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An Analysis of Current Supply Chain Best Practices in Die Casting Industry

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Abstract: In support of the Supply Chain, Project identifies current best practices in Die casting industry. Supply chains with a specific focus on mass production and melting and metal treatment, preparation of moulds and cores. Using a survey of current literature for context of industry the current state of the Die casting industry and analyzes case studies aluminum on Die casting industry, Supply chain best practices. Topics covered are supply chain strategy and business strategy linkage, operating models, supply chain design, replenishment plus distribution processes and ongoing supply chain improvement initiatives. Die casting industry found to have very different supply chains in terms of structure and processes, based on their different operating models. Supply chain strategies designs, and processes that clearly support their business strategies.

Additionally tailor processes to fit specific product and demand profiles collaborate extensively with Supply chain partners to invest significantly in information technology and focus on operational efficiency and leverage scale to facilitate competitive advantage through Supply chain management. Based on the common and unique aspects of Die casting industry Supply chains, we provide recommendations for the potential transferability. Die casting practices within the Die casting industry and to other industries.

Index terms: supply chain management

I. INTRODUCTION

The best companies around the world are discovering a Powerful new source of competitive advantage. It's called Supply-Chain Management and it encompasses all of those integrated activities that bring product to market and create satisfied customers. The Supply Chain Management Program integrates topics from Manufacturing operations, purchasing transportation and Physical distribution into a unified program. Successful supply chain Management then coordinates and integrates all of these activities into a seamless process.

It embraces and links all of the partners in the chain. In addition to the departments within the organization these partners include vendor's carrier's third party companies and information systems providers.

Within the organization the supply chain refers to a wide range of functional areas these include Supply Chain Management-related activities. Such as Inbound and outbound Transport at warehousing and inventory control. Sourcing procurement and supply management fall under the supply-chain umbrella too. Forecasting production planning and scheduling order processing and customer service all are part of the process as well. Importantly it also embodies the information systems so necessary to monitor all of these activities.

The supply chain is a goal-oriented network of processes and stock points used to deliver goods and services to customers. This definition processes represent the individual activities involved in producing and distributing goods and services. They could be manufacturing operations service operations, engineering design functions or even legal proceedings but since our focus is on the overall performance of the supply chain we will concentrate primarily on the flow of goods and services so we will usually view the processes in generic terms with only as much specification as necessary to describe their effect on these flows.

This perspective will enable us to apply our models across a broad range of industrial settings and adapt insights from one industry to another. In addition to processes, our definition involves stock points which represent locations in the supply chain where inventories are held.

These inventories may be the result of deliberate policy decisions (e.g. as in the case of retail stocks) or the consequence of problems in the system (e.g as in the case of a backlog of defective items awaiting repair).Because managing inventories is a key component of effective supply chain management it is vital to include stock points in the definition of a supply chain. Processes and stock points are connected by a network which describes the various paths by which goods and services can flow through a supply chain.

II. PROBLEM DEFINITION

If we take the view that Supply Chain Management is what Supply Chain Management people do then in 1997 Supply Chain Management has a firm hand on all aspects of physical distribution and materials management. Seventy-five percent or more of respondents included the following activities as part of their company's Supply Chain Management department functions

1) Inventory management
2) Transportation service procurement
3) Materials handling
4) Inbound transportation
5) Transportation operations management
6) Warehousing management

Moreover the Supply Chain Management department is expected to increase its range Responsibilities most often in line with the thinking that sees the order fulfillment process as one co-ordinate set of activities. Thus the functions most often cited as planning to formally include in the Supply Chain Management department are

a) Customer service performance monitoring
b) Order processing/customer service
c) Supply Chain Management budget forecasting On the other hand, there are certain functions which some of us might feel logically belong to Supply Chain Management which companies feel are the proper domain of other departments. Most difficult to bring under the umbrella of Supply Chain Management are
d) Third party invoice payment/audit
e) Sales forecasting
f) Master production planning

A. The Most Common Supply Chain Problem

1) *Customer Service:* Effective supply chain management is all about delivering the right product in the right quantity and in the right condition with the right documentation to the right place at the right time at the right price. If only it were as simple as it sounds. Supply chain operating costs are under pressure today from rising freight prices, more global customers, technology upgrades, rising labor rates, expanding healthcare costs, new regulatory demands and rising commodity prices.
2) *Cost Control:* To control such costs there are thousands of potential metrics that supply chain organizations can and do measure. Managers need to zero in on the critical few that drive to organizations.
3) *Planning And Risk Management:* Supply chains must periodically be assessed and redesigned in response to market changes including new product launches, global sourcing, new acquisitions, credit availability, the need to protect intellectual property, and the ability to maintain asset and shipment security. In addition, supply chain risks must be identified and quantified. SCC members report that less than half of their organizations have metrics and procedures for assessing, controlling, and mitigating such risks.
4) *Supplier/partner Relationship Management:* Different organizations, even different departments within the same organization, can have different methods for measuring and communicating performance expectations and results. Trust begins when managers let go of internal biases and make a conscious choice to follow mutually agreed upon standards to better understand current performance and opportunities for improvement.

