Computerized Information System for Small Manufacturing Company

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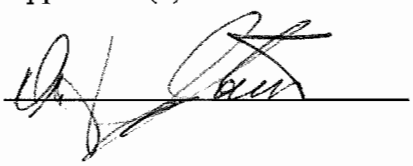

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Abstract

The objective of this study was to design and develop information system for XYZ company to assist in improving the effectiveness of there manufacturing processes. The proposed system was designed to assist a small manufacturing company transition from traditional methods of record keeping and reporting to scheduling and planning utilizing enterprising software. The system includes basic functionality for general manufactuting processes and is customized to fit the requirements of the XYZ company. The new system has established a structured flow connecting the all the basic processes starting from entry of custom order in the system to finalizing the customer order and dispatch. This will potentially asssit the company to trace the production process and allows for monitoring the production process in the shop floor through various checkpoints. Anticipated preliminary outcomes from a new system would be to assist the company to manage the inventory, and to schedule the work process.

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Chapter I: Introduction

The problem statement is taken from XYZ Company, a private owned company categorized by North American Industry Classification System (NAICS) of 3312 code under Steel Product Manufacturing, and is located in Midwest. The company is small and employs twelve employees from production to administrative positions. The main processes of the company include welding, pressing, bending, laser cutting, machining, and assembly. The company outsources some manufacturing processes like painting, glass fitting and the reassembling of the parts is done in the company. According to the company, they specialize in custom metal manufacturing projects. The company has the goal of providing quality of metal fabricated products and services adhering to a timely delivery process. They focus on eliminating non-value activity to maximize turn over time and cost saving of the customer.

Company XYZ uses a manual process for scheduling, planning and material management. These processes are done manually based on the past history of the manufacturing processes. They accept or reject the customer order request based on historical data of capacity to deliver. The duration for order process completion is purely an estimate and manufacturing processes are completed without the aid of any scientific methods. Due to the lack of technology the business frequently cannot meet the deadline of the customers. They do not have the capacity requirement planning, material requirement planning, or resource planning. The planning is done for a process or a job. To overcome the problems encountered in shop floor management they are in need of system which can help them by providing capacity model of available resources, inventory level of the materials in hand, schedule of the work, and utilization of resources.

The company makes decisions regarding the outsourcing of parts/ materials comparing the cost to manufacture verses buying the completed parts/materials from other companies. The other decision which the company makes regarding the re-order point is based on the manual counting of the items in stock verses predicted needs of the customer. XYZ Company is in need of the system which facilitates better production related decision making at various points in manufacturing processes. The company is also in need of flow of accurate information regarding the work status of each job going under the various stages in the shop floor.

Significance of Study

The study is primarily focused on developing computerized information system for XYZ Company to aide in managing the manufacturing processes. The solution would overcome the problems encountered in executing daily manufacturing processes such resource management, planning, scheduling of work processes, materials, and machines. The system would facilitate the company in simplifying the process like tracking sales and purchase order. The system would provide easy access to the information of customers and suppliers. The new system will help management make better decisions based on the facts such as it is more beneficial for the company to produce a part verses purchasing completed part/materials.

Goals of the Research

The basic objective of the study is to build the computerized information system for the company with the aim to fulfill the following goals:

i) Provide accurate and timely information required to operate the shop floor.

ii) Provide capacity requirement plan and material requirement plan.

iii) Reduce the time required to make decision.

iv) Help in determining strategies by taking input from business processes.

v) Provide reliable service to the customer.

Problem Statement

What benefits do small manufacturing businesses achieve by implementing the computerized information system?

Assumptions

These are the assumptions of the study:

i) The prospective users of the system are trained to use the system.

ii) The users of the system have knowledge to use the system.

iii) The company can afford regular system upgrade and maintenance.

iv) The existing programs are compatible to the new proposed solution.

Limitations of the study

This study is intended to provide simple software which helps the company to automate manufacturing processes like planning, scheduling and material management. This software does not provide a full automation as the Enterprise Resources Planning (ERP) software available in the market.

It is beyond the scope of the project to provide real time tracking of manufacturing processes in the company and provide the tools to analyze the finance.

Methodology

Field visit, observation, interview and joint discussion were the main methodologies followed in collecting data from the company. The owner and employees were the main sources of requirements for the new system in addition to the current excel software used in the company. The data thus collected were reviewed and verified in each successive meeting with the stake holders.

Definition of Terms

System prototype. Prototype is a working model of the system which helps to communicate a new product's design and functionality (Cooper, 2001).

Functional Requirement. Functional requirement describes the core functionality of the system; it includes the details regarding what the system is supposed to do.

Critical Success Factors (CSF). Critical success factors are the factors which are required to ensure the success of the project (Dictionary.com, 2010)

Electronic Data Interchange (EDI). Electronic data interchange is the way of transferring information via electronic means (Businessdictionary.com, 2010)

Enterprise Resource Plan (ERP). Enterprise Resource Planning is an integrated computerized system used to manage the internal and external resources of the companies (Wallace & Kremzar, 2001).

Just In Time (JIT). Just in time refers to an operation and production in which materials are moved smoothly through the system and services are delivered with precise timing (Toomey, 1996).

Manufacturing Resource Planning (MRP). Material resource planning is computerized system for planning and scheduling manufacturing works (Wallace & Kremzar, 2001).

Work In Progress (WIP). Work in progress is the work that has been started but not finished.

Bill of Material (BOM). Bill of material is the list of parts used to make the product under the manufacturing environment.

Master Production Schedule (MPS). Master production schedule is the plan developed during the production process which takes in demand, cost, and available resources as input and gives the quantity to be produced as output (Tersine, 1994).

Crystal Report. Reporting and analysis software for windows that is used to retrieve data from the database.

Chapter II: Literature Review

Perhaps almost all the companies small or large have their own challenges with integrating and implementing technology as a means to secure the sustainable competitive advantage over the competitors. The change in technology has narrowed the wide world and the competition has grown rapidly in every industry independent of the geography. Reduced lead time, improved quality, and better customer service appears to be the primary focus of the company. Having computerized information system is the basic need of the companies as it provides them easy and fast access of information. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP II), Capacity Planning, Scheduling, Inventory Management and Information System are the keywords that the researchers use to find the literature reviews from the electronic and printed media.

Material Requirement Planning (MRP)

Koh, Jones, Saad, Arunachalam & Gunasekran (2003) performed a study for measuring uncertainties in MRP environments. In the study the authors have defined MRP as "set of techniques that uses a Bill of Material (BOM), inventory data and Master Production Schedule (MPS) to calculate requirements for materials." According to (Koh et al., 2003) MRP system takes fixed lead-time, infinite resource, fixed routing, constant scrap rate and 100 per cent adherence to schedule receipt and schedule release.

