Supply Chain Optimization for a Contract Manufacturing Firm

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Abstract

"Supply Chain Optimization for a Contract Manufacturing Firm" is a project that was underway at A-1 Jay's Machining Inc spanning one year. Contract manufacturing firms can be considered to be the backbone of the entire manufacturing industry. Machine parts that any company cannot or does not choose to manufacture are made at contract manufacturing firms such as A-1 Jay's Machining Inc. Contract manufacturing firms also have to rely on its raw material suppliers to be able to deliver the best in a very short time. Our project looks into the current operations and suppliers of A-1 Jay's Machining Inc. and makes recommendations based on our findings. The project aims at saving operating costs, inventory costs and cost of logistics for the company. The report is a result of the detailed analysis carried out at the company and the recommendations made are well supported with economic analysis. Based on the work done at A-1 Jay's machining Inc, our team will also look at the possibility of launching ourselves into the consulting market. A complete analysis of the investment to be made on infrastructure, revenue generation, profit and loss statement, break –even analysis and Return on Investment calculation is done to see if it is feasible to launch a consulting firm.

Acknowledgement

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1. Introduction

The mission of most manufacturing companies is to be able to provide quality products at competitive prices. Although quality has to be built in, the company may not be able to sell its products at competitive prices due to an inefficient supply chain. The reasons for this inefficiency may differ with different companies. Every manufacturing firm is posed with several challenges each day pertaining to its supply chain. The total cost of the product depends upon various factors such as cost of raw materials, transportation, inventory holding and handling, manufacturing, shipping and delivery etc. Hence it is essential to identify the loop holes and eliminate slackness in all the operations stated above in order to reduce total cost. This report comprises the final draft for the scope of the project. The report has been subject to refinement in scope, objectives and methodology of analysis since the preliminary scope report. It combines the findings and analysis carried out so far pertaining to the inventory management techniques and lead time reduction along with the literature review and economic justification of the recommendations made. A-1 Jay's Machining Inc is a mid-sized contract manufacturing firm that deals with jobs related to precision machining and assembly. The company has a customer base of about 15 companies and it relies on about 25 different suppliers for the supply of raw materials. Supply Chain Optimization is a process which involves a preliminary analysis similar to a diagnostic check which reveals the problem causing processes. After determining the cause of these problems, the next step is to look for alternatives and recommend changes to be made based on relevant economic analysis

2. Company Background

A-1 Jays Machining Inc. is an established machining company located in the heart of Silicon Valley. Founded in January of 1991, it has a floor space of approximately 38,500 sq. feet of machine shops and assembly departments, onsite office manager and accounts department. It has a workforce of 60 employees and has over 2.5 million dollars in machine tool capability. They have recently acquired A-1 Laser International to exclusively license to manufacture the LPL Stent cutting systems. The company specializes in Precision Machining, Wire EDM, Sinker EDM, Precision Grinding, Double Disk Grinding, Milling, Lathe, Marking Metal

Current Customers: Western Digital, J.S.D.U., OSC, Headway, Evalve, Lockheed Martin, Finsar, Intel, J and J Advanced Medical Group, Memry Corp, NDC, FormFactor, Fluid Medical, Pulse Systems, New Focus, Neo Photonics, Pacific Bio Science, Solfocus, Crux Medical, MRS, Samsung, etc.

3. Objective

The company caters to a variety of customers and has plans for expansion in the near future; this would be the perfect time for the company to overhaul its supply chain in order to be able to handle the expected surge in demand. A detailed study of the current manufacturing practices and supply chain strategies will help the company identify the loop holes and eliminate them beforehand. This presents our project group with an opportunity to use our knowledge of Operations, Logistics and Supply Chain Management and Economic Analysis to benefit the company. Looking into all the above

mentioned areas and making changes to all of them will not be feasible in the time we have at our hands. We realized that the root cause of all the problems faced by the company ranging from high lead time to bull-whip effect is the lack of management of inventory. The company currently has a pull system for its supply chain which means that all the operations in the entire supply chain are triggered only after the order is received. One advantage of this system is that the company does not need to forecast anything beforehand. However, this means that the company must rely on the efficiency of its suppliers and its logistics in order to deliver the fast turn around time that it promises. Our main aim is to find possibilities of implementing a semi-push system which would mean maintaining an optimum amount of inventory of raw materials. A correct forecast of the optimum level can be decided only by looking at orders made in the past two years.