III. SUPPLY-CHAIN PRINCIPLES

If supply-chain management has become top management's new "religion," then it needs a doctrine. Andersen Consulting has stepped forward to provide the needed guidance, espousing what it calls the "Seven Principles" of supply-chain management. When consistently and comprehensively followed, the consulting firm says these seven principles bring a host of competitive advantages

The seven principles as articulated by Andersen Consulting are as follows

1) *Segment Customers Based On Service Needs:* Companies traditionally have grouped customers by industry, product, or trade channel and then provided the same level of service to everyone within a segment. Effective supply-chain management by contrast groups customers by distinct service needs--regardless of industry--and then tailors services to those particular segments.
2) *Customize the Supply Chain Management Network:* In designing their Supply Chain Management network companies need to focus intensely on the service requirements and profitability of the customer segments identified. The conventional approach of creating a "monolithic" Supply Chain Management network runs counter to successful supply-chain management.

3) *Listen To Signals Of Market Demand And Plan Accordingly:* Sales and operations planning must span the entire chain to detect early warning signals of changing demand in ordering patterns customer promotions and so forth. This demand-intensive approach leads to more consistent forecasts and optimal resource allocation.
4) *Differentiate Product Closer To The Customer:* Companies today no longer can afford to stockpile inventory to compensate for possible forecasting errors. Instead, they need to postpone product differentiation in the manufacturing process closer to actual consumer demand.
5) *Strategically Manage The Sources Of Supply:* By working closely with their key suppliers to reduce the overall costs of owning materials and services, supply-chain management leaders enhance margins both for themselves and their suppliers. Beating multiple suppliers over the head for the lowest price is out, Andersen advises. "Gain sharing" is In.
6) *Develop A Supply-Chain-Wide Technology Strategy:* As one of the cornerstones of successful supply-chain management, information technology must support multiple levels of decision making. It also should afford a clear view of the flow of products services and information.
7) *Adopt Channel-Spanning Performance Measures:* Excellent supply-chain measurement systems do more than just monitor internal functions. They adopt measures that apply to every link in the supply chain. Importantly, these measurement systems embrace both service and financial metrics, such as each account's true profitability. The principles are not easy to implement, the Andersen consultants say, because they run counter to ingrained functionally oriented thinking about how companies organise, operate, and serve customers

A. Benefits Of Supply Chain Management

1) *Profitable Growth:* Supply chain management contributes to profitable growth by allowing assembly of "perfect orders," supporting after-sales service, and getting involved in new product development.

a) *Working-capital Reductions:* Accelerating the cash-to-cash cycle all are affected by supply chain execution.
b) *Fixed-capital Efficiency:* This refers to network optimization--for instance, assuring that the company has the right number of warehouses in the right places or outsourcing functions where it makes more economic sense.
c) *Global tax Minimization:* There's a ton of money here" Thompson says, if companies look at assets and sales locations, transfer pricing, customs duties and taxes.
d) ***Cost Minimization:*** This largely focuses on day-to-day operations, but it also may involve making strategic choices about such issues as outsourcing and process design.

B. Goals Of Supply Chain Management

1) Identify the areas of greatest leverage.
2) Determine which policies are likely to be effective in a given system.
3) Enable practices and insights developed for one type of environment to be Generalized to another environment.
4) Make quantitative tradeoffs between the costs and benefits of a particular Action.
5) Synthesize the various perspectives of a manufacturing or service system, including those of logistics product design, human resources, accounting, and Management strategy.

IV. DIE CASTING PROCESS

The basic die casting process consists of injecting molten metal under high pressure into a steel mold called a die. Die casting machines are typically rated in clamping tons equal to the amount of pressure they can exert on the die. Machine sizes range from 400 tons to 4000 tons. Regardless of their size, the only fundamental difference in die casting machines is the method used to inject molten metal into a die. The two methods are hot chamber or cold chamber. A complete die casting cycle can vary from less than one second for small components weighing less than an ounce, to two-to-three minutes for a casting of several pounds, making die casting the fastest technique available for producing precise non-ferrous metal parts.

A. The Future of Die Casting

Refinements continue in both the alloys used in die casting and the process itself expanding die casting applications into almost every known market. Once limited to simple lead type today’s die casters can produce castings in a variety of sizes, shapes and wall thicknesses that are strong durable and dimensionally precise.

B. The Advantages of Die Casting

Die casting is an efficient, economical process offering a broader range of shapes and components than any other manufacturing technique. Parts have long service life and may be designed to complement the visual appeal of the surrounding part. Designers can gain a number of advantages and benefits by specifying die cast parts.

1) *High-speed Production:* Die casting provides complex shapes within closer tolerances than many other mass production processes. Little or no machining is required and thousands of identical castings can be produced before additional tooling is required.
2) *Dimensional Accuracy and Stability:* Die casting produces parts that are durable and dimensionally stable, while maintaining close tolerances. They are also heat resistant.
3) *Strength and Weight:* Die cast parts are stronger than plastic injection moldings having the same dimensions. Thin wall castings are stronger and lighter than those possible with other casting methods. Plus, because die castings do not consist of separate parts welded or fastened together, the strength is that of the alloy rather than the joining process.
4) *Multiple Finishing Techniques:* Die cast parts can be produced with smooth or textured surfaces, and they are easily plated or finished with a minimum of surface preparation.
5) *Simplified Assembly:* Die castings provide integral fastening elements, such as bosses and studs. Holes can be cored and made to tap drill sizes, or external threads can be cast.

