hall, Englewood Cliffs,

20. Praha, Engineering Design,

21. Prusak, Z., "Laboratory Experiments in Process Design and Optimization", Proceedings of ASEE Annual Conference, June 24-27, 2001, Albuquerque, NM.

22. Ruediger Zarnekow, University of St. Gallen, Institute of Information Management, "Distribution of cost over the application lifecycle - a multi-case study.

23. Trucks, H.E., (1987)"Designing for Economical Production", SME,.

24. Veeramani, Dharmaraj, Kung-Jeng Wang and Jose Rojas. (1998). "Modeling and simulation of auction-based shop-floor control using parallel computing".

25. Wood, K.L., Jensen, D., Bezdek, J., Otto, K.N., (2001) "Reverse Engineering and Redesign: Courses to Incrementally and Systematically Teach Design", Journal of Engineering Education.

26. www.ncst.ernet.in/education/apgdst/comfac/lecture/Automation

27. http://www.mbtmag.com/current_issues/2006/oct/busperf2.asp

28. www.thespot4**sap**.com

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