Evolution of MRP System

Conceptually the manufacturing and information technology (IT) industries are taken as separate entities. Information technology deals with effective and efficient information flow

which can be used in decision making, planning and scheduling while manufacturing deals with shop floor activities such as machining, assembly and inspection (Rattner & Hsu, 1989). With the latest inventions in IT, information assuring integration has become a top demand in almost all industry sectors. Manufacturing industry is influenced by information technology and due to that influence has advanced the integration of information technology. Many MRP, MRP II to modern fully automated ERP systems are being used in present days. According to the author (Rattner & Hsu, 1989) the degree to which these manufacturing and information technology system are integrated with a common architecture defines the degree of enterprise automation and determines the potential for enterprise productivity.

In recent year significant attention has been paid to the integration of information technology with manufacturing processes. But often, early in the process it appears that the only need exists to manage and control the inventory. Although the beginning requirement was limited to reduce the cost of inventory but with time it expanded to include production planning. As a result, developing Materials Requirement Planning (MRP) software was needed. With the success of MRP implementation in the business the desire moved to implementing an automated system to help in manufacturing process from planning to distribution which resulted in Manufacturing Resource Planning (MRP II).

Adoption of MRP within Small Manufactures

Earlier MRP systems were implemented for inventory management, but its benefits reflected in many overall performance of the company with more effective customer service, reduction in waste and increase in productivity (Petroni & Rizzi, 2001). With the use of MRP

system the companies can experience a dramatic change in reduction in inventory handling cost, increase in effectiveness of overall process.

The implementation of material requirements planning (MRP) and manufacturing resources planning (MRP II) can bring significant change in cost reduction, increase in productivity, and improve quality. In return MRP implementation needs 1) to have a clear vision 2) support from top management, 3) capable manpower, 4) ability to adopt the changes and affordability. The use of these systems yields the benefits when the practice becomes matured. And this is the point where small manufactures hesitate to invest large amount of money (Harvey, Lefebvre, & Lefebvre, 1992). The other factors that can restrict the small and medium manufactures (SMEs) from implementing these types of software is the complex nature of the software , restriction to customize , usability of all the modules and support from the vendors.

Factors that support adoption

Material requirements planning (MRP) systems appear to require the companies to determine the amount to purchase based on the data entered into the system. It helps to make fact based production decisions by balancing the customer order in relation to the inventory based on the demand (Petroni, 2002). According to the author MRP supports the just-in-time operation in the company by scheduling the purchase orders and production orders. Significant difference can be observed in the performance of the company after the implementation of MRP system. According to (Petroni, 2002) following are some of the factors that support the MRP implementation:

- Better capacity planning.

- Better inventory control.
- Better production scheduling.
- Improved product quality.
- Improved productivity.
- Increased throughput.
- Reduced costs.
- Reduced lead times.
- Reduced overtime.
- Reduced scrap.

Except from above mentioned points there are many factors which can justify the investment made in the system.

Factors that reduce success with adoption

Material requirements planning (MRP), manufacturing resource planning (MRP-II) and enterprise resource planning (ERP) are the standard software packages intended to bring automation to the production processes (Rell & Basel, 2010). There are various cases of success and failure in the MRP implementation. The reality is that often companies face difficulty in implementation of such standard software packages. According to (Rell & Basel, 2010) enterprise systems are sophisticated and require coordinated involvement of the whole organization. Chung (2005) mentioned that often a lack of coordinated efforts results in a

decrease in efficiency achieved (as cited by Rell & Basel, 2010). MRP, MRP-II and ERP share same variables and have many similar types of implementation issues and following are the ones discussed by (L. Zhang, Lee, Z. Zhang, & Banerjee, 2002).

- Top management support.
- Re-engineering Business Process (BPR).
- Effective Project Management.
- Company-Wide Commitment.
- Education and Training.
- User Involvement.
- Suitability of Software and Hardware.
- Data Accuracy.
- Vendor Support.

In reality it appears integrating the software system is a major challenge for most of the companies as they may not have a good organizational culture, and good financial support. All the above mentioned issues are equally important and lack to address any of these can result in failure. Braglia and Petroni (1999) have stated that due to the highly complex nature of the system, the need for intensive training, restructuring the business processes, and the need of high commitment are usually shortcomings associated with MRP adoption.

Capacity Planning

Capacity planning is the process of making plan which is required in providing goods and services to the production floor so as to meet the requirement of the customer (Galloway, 1993). It helps company balance the capacity to meet the demand of the customer. Capacity planning is to create and provide sufficient, flexible capacity and best plan to meet the demand (Thacker & Associates, 2009). Capacity planning helps the companies find the answer of which, how much and when the resource is required (Kenworthy, 1997). Well executed capacity planning helps company meet the demand and retain the customer satisfaction.

Demand. Demand is defined as the amount of product the customer wants from the seller at any specific point of time (Kenworthy, 1997). The amount to be delivered to the customer initiates the process of planning and scheduling. The capacity of the company determines whether or not the company can fulfill the demand of the customer.

Design Capacity. Design capacity gives the information regarding the maximum output rate or service capacity of an operation (Stevenson, 2007). The design capacity does not take efficiency of machine and individual, maximum possible utilization of tools into consideration. It gives the maximum rate of output that can be achieved in ideal condition.

Effective Capacity. Effective capacity is the actual capacity of operation; the effective capacity takes setup time, run time, efficiency, and utilization into the consideration. It gives the maximum amount of output that can be achieved in practical working condition. The effective capacity depends on factors like product and service factor, process factor, human factor,

operational factors and external factors. As stated by Occhino (2000), effective capacity is calculated with the full consideration of tools availability, tools utilization as

Effective Capacity= working hrs / week* machine availability (%)* machine utilization (%) * process throughput.

According to Stevenson (2007) efficiency and utilization can be calculated as:

Efficiency=Actual Capacity/ Effective Capacity

Utilization=Actual Output/Design Capacity

Where, actual capacity is the output that is achieved from the work floor.

Accurate capacity planning helps organization meet the deadline of the customer requirement with maximum utilization of available resources. Effective capacity planning helps companies make the decision regarding making or buying parts. The factors affecting the make or buy decision in the company mostly depends on available capacity, the demand, cost of making, and cost of buying. The decision for making or buying is to be taken based on the factors mentioned above.

Standard Time (ST). Standard time is the time taken by the person or machine to finish the job working under a sustainable rate in predefined manner (Stevenson, 2007). Standard time is product of normal time (NT) and allowance factor (AF) and is expressed as;

ST=NT*AF,

Normal time takes in account the observed time (OT) and performance rating (PR) into consideration, and is calculated as,

NT=OT*PR,

Observed Time (OT) is the time recorded for any process from the start to the end and Performance rating (PR) is the rate of doing work. In real work environment the performance rating cannot be 100%. And Allowance factor (AF) includes delays in work, work break due to labor fatigue and machine overheating. XYZ Company has its own norms, standards they have the set performance rating of the employees to be 80% and 45 minutes of allowance factor. XYZ Company has set the efficiency factor for various functional areas like laser, press, machining, welding, drilling, assembly, PEM insertion, norlock as 13% for laser and 10% for rest of the processes.

Resource Availability. Resource availability deals with the degree to which resource is available for operation. Effective capacity planning needs to have the information regarding the degree to which the resource is available in relation to the effort to produce the desired result. Higher availability of resources could be tied to a more positive result of meeting the demands of the customer.