C. Aluminum Casting

About two-thirds of all aluminum castings are used in the automotive industry e.g : In cars, buses, lorries, trains and aircraft. The need to reduce vehicle fuel consumption and weight has increased the interest in aluminum. The total mass of aluminum in a European car roughly doubled between 1990 and 2000. This growing use of aluminum in its major user sector clearly has an effect on the overall number of castings produced. Many different types of melting furnaces are used in aluminum foundries the choice depending On individual requirements. directly and indirectly heated furnaces using fuel and electricity reapplied. The fossil fuels currently used are natural gas, Liquid Petroleum Gas (LPG) and Oil. Natural gas is favored by most foundries on convenience grounds. electrical heating may be provided by either resistance elements or by induction. capacity is one of the most important Parameters for melting and holding furnaces. today induction furnaces are normally used when high melting capacity e.g: Above 10 tonnes/hour is needed. Shaft melting and holding Furnaces as well as crucible furnaces are often used when the melting capacity is less than five tonnes/hour. Small and medium crucible furnaces are often used when it might be necessary to be able to change the alloy easily or if the production rate is low. For holding, electric furnaces have the advantage of not producing burner off-gases and being able to sustain a homogeneous temperature over the whole molten volume, at a relatively low energy expense. Aluminum melting in foundries generally uses alloyed ingots as a starting material, although in some cases cycle time directly can be tedious.
We must time stamp each entity as it enters the system, record its completion time, and maintain a running average. While many manufacturing execution systems (MES) are capable of tracking such data, it is often simpler to keep track of WIP and throughput than cycle time (i.e., everyone tracks throughput since it is directly related to revenue and tracking WIP involves only a periodic system-the metal is delivered already as a liquid. The secondary melting of aluminum scrapes usually not performed in foundries and falls outside the scope of this document. It is discussed in the BAT reference document for the non-ferrous metals industries.

D. Electric arc Furnace (EAF)

The melting furnace used in non-ferrous melting is dependent on the foundry size. Non-ferrous Foundries often use a variety of different alloys and/or have a limited melting capacity. Melting Is done in small volume furnaces, for which the crucible furnace is most suited. Additionally Die casting is the major casting technique. In this case, there often is no need for a centralized Melting. As the melting (and holding) furnace is integrated into the casting machine, Non-ferrous Foundries with a higher capacity and a need (or reason) for centralized melting typically use Induction hearth type or shaft furnaces for melting, and then distribute the molten metal to holding furnaces and casting crucibles. The EAF is a batch-melting furnace consisting of a large bowl shaped refractory lined body with a dish shaped hearth. The wide furnace shape allows the handling of bulky charge material and leads to efficient reactions between the slag and metal. Typically the shell diameter is 2 to4 m. As shown in Figure 2.12, the furnace is covered by a refractory roof, which has ports for three graphite electrodes. The electrodes are supported by arms, which allow movement up and down. Most furnaces use roof charging: by moving the roof and electrodes aside the furnace can be charged using a drop bottom charging bucket or a magnet. The metal charge is heated by an electric arc, which is created by a three phase alternate electrical current between the three graphite electrodes. These are positioned above the charge, which itself acts as the neutral.

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Fig. 4.1 Electric arc furnace (EAF)

The furnace is tapped by tilting it, forcing the metal to flow out through the spout. Opposite the spout, an operable door allows deluging and sampling operations to be carried out prior to tapping. The lining of the furnace may be acidic (sio2 based refractory) or basic (mgo based refractory). A basic lining allows the use of virtually all kinds of steel scrap. The furnace can also be used for the production of high alloy and manganese steels. If scrap with high phosphor or sulphur content is used, lime and limestone which are usually added for dephosphorisation and desulphurization. An acidic lining would be attacked by these compounds. Therefore, the acidic type refractory is used for melting scrap with a low sulphur or phosphorus content only.
Electric arc furnaces are almost exclusively used for the melting of steel. Only in a few cases are they used for cast iron production, which requires an addition of coal dust to the melt. Electric Arc furnaces designed for steel foundries' purposes usually range from 2 to 50 tones capacities. They can be run intermittently and are suitable for a wide range of steel analyses. They can provide steel at high temperatures, with typical meltdown times of about one to two hours, while achieving high thermal efficiencies of up to 80 %1. Power consumption varies from 500 to 800 kwh/ton of molten steel, depending on the furnace capacity, the hot metal consumption, and the refining techniques, tapping temperature and pollution control equipment applied. The total melt time is typically 1 to 4 hours.

E. Raw Material Inspection

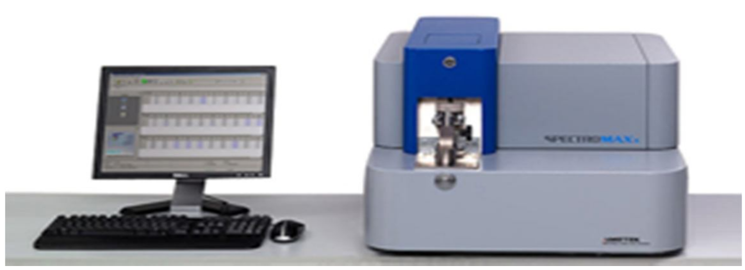

Fig. 4.2 spectrometer

Commonly available Spectrometers and Inspection Equipment are found as used, second hand Spectro Spectrometer Spectrograph for analytical metal analysis Aluminum, Zinc, Magnesium and Copper Alloys. Spectro spectrometers are commonly used in die casting and foundry Quality Control applications.