4. Literature Review

4.1 Inventory Management

The inventory which includes raw material, work-in-process and finished goods constitutes a large amount of capital with a limited level of liquidity. Constant monitoring and management of this inventory provides large opportunities for cost savings. The process involves analyzing various factors that contribute to the cost of the materials. It includes material cost, procurement cost, storage and handling cost and the impacts on the lead time. The responsiveness of the supply chain, the ability of the supplier to process the customer order, is heavily dependent on the inventory level and information systems. The most important process in the optimization of a supply chain is to connect

the supplier, distribution warehouses and the logistics systems involved using a common platform. Also to be considered are the importance of analyzing the profitability in terms of net present value (NPV) and the responsiveness of the supply chain by analyzing the transportation time, inventory management and process scheduling. (Yu and Grossmann, 2007)

4.2 Analysis of Bullwhip Effect

The bullwhip effect indicates that the delays in production or delivery rates can make supply chains dynamically unstable with regards to the changes in the consumption rate (Nagatani and Helbing, 2003). The ability to forecast the stock levels can bring about stability to the supply chain to great extents. The supply chain is a series of suppliers, *i*, who receive the products from an upstream supplier, *i -1*, and generates products for a downstream supplier, *i +1*(Nagatani and Helbing, 2003). The paper explains the importance of the rate of consumption in the supply chain. It is expressed as the rate of change in the inventory level at the supplier location due to an order placed by the next downstream supplier.

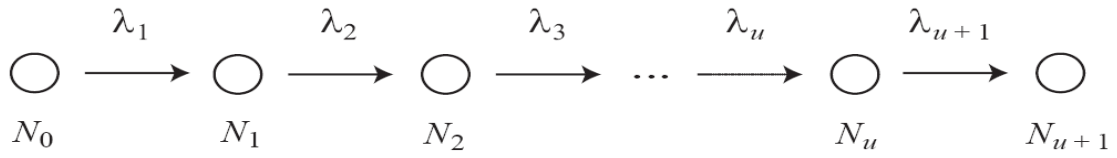


Figure 1: Linear supply chain

(Nagatani and Helbing, 2003)

The circles in Figure 1 indicate different suppliers *i, Ni* their respective stock level and *λi* the delivery rate to supplier *i* or production speed of this supplier (Nagatani and Helbing, 2003). Now consider supplier *i* delivering the product/s to the next downstream supplier

i+1 and the level of inventory at supplier *i* is represented as *Ni.* The change in the inventory level over time can be represented as

$$\frac{dN_i}{dt} = \lambda_i(t) - \lambda_{i+1}(t) \ .$$

Here λi is the rate at which the supplier receives the orders from supplier *i-1* and λ_{i+1} indicates the rate at which supplier λi delivers products to downstream supplier *i +1* (Nagatani and Helbing, 2003)

The method can be efficiently incorporated into the existing inventory management structure. By performing the analysis of the delivery rate, the responsiveness of various suppliers can be derived which will help in optimizing the supply chain. The pricing decisions and demand forecasting can be performed using historical sales and price data and can be help in the analysis of the reference pricing decision making (Reiner & Fichtinger, 2008). A comprehensive analysis of the weekly sales and purchase data will provide necessary information about the demand, both from suppliers and customer (Reiner & Fichtinger, 2008)

4.3 Safety Stock Analysis

The feasibility of maintaining a safety stock requires an in-depth analysis of the supply and demand requirements. The complexities in safety stock analysis originate from various factors like the nonlinear performance functions related to service level, expected inventory, interdependence of suppliers and relation between production capacity and

demand (Jung et al, 2007). Service level, the fraction of demand that the supply chain can satisfy within a predefined allowable delivery time window, is a measure of the supply chain performance (Jung et al, 2007). Safety stock level offers a buffering capability to the supply chain which in turn helps in maintaining the promised service levels to customers (Jung et al, 2007).The importance of optimization is quite transparent in this area as the level of safety stock maintained will directly impact the cost involved in the business operations. Another commonly used method of inventory management is the base- stock policy; where a constant level of inventory is constantly maintained. The inventory level is decided based on the orders placed but yet to be delivered and net inventory level at the production site (Jung et al, 2007).

4.4 Inventory Management Models

A strategy used in inventory management is the utilization of Vendor Managed Inventory (VMI) in supply chain. The system works on a partnership formed between the vendor and the retailer based on information sharing. VMI focuses on overall inventory optimization while reducing the cost involved in the replenishment of the inventory (Yu et al, 2005). VMI system is based on a centralized replenishment process that enables the vendor to organize their production and distribution process according to customer demand, mitigate bullwhip effect and utilize the benefits of economies of scale (Yu et al, 2005).

Consignment Inventory (CI), unlike VMI provides the customer with an authority over the timing and quantity of replenishments (Gumus et al, 2006). The goods are owned by the vendor until they are used and the goods are stored at customer's premises. The

customer has authority over the timing and quantity of the goods ordered and he pays for the goods only upon the usage or just afterwards (Gumus et al, 2006).

The two methods, when used according to the requirement, can create potential opportunities for cost savings. The implementation of a hybrid model by combining both and extrapolating it over sourcing requirements can help in optimizing the inventory management system.