Resource Utilization. Resource utilization gives the degree to which the resource is utilized in normal working condition. The resource utilization must take into consideration the possible wear and tear in the machine, and operator fatigue. High degree of resource use can help the company to produce more output but can result in high maintenance cost of machines and decrease in performance of manpower (Stevenson, 2007). So, potentially the proper use of resources may be connected in achieving the long term benefits from MRP adaption.

Throughput. Process throughput is the time taken by the job between the order releases to the completion of the job (Chincholkar, Burroughs, & Herrmann, 2004). Reducing the extent of time helps company reduce the inventory, operating cost and increase the customer satisfaction and increase the flexibility in production. But it is not that easy for the companies to reduce the process throughput because of inherent delays in the system and its defined processes.

It is assumed that XYZ Company can develop a plan based on the effective capacity, demand of the customer and throughput. Assuring that one has the correct information regarding the capacity and process will help the company make better schedule and production plans.

Scheduling

Scheduling is defined as" the allocation of resources over time to perform a collection of tasks" in Baker's book (as cited by Dorn & Froeschl, 1993). According to Dorn & Froeschl (1993) scheduling is performed as an assignment based on the sequence of operations to be carried out for completing an order and the availability of resources. Generally there are two major categories of scheduling i.e. deterministic and stochastic. Deterministic scheduling is used when the processing time, set-up time and job priorities are known in advance. Stochastic scheduling is used in case the variables are not known (Peres, Castagliola, & Lahlou, 2008). During Production scheduling various decisions like releasing jobs for production, assigning resources, reassigning the resources, prioritizing the tasks are to be made and for that a company must follow some production policies.

Scheduling policies

Production scheduling has to determine a timely assignment of operations of all released orders to resources in order to best meet a predefined goal (Dorn & Froeschl, 1993). Various

policies and rules are applied for variety of problems in the production processes. Pre-emptive and Non-Preemptive are the two scheduling policies generally used in scheduling problems.

Preemptive Scheduling. In preemptive scheduling the execution of an operation or a task can be interrupted and completed later, either on the same or different machine.

While following the preemptive scheduling the tasks are divided into various sub-tasks and the resources are allocated for individual a subtask, which provides the flexibility in resources allocation (Billaut, Moukrim, & Sanlaville, 2008). Shortest processing time (SPT), longest processing time (LPT), earliest due date (EDD), minimum slack time (SLACK), first in first out (FIFO), smallest number of remaining operations are the rules can be implemented while following the preemptive scheduling policy (Dorn & Froeschl, 1993).

Non-preemptive Scheduling. In non-preemptive scheduling the execution of an operation or a task cannot be interrupted. The resources once assigned to a particular process cannot be withdrawn until the completion of the process.

The flow structure of the process used to deliver a product impacts facility layout, resources, technology decisions and work methods. According to Billaut et al. (2008) the process flow structure can be broadly divided into flow-shop and job-shop. In flow shop each job consists of m operations and the order of execution on different machines is the same for each job. In Job-shop the number of operations is not necessarily the same for each job, and every job has its own order of execution on the machines. A job shop flow is more flexible than the flow shop.

The methods most often use to resolve Job Shop Scheduling (JSS) problems include Linear Programming, Branch and Bound, and the use of Approximation. In linear programming method the problem is converted into the mathematical model and solution is obtained by

solving the mathematical equations. In Branch and Bound method the solution is obtained by evaluating low cost branch that represents a dynamically constructed tree structure that includes solution space. And last, the Approximation method involves using a Priority dispatch rule, Constraints satisfaction approach, or Neural network approach.

Since the XYZ company has limited number of resources and follows a flexible scheduling the policy it appears they are using is preemptive scheduling. Production operations are not same for each job and require continual customization in the operation which conforms to a process flow used in Job –Shops. It is the recommendation this researcher to follow the Priority dispatch rule under approximation method to solve the JSS and make effective schedules.

Inventory Management

The raw material, work -in-progress (WIP), and finished good are considered as the inventory (Ballard, 1996). According to Silver, Pyke & Peterson (1998) inventory can be classified as cycle inventory, cognition stock, safety stock, anticipation inventory, pipe-line inventory, and decoupling inventory. Generally it is believed that the inventory level of a company defines your strategic position in the market. Ever since 1980s inventory management is believed to provide strategic benefits (Silver, Pyke, &Peterson, 1998) to the companies which helps them make better plans and hold the competitive advantage over the other. According to Silver, Pyke, &Peterson (1998) make-to-stock inventory, assemble-to-order inventory and manufacture-to-order inventory are mostly used strategies for inventory management. These strategies are helpful for the company to address the issues of uncertainty, and customer service (Wanke & Zinn, 2003).

Bill of Material (BOM). Bill of material is the input to the MRP system which is the list of items, assemblies, subassemblies that are required to get the desired output from the manufacturing process (Wallace & Kremzar, 2001). According to Toomey (1996) it is the bill of material file which consists of details about the product structure. The detail processes included in the bill of material helps companies to decide and plan the manufacturing process. Tersine (1994) has stated that "an accurate bill of materials is needed for every master scheduled item".

Master Production Schedule (MPS). Master production schedule is timetable designed for the execution of planned activities under the manufacturing environment. According to Toomey (1996) MPS is the driver of MRP which includes the items, assembly processes, subassemblies and raw material as the input of the scheduling process. Material requirements planning (MRP) takes the master schedule and translates it into time-phased components requirements for each individual task (Tersine, 1994). According to Tersine (1994) MPS is used for different end items depending upon the environments like in make-to-order the schedule is made for customer orders, in make-to-stock the schedule is made for items to be finished and stocked and for assemble-to-order it is the schedule for intermediate assemblies.

Lead Time. Generally lead time is the time duration between placing an order to the receiving to the order. According to Wallace & Kremzar (2001) it is the time required to perform an activity which includes preparation time, queue time, transportation time and time for inspection and confirmation. It is the assumption that lead time must be as accurate as possible because a wrong estimate can increase the holding cost if the estimate is too long and can create the material shortage if the estimate is too short. Lead time must be a variable rather than a

constant and it is usually better to have shorter lead time as it can improve customer service, reduce inventory cost (Tersine, 1994).

Annual Carrying Cost. The cost of carrying items in the inventory includes the opportunity cost of the money invested, the expenses incurred in running the warehouse , handling and counting costs, the costs of special storage requirements , deterioration of stock, damage , theft , obsolesce, insurance and taxes. Annual carrying cost is the vital cost and must be optimized. The lack of effective and efficient methodology in calculating the carrying cost can affect the overall performance of the organization. The strategies of Make-To-Stock Inventory, Assemble-To-Order Inventory and Manufacture-to-Order Inventory must be identified based on the inventory carrying cost. Classifying the inventory based on the types and analyzing those using ABC analysis techniques helps companies manage the inventory better. ABC analysis has the basic assumption that not all the stock is equally valuable and may not need equal attention in managing.