Die casting is a metal casting process that is characterized by forcing molten metal under high pressure into a mold cavity. The mold cavity is created using two hardened tool steel dies which have been machined into shape and work similarly to an injection mold during the process. Most die castings are made from non-ferrous metals, specifically zinc, copper, aluminum, magnesium, lead, pewter and tin based alloys. Depending on the type of metal being cast, a hot- or cold-chamber machine is used.

In Zinc Die-casting, alloys typically contain 96% zinc and 4% aluminum. The die-casting process uses a two-piece steel die and a casting press to hold the die halves together during injection of the molten metal. Inside the steel die is a cavity that has the negative image of the part to be cast. The molten metal is injected into the cavity under pressure, accurately filling the entire void. The metal cools, and the press opens the die halves, revealing the formed part.

The zinc cast parts are very close to the desired shape, requiring little machining before they are placed into an assembly. Typical applications include copier, aircraft, and medical instrument parts. Automobile makers use zinc die castings for emblems, moldings, door handles and brackets. Zinc die castings are easily chrome plated for durability and appearance.

Secondary alloys are made from scrap zinc castings which have been removed from other people's scrap such as automobiles, electronic components and machinery. If done with proper control the composition can be maintained. However this requires great care to be exercised by the alloyed. Incoming scrap material must often be hand sorted, to ensure that contaminated material does not enter the system.

Even so the resulting alloy will often be close to maximum allowable impurity limits thus leaving a smaller margin for the die caster. Also alloy composition will tend to be more variable between batches as compared to alloys made from primary or recycled material. This in turn will produce variations in the cast ability and finishing. Secondary alloy is usually marginally less expensive than alloys produced from primary or recycled material. This price difference is intended to account for some of the following aspects, which the die caster must contend with the need for greater quality control involving frequent spectrographic analysis. In spectrographic analysis, the metal is burned under a protective cover using an electrical arc. The light emitted by the burning metal is passed though an apparatus much like a prism, which breaks the light into all of its individual colors. Every element has a different set of colors, or spectrum, which is like a fingerprint. Any foreign material will alter the spectrum, and in doing so show its unique color spectrum, identifying it. The computer in the spectrograph uses sensors to pick up these colors. The computer program then produces a printout that identifies each element in the spectrum and the concentration within the metal. Elements can be reduced or increased to alter the composition.

Light-alloy castings produced for the automotive industry, such as wheel rims steering knuckles and steering gear boxes are considered important components for overall roadworthiness. To ensure the safety of construction, it is necessary to check every part thoroughly. Radioscopy rapidly became th accepted way for controlling the quality of die cast pieces through visual or computer-aided analysis of X-ray images. The purpose of this non-destructive testing (NDT) method is to identify casting discontinuities which may be located within the piece and thus are undetectable to the naked eye.

F. Aluminum High Press Casting Practices

Fig. 4.3 530T Eco- bucheler machine

1) Capacity
2) Make
3) Model
4) Nos.530 TON
5) Buhler
6) 2010
7) 1

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G. Die Heating Procedure

White the coasting yields best result in upper half of the range graphite coating works fine about 150^{0}c or even less. For the reason the heated die is first applied white coating and rth All coatings used in GDC process adhere to the mold wall at temperature range of 150-220^{0}c . e black coat applied on cooling die. For heating the die not just for coating preparation but also for pre-stating heat profile burners must used. These profiles are specifically desgined for the given mold only ensure that there is no amount of the heat(as for as possible). Infra-red digital thermometer is very convenient to measure die temperature and initiate the coating process.

1) Profile burners are strongly recommended for uniform die heating.
2) Behavior of dies varies drastically with temperature variation.
3) Measurerement of each of die element is essential with help of series production are minimum.
4) To maintain consistent quality of any series production makes as many casting parameters measurable as possible.

V. METHODOLOGY

For one they focus intensely on actual customer demand. Instead of forcing into the market product that may or may not sell quickly (and thereby inviting high warehousing costs), they react to actual customer demand. And by doing so, these supply-chain leaders minimize the flow of raw materials, finished product, and packaging materials at every point in the pipe line.To respond more accurately to actual customer demand and keep inventory to aminimum, leading companies have adopted a number of speed-to-market management techniques. The names by now have become part of the Supply Chain Management vernacular JIT manufacturing and distribution, quick response (QR) efficient consumer response (ECR), vendor managed inventory (VMI), and more. These are the tools that help build a comprehensive supply-chain structure.