Annual Ordering Cost. Ordering cost includes the cost of order forms, postage, telephone calls, authorization, typing of orders, receiving, inspection, and following of unexpected situation and handling of vendor invoices (Tersine, 1994). Though not significant in amount but above mentioned cost sum up to a big total and must be minimized in order to better manage the inventory. Other than the cost, time consumption is another major problem in traditional ways of placing orders. EDI (Electronic Data Interchange) is the good option to reduce the cost and to better handle the customer request. Electronic data exchange is the process to send the business transactions over the standard communications lines within the

company or between the company and the vendors (Muller, 2003). The use of EDI helps in easy and fast flow of information and helps to reduce the delay.

Economic Order Quantity (EOQ). The order size that minimizes the total inventory cost is the economic order quantity (Tersine, 1994). The EOQ helps companies to minimize the annual inventory carrying cost and also prevent the stock out situation. According to Toomey (1996) EOQ must balance the ordering cost to the inventory carrying cost. It is the general assumption that for any EOQ to be valid the demand must be uniform. In order to manage the situation where the demand is not uniform and continuous, often many companies will maintain a specific level of safety stock.

Economic Order Quantity (EOQ) vs. Just In Time Purchasing (JIT). The task of inventory management is largely based on the purchasing style employed by the company. The cost associated in inventory can be totally different based on the purchasing style. According to Schniederjans and Cao (2001) under EOQ system of purchasing the total cost of an item includes ordering cost, carrying cost and the actual cost of the ordered item while in just-in-time (JIT) purchasing the carrying cost is zero. Based upon the purchasing style practiced by the company the purchasing price can be different and is higher while using JIT purchasing style. The final decision regarding the best purchasing style depends on the carrying cost for EOQ method and Unit price for the JIT method (Schniederjans & Cao, 2001).

Software

The need of Information technology is being accelerated with the latest inventions in science and technology. Generally, in every sector from education to manufacturing the need exists for some sorts of tools to help them perform better and or maintain the competitive

advantage. Oracle (2006) mentioned that correct information is very important to determine opportunities and threats (as cited by Uusitalo, Janakola, & Gronhaug, 2010). The performance of the company depends on the ability of the company to gather, interpret and make use of data (Uusitalo et al., 2010). It is the need of the companies to find suitable system/software for them and compete with the world with improved performance. There are many software development companies dedicated to do deliver the software according to the need of the customer. Generally software comes in Packaged or Customized form.

Custom software. Custom software is designed and developed according to the requirements of the particular organization. These types of software are made based on the basic needs of company preserving the compatibility to the existing business process and architecture.

Packaged software. Packaged software is designed and developed including best practices in the industries. This software is packaged and delivered to the customer based upon common assumptions of the companies needs. Packaged software is well-structured, documented, supported and maintained. It is built by consolidating the needs of several companies in the industry. Often, small companies find that packaged software isn't responsive to their specific needs.

Custom vs. Packaged software. According to (Wilbert, 1994) it is always the dilemma for the companies to decide whether to go for customized or packaged software. The central question which most of the companies face is will my software conform to my business, or must my business conform to my software (Wilbert, 1994). Generally packaged software works for a majority of manufacturers. The need of business process re-engineering (BPR) could be requirement for companies going for packaged or of the self software. According to Wilbert (1994) adapting the packaged software can raise the issue of compatibility, usability and

flexibility. Due to the complex nature of the packaged software most of the modules in the software are not used and those which can be used are merely rigid.

But in contrast to the packaged software, custom software takes a singular approach to each and every process that exactly follows the business processes of the companies (Wilbert, 1994). It offers higher flexibility, compatibility and usability. Generally the initial cost of custom application is more than that of packaged application. This occurs as the custom application involves the cost of licensing, training, business process re-engineering, and cost of modifications required from the specific company.

(Light, 2005) the packaged software is already built and is readily available for implementation; it does not take long time as the custom application. Since packaged software is well- structured, supported and maintained often most of the companies prefer to use reliable packaged software. Usually when the company wants to move in the direction not supported by the software they do have to wait for new updates in the system from the vendors.

XYZ company is in need of software solution that provides them flexibility, compatibility and usability. They are not willing to change their business process as required by the implementation of packaged software. They are small in size; they have less number of people to access the system and cannot afford high cost for the software. They need the software that confirms their need and business process.

Chapter III: Methodology

Introduction

The easy access to information appears to confirm the need for companies to maintain efficient information systems. It is the belief that efficient and effective information system helps companies make faster decision and provide better customer service. It is in the best interest of small and medium companies to have good system to support them in their business process. XYZ Company, a small steel structural manufacturer has the need of system that helps them in managing the inventory, tracking the production process, managing customer, and planning and scheduling works.

Data Collection

The primary source of data was the existing Microsoft Excel program. Details of the company, and working procedures were obtained from the interaction with the company owner. Field visit, observation, interview and joint discussion were the main procedures followed in collecting data. The manager and the company owner justified the need of the new system and basic functional requirements were collected from them. The data about operational details, production process and work flows were obtained from the Microsoft excel program from the company and verified from the users. During field visit and observation phase the information regarding the process and procedures in XYZ Company were collected. During the interview session expectation of the company for the new system was taken. The other data collected during the process were related to how they handle the overall process, the various stages from customer request to finished order, how they take make or buy decision, what are the processes they perform in the company.

Information was collected mainly on the following headings:

i) Customer and supplier information.

The data taken under this category was the detail regarding the customer and supplier. Customer orders and supplies taken from the suppliers in the past were received.

ii) Product details.

Product details included the specification of the part, bill of materials (BOM), and assembly instructions.

iii) Process details.

Process details included the operation details for machines used in processes like welding, machining, forming, assembly, and painting.

iv) Inventory records.

The inventory records included the details information of the raw materials, work-in - progress (WIP), finished parts, the re-order point, and lead time.

v) Capacity.

a) Machine Capacity: The capacity of machine for welding, machining, press, norlock, and forming were included in machine capacity data.

b) Labor Capacity: The labor hours available for in-house operations were taken and noted as the labor capacity. The data about the break time and rate of efficiency were also received.

vi) In-house and outsourced processes.

The details of in-house and outsourced processes were collected.

In joint discussion stage various issues regarding the functional requirements of the system were discussed, concrete data were collected and the functional requirements of the system were finalized.

Since the data was collected in many instances by using all possible ways like interview, observation, field visit and joint discussion the data was rcliable and valid.

Methods

Conducting a field visit was the first phase of data collection and involved collecting the details of products and various manufacturing processes performed in the company. The second phase of data collection was to collect the information regarding the practices used in the company from the Microsoft excel program. The third phase of data collection was to interview the system users in the company. And last, the fourth phase of data collection was the discussion in the joint session.

Once the data was collected, it was analyzed and verified with the potential users. The next step was to convert the functional requirements into the code, the coding was done, each module was debugged and tested with the real data, and once the testing was error free the data was migrated from the existing system to the new system.

During the third phase, an interview process was used with people from the company being asked about the expectations from the new system and the functional requirements. During the discussion session a system prototype was given to all the participants and they were asked to compare the current system with the system of their expectation. As a result of discussion with employees, ideas were generated that could improve the efficiency of proposed

system. The employees were asked to evaluate and provide suggestions about the system and included graphical user interface (GUI), help features in the system, ease of information access, organization of data, and quality of database.