A. Flow Chart of Project Methodology

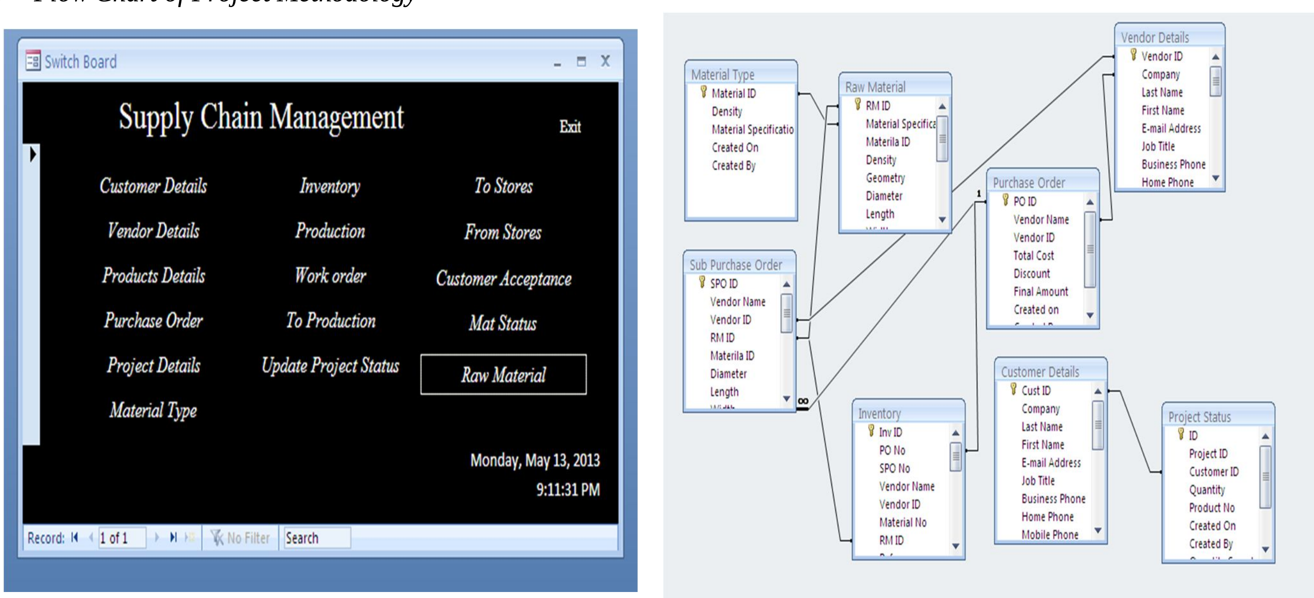

Fig. 5.2 Production Form and Relation Ship

VI. RESULTS AND DISCUSSIONS

Our studies was carried out in an analysis of current supply chain best practice in die casting Industry and discovers and understand .various strategies for managing such casting supply chains. There are a number of technical and managerial aspects in the planning and operation of such supply chains. In the present study to analyzing the casting supply chain, with special reference to the auto industry that increasing demands on final product performance, variety, and quality. by using Ms acess data base tool Forecasting production planning and scheduling, order processing, and customer service all are part of the process as well in organization.

Simple statistical methods using Microsoft access software data analysis program has been used to analyzed to complete supply chain in project

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A. Switch Board

This form provides the combination of all the Forms that has be displayed on the one form, so that every form will appears in a prescribed format for the completion of the project.

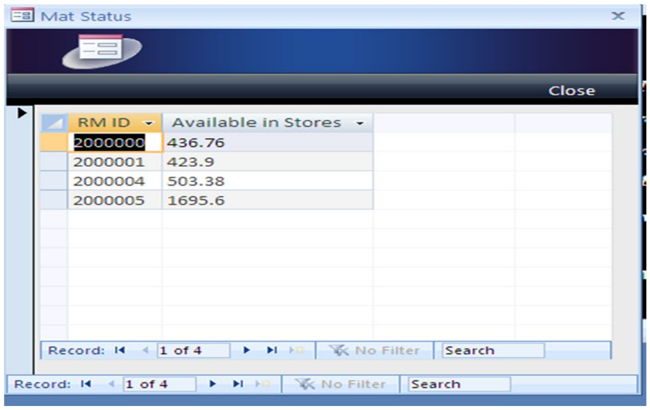


Fig 6.1 Switch Board

B. Steps Impemltion in Microsoft Access Databases

Sample Project

1) *Step1:* Consider the new customer M/s Manjunath Enterprises . So open the Customer Details form to add this customer to database and New customer M/s Manjunath Enterprises has been added to database with Customer ID as 80000003 which is a Unique Number

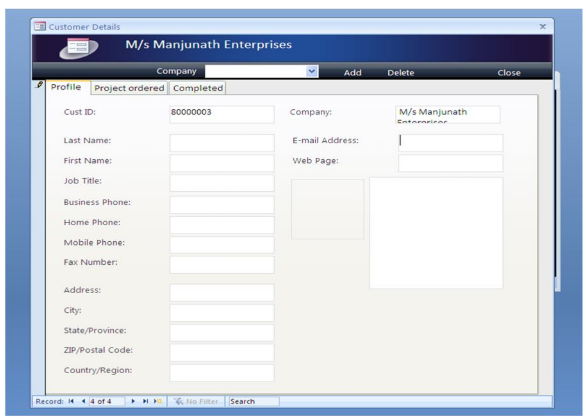


Fig. 6.2 Customer Details

2) *Step2:* Create a new Raw Material having different dimensions. Open the Raw Material form and The New Material with Raw Material ID (RM ID) as 2000006 which is also a Unique Value