Before fully implementing the new system in the company environment, an evaluation was done to compare the performance of the new system with the existing system. Significant changes were observed, the reaction from the users was very good. Based on the feedback of the people and the performance, the new system was recommended to the company.

Limitations

The data was collected by using various methods like field visit, observation, interview, and discussion in joint session. Field visit and observation were the two initial data collection methods while the other two; interview and discussion were the methods to collect information regarding the new system prototypes. The limitation with the process of data collection was not being able to get views from all the employees working in the company. It was due to the time constraints of the project. If we had collected the views from all the employees we could have collected more views and recommendations. The other limitation in the data collection was related to the process used to obtain and interact with the business. Breakdowns in communication resulted in company being reluctant to move ahead in the process.

Chapter IV: Results

Introduction

The study was conducted to design and develop a computerized information system for XYZ Company specially focused at facilitating the development of technology driven planning, scheduling, and inventory management system. The expectation from the system is to help in making decisions, and improve customer service. This chapter includes the result obtained from the development of the new system and the comparison with the existing system. New system has connected all the processes with the provision of various checkpoints where one can track the progress of the manufacturing works in the company.

New system

The new system is developed using Visual Basic 2008 for the front end, Microsoft Access for the backend, and Crystal Report is used to generate the report. Appendix B shows the part of coding while the snapshots, view of database, and view of crystal report are shown in Appendix C. As shown in the system flowchart in Appendix A the system takes customer orders as input from the users, after receiving the orders the system checks the ability of the company to meet the deadline. The decision behind this is taken based on the raw material available, machine capacity, and the capacity of the manpower. The system gives the information of raw material available, the product in production floor , finished products, jobs in queue, status of the machine, machine and labor hour available . On the basis of these data the company can make the decisions weather to accept or reject the customer order. This feature is new for the company. It is the belief that the lack of sufficient information regarding the

inventory details, machine status and labor hours is the problem for the company. This new feature facilitated the company in making decision for accepting or rejecting the customer order. The new feature can help company to reduce the number of the orders crossing customer deadline. The right information about the inventory and capacity helps the people at planning and scheduling level make the decision effectively and efficiently.

Once the decision is made to accept the customer order and the date of delivery is decided, the company can make the decision to buy or make the product based on the cost incurred, resources available and time required. The system can be used to make bills of material (BOM) for the customer orders that are accepted. In case of purchasing, the system gives the details of the suppliers whom the company can contact. In case of making the user enters what processes and resources are required, after entering the details the system puts the process in queue. Based on the details entered by the user, the production processes are scheduled.

Once a particular process comes to the top of the queue it sends message to all the concerned people about the process. It is the feature in the system that the user can check the status of the process at any time for the product of the interest. It is the assumption of the system that once a process is finished the operator will notify the system about the completion so that the information can be updated in the database. With this updated information the resources can be assigned to other tasks which are on top of the priority.

It is the assumption that one of the problems for XYZ Company is the lack of information of the inventory on hand. With a new system it will provide them the exact information about the inventory. The inventory has been classified by priority into three different headings based

on the usage annually. The inventory with maximum usage is ranked A, and less and least usage are ranked B and C. The system has provision to locate the inventory in distinct areas so that they can be searched and obtained at the time of need. The system sends trigger when the inventory level goes below threshold and informs about the stock out stage. Based on the information they can initiate the process to acquire the materials from the suppliers.

The system gives the costing details for the products under the manufacturing process in-house. The costing includes the external process cost, internal cost, laser cost, press cost. Given the correct basic information about the time of various processes like welding, machining, norlock, assembly the system gives the total internal cost.

The system gives information regarding the total labor hours required based on the processes on queue, this information can be utilized and entered in the system which gives the scheduling on the basic of job and the work center.

The new system provides the feature to store the information of suppliers and customers in the database which can used to access the information. This information was stored in excel sheet in the previous system and there were issues regarding the optimization of the data. The new system stores the product details of the customer that are accepted and can be used in future as the reference in case to make the same product next time for the same customer. The customers and suppliers can be searched based on the address, name and the product details.

Purchase and sales order can be generated from the system and the system can give the detail information regarding the status of the purchase and sales. With the updated information from the system the people at the planning level can plan the production works.

Summary

This chapter discussed the features of the new system, the process flow, and the results obtained after the implementation. Appendix A: System Flowchart, Appendix B: Programming code, and Appendix C: Snapshots.

Chapter V: Discussion

Introduction

The subject of this research is related to the facilitation and implementation of the computerized information system for manufacturing business processes of XYZ Company. This section will review the significance of the study, the limitations associated with the study, summary of study procedure, and recommendations and the areas of further research will be included in the chapter.

Significance of the study

The study was focused on developing an information system with the aim to help in planning, scheduling, and inventory management processes. The company has the need to store in the database in structured way so that they can be accessed at the time of the need. It is the general understanding that the easy access to information will help the company perform better than before with better customer service and minimum delay.

Limitations of the study

It was beyond the scope of the project to provide the facilities of full automation, real time process tracking and analysis tools. It is the limitation of the system that it cannot track the status of outsourced processes. The system has been developed around some assumptions, most important on the list of assumptions is the entry of real and accurate data at various data entry points; the system has no provision to automatically change the status of the production process, reduction of inventory database.

Summary of study procedure

During the research various procedures were carried out starting from collecting information to coding and finalizing the system. Data was collected in various stages by using the field visit, observation, interview, and discussion in joint session. The collected data was finalized and approved by consecutive consultation with the concerned authorities. Coding, debugging and integration were the other procedures followed while developing the software. Coding was done in Visual Basic 2008, database was designed with the Microsoft Access, and the Crystal Report was used for the reporting.

Conclusion

It was the conclusion taken from the research that the decision making procedures is greatly influenced by the use of information system. The structured process flow helps the company manage the internal and external processes and plan the activities. The use of effective mechanism to manage the inventory helps the company to reduce the cost associated in the inventory. Job shop scheduling (JSS) policy recommended by the researcher helps company to increase the efficiency in the scheduling process of the company and achieve optimum utilization from the available resources.

Recommendation

After the completion of this field problem, researcher outlined a number of recommendations to the company. It is the recommendation of the researcher to continually act on adding the new bolt-on in the system as per the need. Addition of bolt-on gives more facilities to the users. Migrating database from Microsoft Access to other database management

system like Oracle, SQL server, and My-SQL will help company to increase the security in the database and manage the data better than before. The system has been developed based on various assumptions of the researcher and these assumptions must be fulfilled to obtain the expected result. It is the belief of the researcher that the results obtained from this study will help small organization. The software solution is intended for those organizations which are small and do not want to change the business process as per the need of the enterprise software. The procedures followed in this paper can be used to develop customized software by any other organizations.