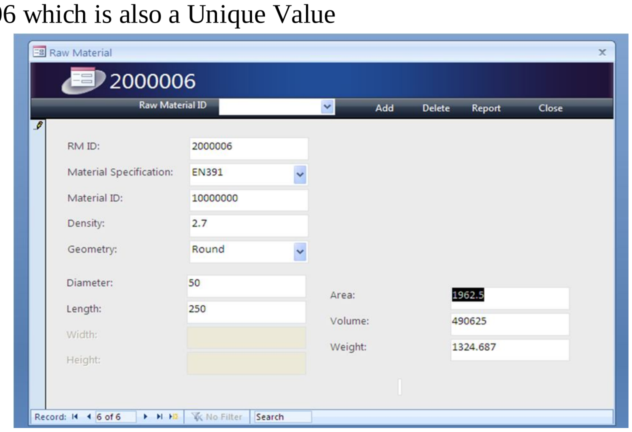


Fig. 6.3 Raw Material Form

3) *Step3:* Create a new Product with this RM ID. Open Product details

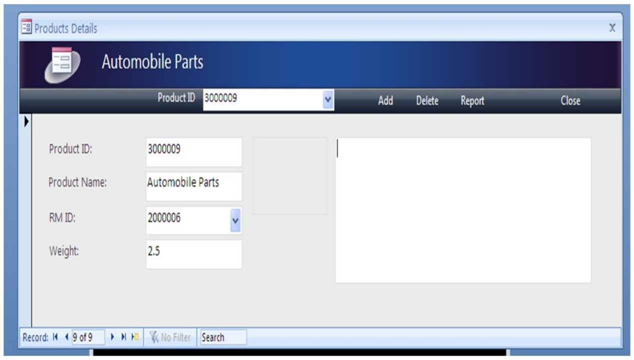
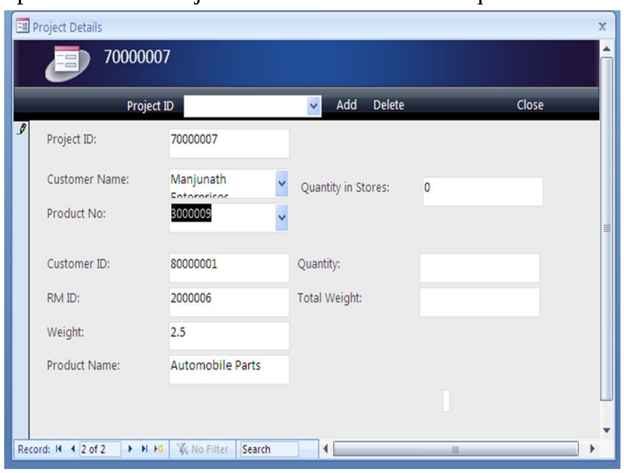


Fig.6.4 Product Details

New Product has been created with Product ID 3000009 which is a unique Value

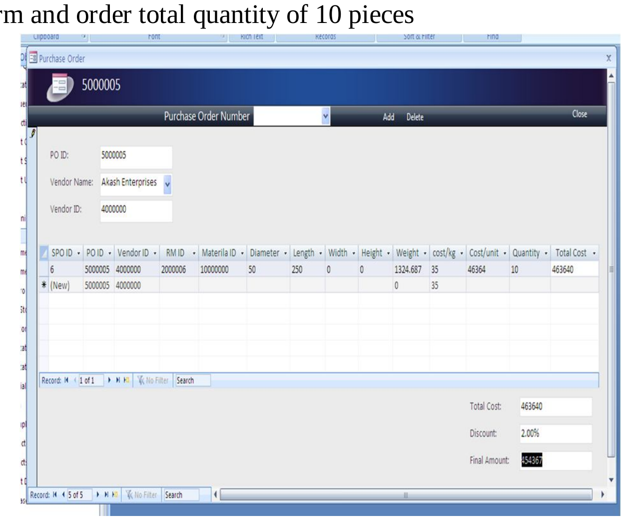
4) *Step 4:* Create a New Project for the Customer M/s Manjunath Enterprises who orders the Product bearing Product ID 3000009 and Raw Material ID 2000006 . Open the New Project Form and enter the required Product ID



In the above fig we can find that Quantity in stores will be Equal to 0 and this can also be check by opening Mat Status and hence we can find that RM ID with 2000006 will be present. So create a purchase order to purchase the RM ID 2000006

Fig. 6.5 Products Details Form

5) *Step 5:* Open Purchase order form and order total quantity of 10 pieces



Once this Purchase order has been created and this has to be send to vendor for purchasing the required number of materials and this can be visible in the Vendor Details form. As shown in the below form we can identify the RM ID with 2000006 has been ordered with the quantity of 10

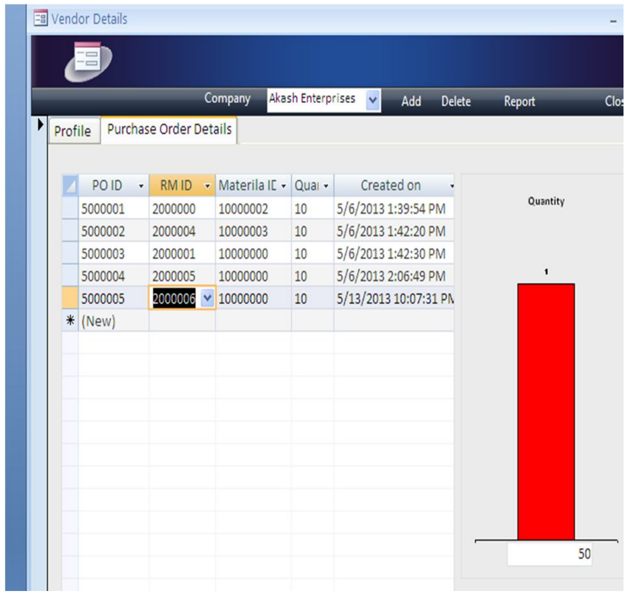


Fig. 6.6 Purchase And Order Form

6) *Step 6:* Receive the Quantity from the Vendor and that has to be added to the database. So open the inventory form which gives the information corresponding to the Purchase order and Sub Purchase order details

Fig. 6.7 Vendor and Inventory Form

Enter the total quantity that had been received in and automatically this will be added to the stores. Now Check the Material Availability in the stores.

7) *Step7:* Now go back to New Project form and create the new project (Project ID will change for every new entry for maintaining the Primary key constraints) with RM ID with 2000006 and Product ID 3000009 and don't forget to add the quantity that is required.

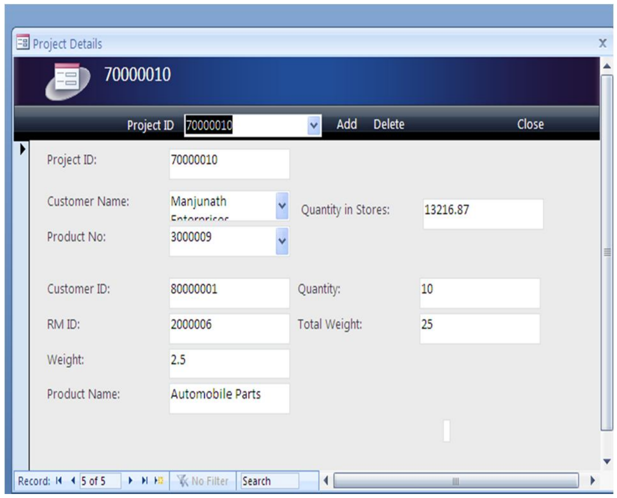


Fig. 6.8 Project Details

8) *Step 8:* Go to Production and just enter or select the newly created Project ID and rest of the things will be automatically highlighted and click Add

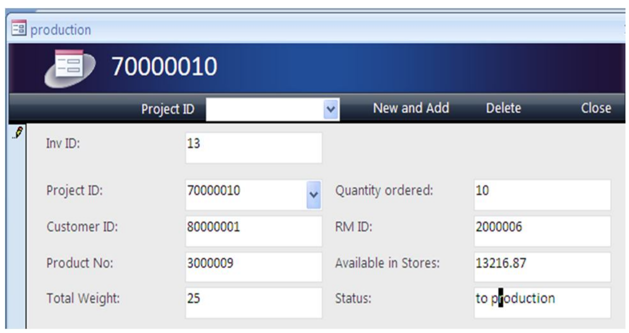


Fig. 6.9 Production Status

If the status value is to production then only the particular project will be highlighted in the further forms.

9) *Step 9:* Create the work order, just enter the newly created project ID and remaining things will be automatically highlighted

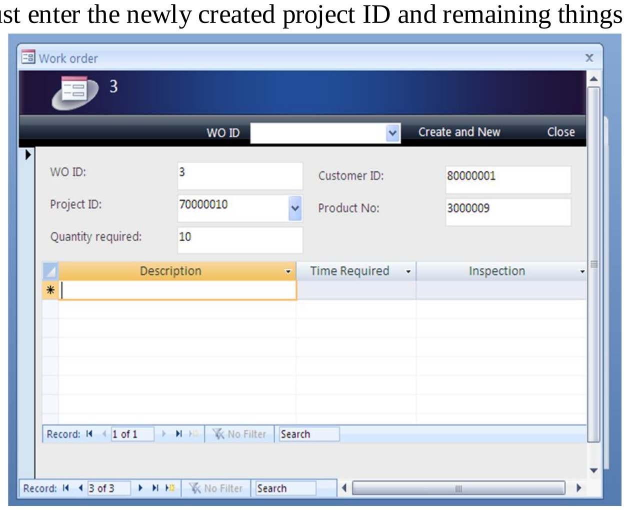


Fig. 6.10 Work Ordered Form

10) *Step 10:* Go To "To Production" to add the project for which work order is created