Summary

This chapter restated the scope and purpose of the study, the procedures followed in developing the software, and assumptions and limitations of the study. Recommendation included in the chapter can be used by the companies which fall in the similar categories like XYZ Company categorized by North American Industry Classification System (NAICS). This research can be a good foundation for the other researcher for their research on developing customized software solutions for business organizations.

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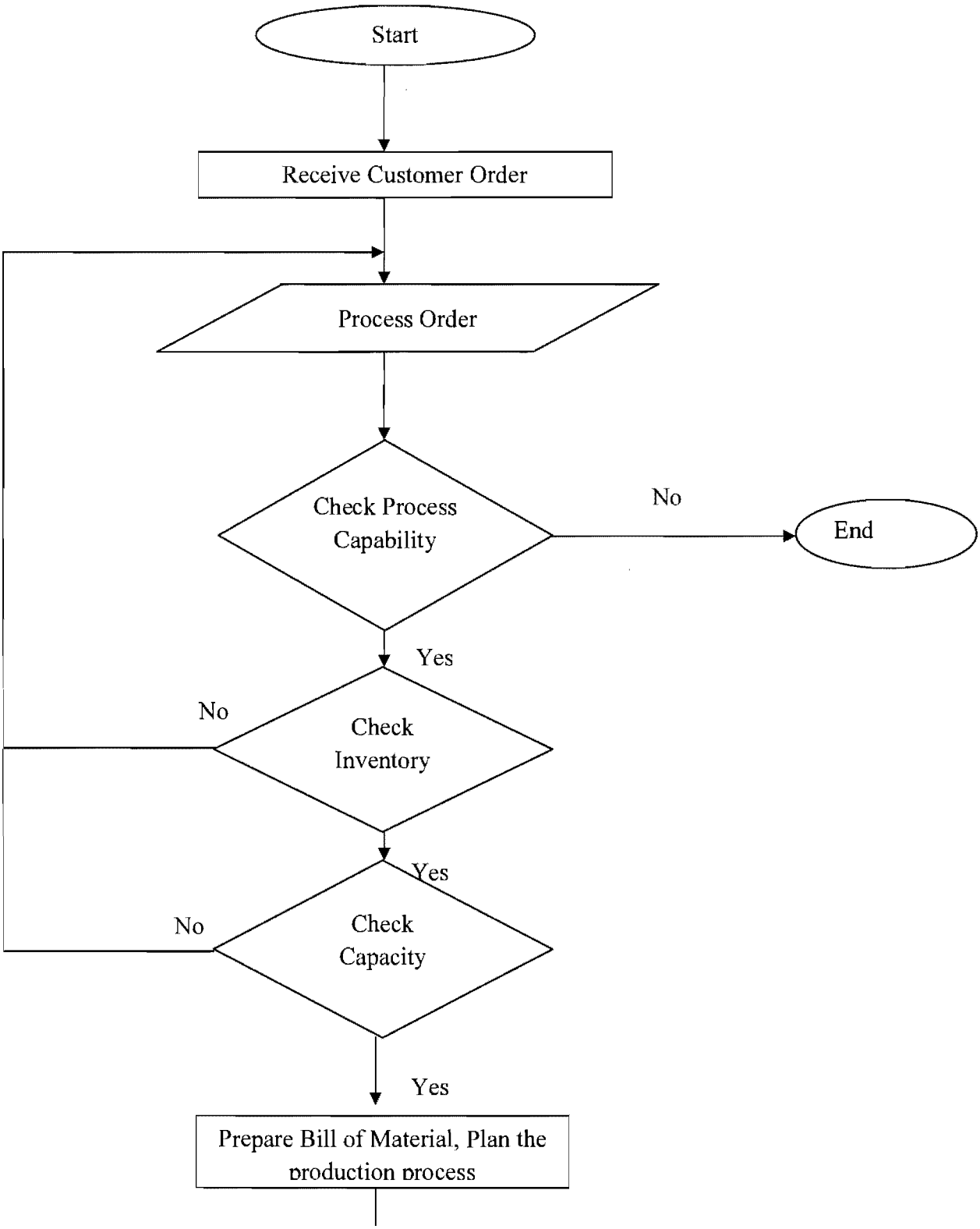
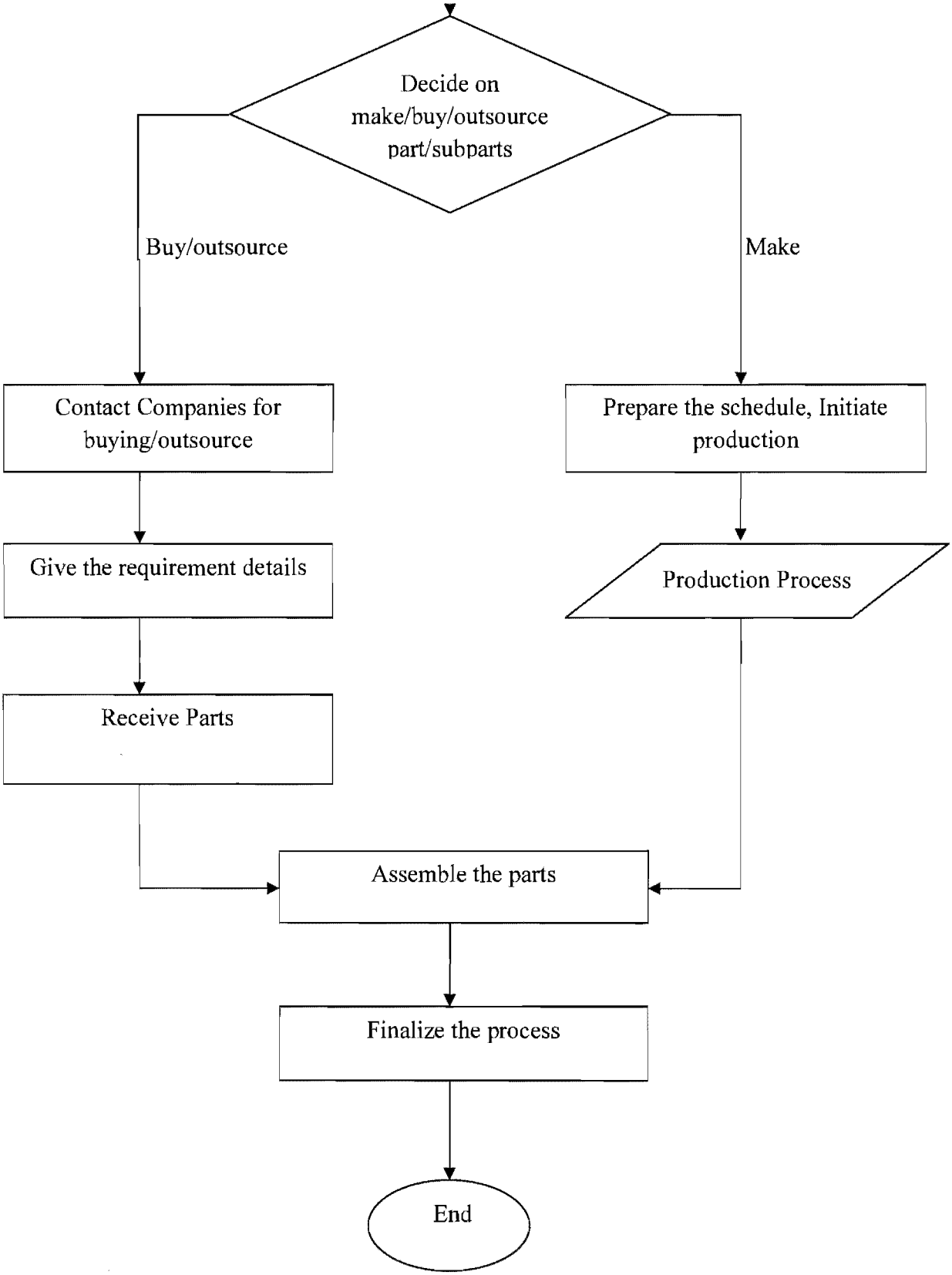
Appendix A: System Flowchart