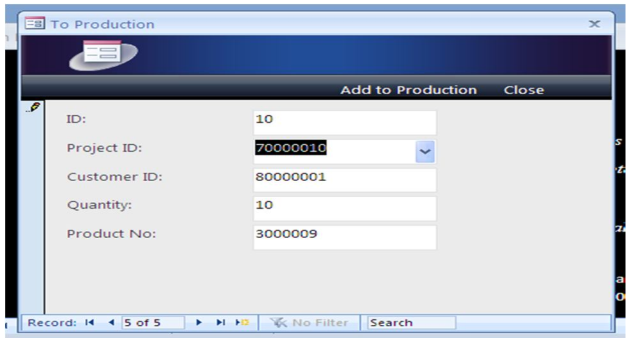


Fig. 6.11 Production Form

VII. CONCLUSION AND FUTURE SCOPE

A. Conclusion

This project the three sections of the industrial supply chain need to interact to ensure goods or services reach consumers. The efficient delivery of the product to the consumer at the right price, in the right place and at the right time will result in good business for each link of the chain. This takes strategic planning and effective collaboration with all partners. other industry specialists reduces costs to the business, the customer and the environment Through effective supply chain management.

It benefits itself the environment and other businesses. Functional products in stable markets need a supply chain production system that focuses on reducing volume cost and increasing production Efficiency by use help Microsoft access data base tool using supply chain best practice in die casting industry.

B. Future Scope

1) Supply chain management (SCM) remains a high priority for manufacturers as a way to improve margins and retain and increase market share.
2) Supply chain management remains at the top of the agenda for many enterprises today as a way to reduce operating costs and be more responsive to customers.
3) A growing understanding that optimizing supply chain flow at the department or factory or warehouse.

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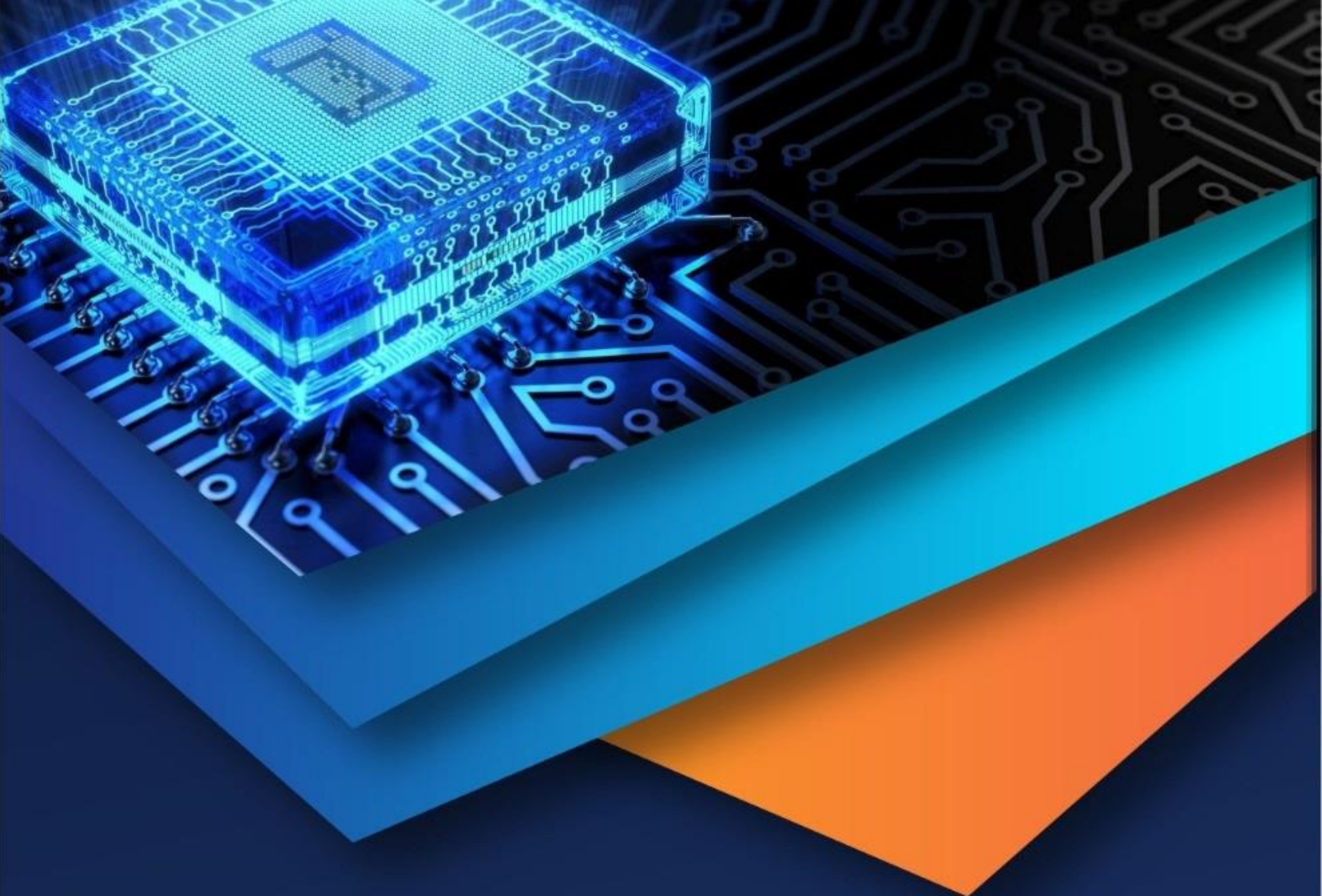

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