Decide on make/buy/outsource part/subparts
Buy/outsource
Make
Contact Companies for buying/outsource
Prepare the schedule, Initiate production
Give the requirement details
Production Process
Receive Parts
Assemble the parts
Finalize the process
End

Appendix B: Programming Code

Database Connectivity:

```
Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
    Try

        cn = New OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;Data Source=D:\employee1.accdb;")
        cn.Open()
        Dim da As OleDbDataAdapter = New OleDbDataAdapter("Select * from result where ('" & textbox1.Text & "')=result.Process1",
        Dim ds As DataSet = New DataSet
        da.Fill(ds, "result")


        cn.Close()
    Catch ex As OleDb.OleDbException
    Catch ex As Exception
        MsgBox(ex.Message & vbCrLf & ex.StackTrace)
    End Try
End Sub
```

The snapshot above shows the code of the Microsoft Access database connectivity.

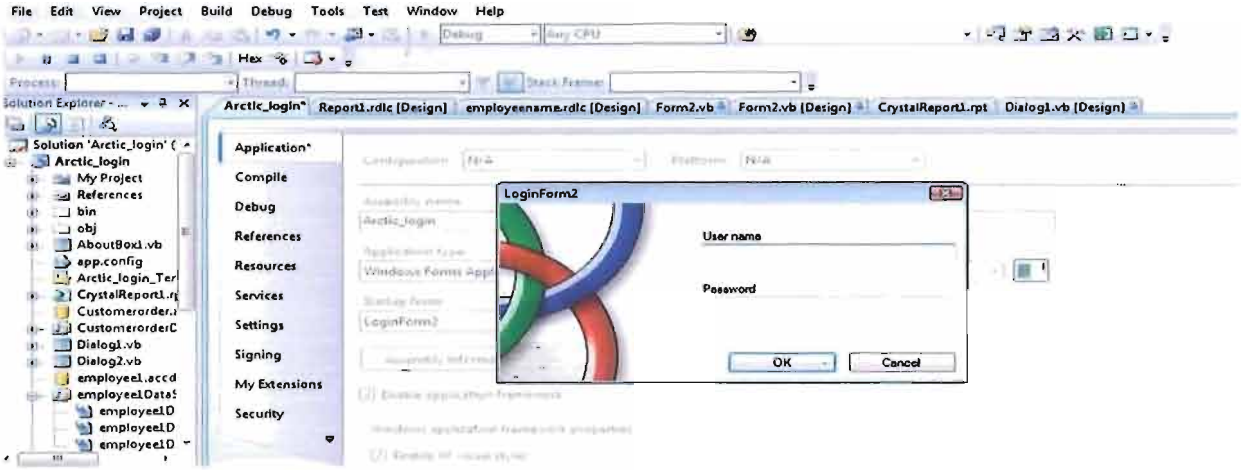
Internal Cost Calculation:

```
Private Sub Button2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button2.Click

    cn = New OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;Data Source=D:\employee1.accdb;")
    cn.Open()
    Dim order As Integer = Convert.ToDecimal(Me.textbox8.Text)

    cmd1 = New OleDbCommand("select Totaltimeperlot from press where (press.Orderid=" & order & ")", cn)
    dr = cmd1.ExecuteReader()
    Try
        While dr.Read()
            value1 += dr(0)

        End While
        textbox13.Text = value1

        textbox14.Text = (textbox13.Text / 60) * 100
    Catch ex As OleDb.OleDbException
    Catch ex As Exception

    End Try


End Sub
```

The snapshot above shows the code for cost calculation done in Visual Basic 2008.

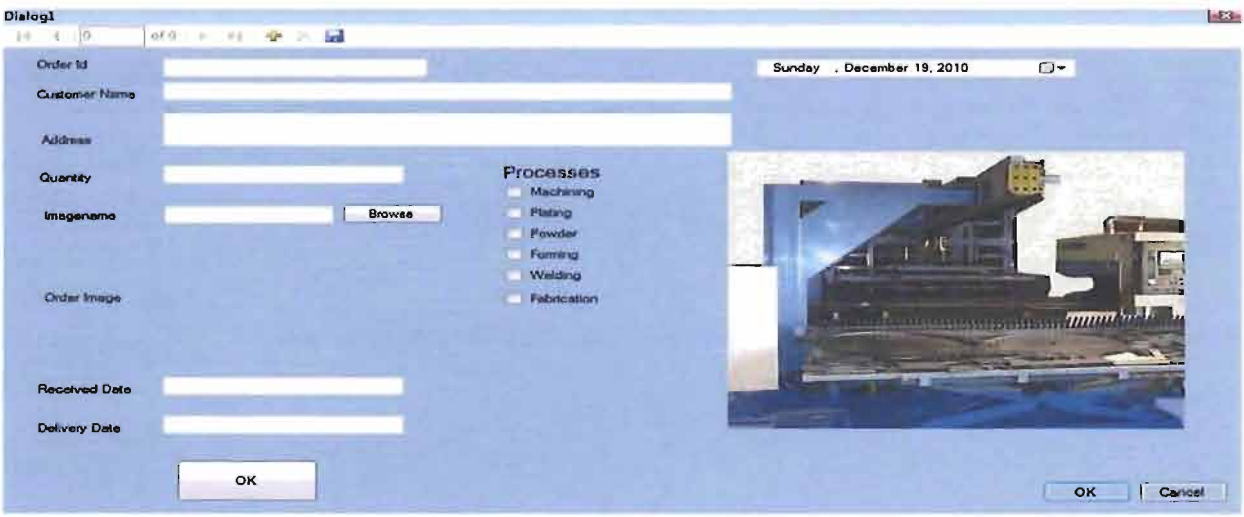
Appendix C: Snapshots

User Login:



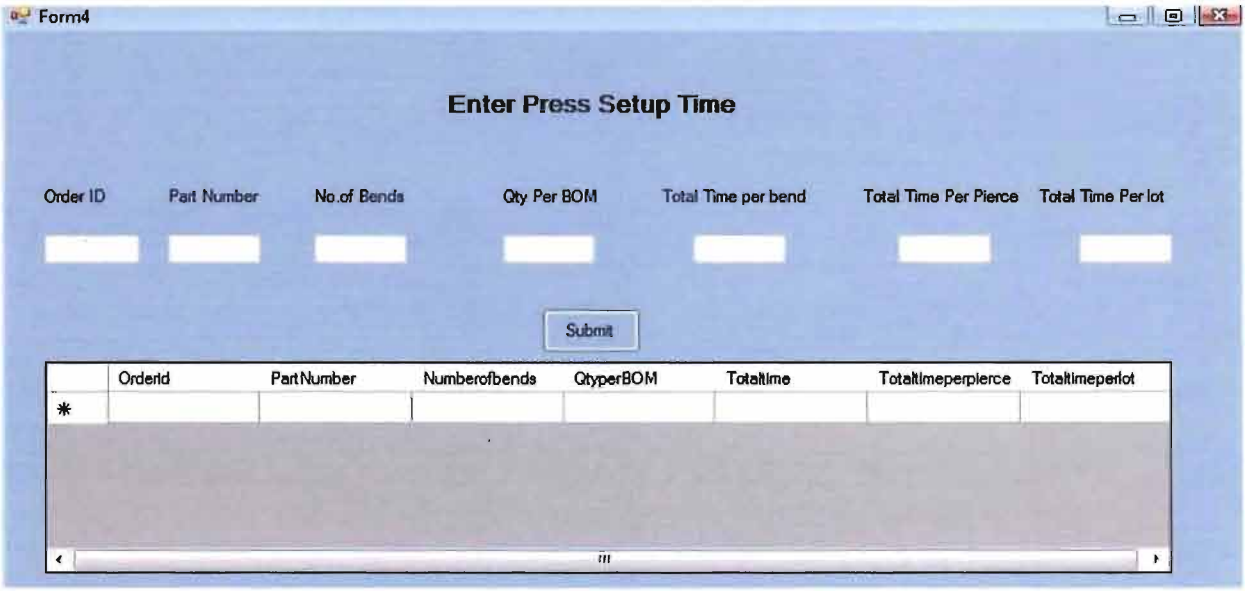
The snapshot above shows the user login, the background shows the Microsoft Visual Studio-2008 development environment.

Window to enter customer order:



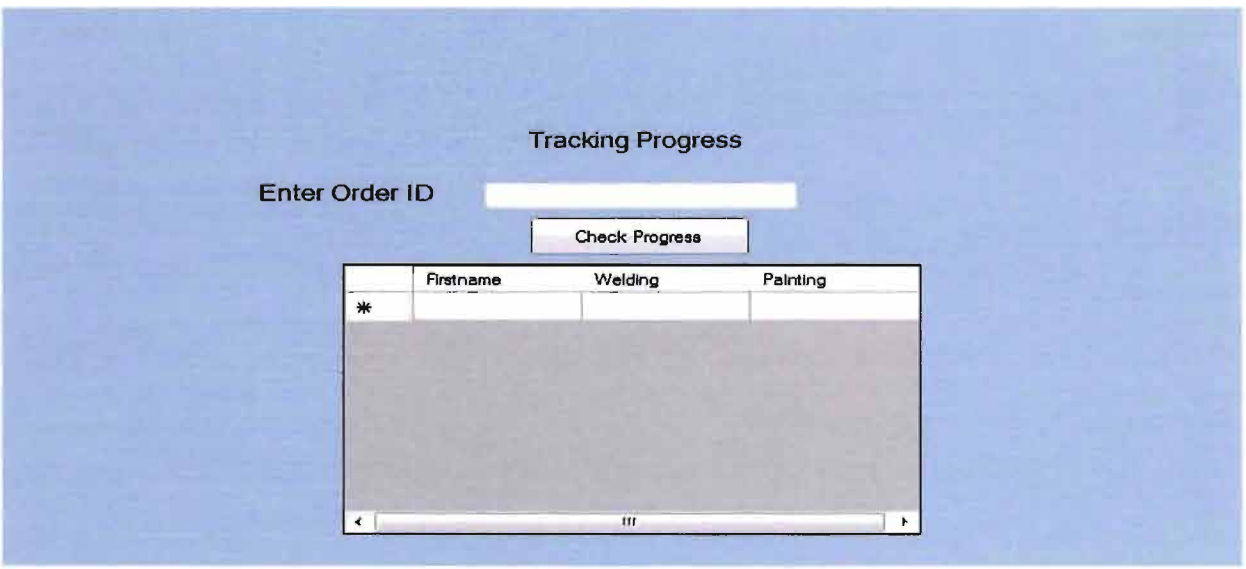
The snapshot above shows the firm where the company can enter the customer request, and notify the system about the processes required.

Form to calculate the cost:



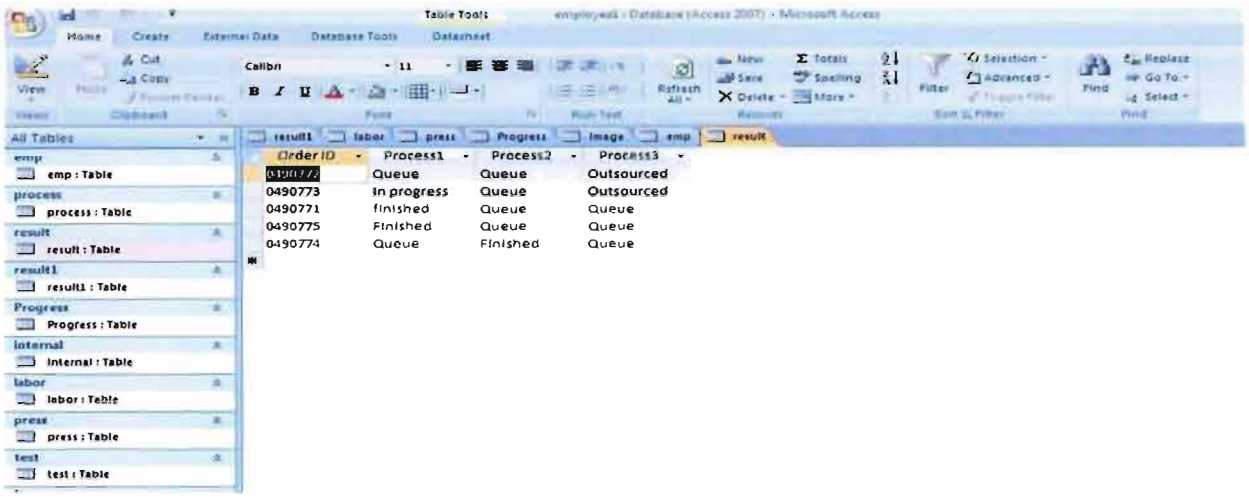
The snapshot above show the form to calculate the cost of the Piercing process.

Form to track the progress of production process:



The snapshot above shows the form to track the progress of production process; given the order id in the text area the system shows the production status of customer order.

Database:



The snapshot above shows the view of database, with the details of the databases on the left and the content of result database, which shows the status of processes of various customer orders.

Reporting:

The snapshot below show the employee record captured in crystal report from the employee table from the database. Crystal report is integrated in Microsoft Visual Studio-2008.