4.5 Pull Systems

Pull systems focuses on the integration of various elements in the Internal Supply Chain (ISC). Operations like machining, milling, painting and stamping can be easily integrated with various downstream activities like assembly using pull systems (Smalley, 2004). The three basic pull system practiced by manufacturing firms are replenishment pull, sequential pull and mixed pull systems. To connect a batch manufacturing process to the assembly, the replenishment pull system is used in combination with a Kanban system, Signal Kanban, for replenishment of supplies (Smalley, 2004). Sequential pull system integrates the supplier capabilities to the ISC and enables the supply chain to be more responsive. Products are usually made to order while efforts are put towards reducing the overall inventory. An important factor to be noted is the sizeable decrease in lead time that can be achieved using a successful implementation of a sequential pull system (Smalley, 2008).

The consumption of the resources at the facility and the rate of replenishment can be calculated effectively with the help of the analysis of the rate of consumption. We believe

a pull system would help in quantifying the consumption rate for various resources, which in turn will help predict the replenishment requirements efficiently.

4.6 Use of Linear Programming in Scheduling

Linear Programming can be effectively employed in scheduling decisions such as when to make, which product to make, what amount to make, how many working hours should be allotted to produce that product etc. A-1 Jay's Machining Inc. currently manufactures about 15 different products. Currently, the company is not able to freeze its schedule at all due to the variation in demand. The analysis of data of demand for the last three years can be used to forecast demand in the next year and steps can be taken to freeze the schedule for as many times as possible. Linear programming will help find the optimal solution to the problem answering all the questions mentioned above. A set of decision variables, constraints and objective functions need to be formulated before the problem can be addressed.

- The objective function is formed in the following manner:

  e.g. maximize $a_1x_1 + a_2x_2$

- Constraints will be of the following form:

  e.g. $b_{11}x_1 + b_{12}x_2 \leq c_1$

  $b_{21}x_1 + b_{22}x_2 \leq c_2$

  $b_{31}x_1 + b_{33}x_2 \leq c_3$

- Decision Variables will be as follows:

E.g. $x_1 \geq 0$ $x_{2 \geq} 0$

The objective function can be used to maximize profitability keeping the labor hours, delivery deadline and availability of raw materials as constraints. (Chopra et.al, 1970)

4.7 Economic Order Quantity

Economic order quantity is the amount of inventory that must be ordered with an aim of minimizing the inventory ordering and holding cost. It can be calculated as follows:

If

D = Annual Demand

C = Fixed cost involved with every order

H = Annual cost of holding

Then the Economic Order Quantity (Q*) can be evaluated as

$Q^* = \sqrt{2CD / H}$

It is interesting to note that Q*, the economic order quantity does not depend on the purchasing cost, but is a function of the holding, ordering cost and the annual demand. (Chopra et. al, 1970)

5.0 Value Stream Mapping

Value Stream Mapping (VSM) provides a snapshot of the series of processes that occur in the firm, starting from the time a customer order is received till the order is shipped to the customer. An important aspect of the VSM is the ease in identifying value-adding processes and non-value adding processes in any process. The ability to identify value-adding and non-value adding activities helps the businesses in identifying the waste occur in process thereby improving the efficiency of the entire operations at the company.

For the purpose of this project, we started with the mapping of the Current State Value Stream Mapping (CSVSM). The CSVSM provides the comprehensive picture of the daily activities performed at the firm. The mapping is so performed that it helped us identify the steps and the time consumed for each step. Through the careful analysis of the current VSM, we were able to identify the value-adding and non-value adding activities.

Once the CSVSM was created, we were able to identify the possibility of a more efficient Future State Value Stream Mapping (FSVSM). The FSVSM is a revised version of CSVSM, created through a series of discussions with the management and the employees. The discussion with both the parties helped us in identifying the factors that affect the non-value adding functions. With the new details, we explored the possibilities of reducing the non-value adding activities, waste activities, through out the entire process map.

5.1 Current State Value Stream Mapping

The firm currently employs Just-In-Time (JIT) ordering of raw materials and standard parts thereby saving a large amount of capital and time with regards to sourcing. The intensity and variability associated with High Variety Low Volume (HVLV) products makes the scheduling of jobs a Herculean task. Through our analysis of the job scheduling, we realized that this results in a considerable amount of uncertainty in the scheduling. To utilize the efficiency of the supply chain achieved through optimum sourcing, the Internal Supply Chain should also be adaptive and efficient to the same level. According Chitturi et al, (2007), every element of the supply chain should be efficient and symbiotic to enjoy the benefits of a responsive supply chain. For a HVLV environment to be agile, two factors take precedence over the rest.

1. The ability of the supply chain to respond any change in demand, be it expected or unexpected, and provide service in an optimum way
2. The ability to identify and absorb the variations in the supply chain and turn it into opportunities for developing business. (Chitturi et al, 2007)

For the purpose of the project we analyzed a customer order starting from the date the order was placed to the date the order was shipped. With the help of this data the CSVSM was constructed. Based on the mapping, we analyzed the value adding and non-value adding function performed during the entire process. The raw material required is normally sourced from the local supplier, in most of the cases, which helps in reducing

the shipping to a great extend. Simultaneously, the required programming and resource allocation are performed by the MRP department.

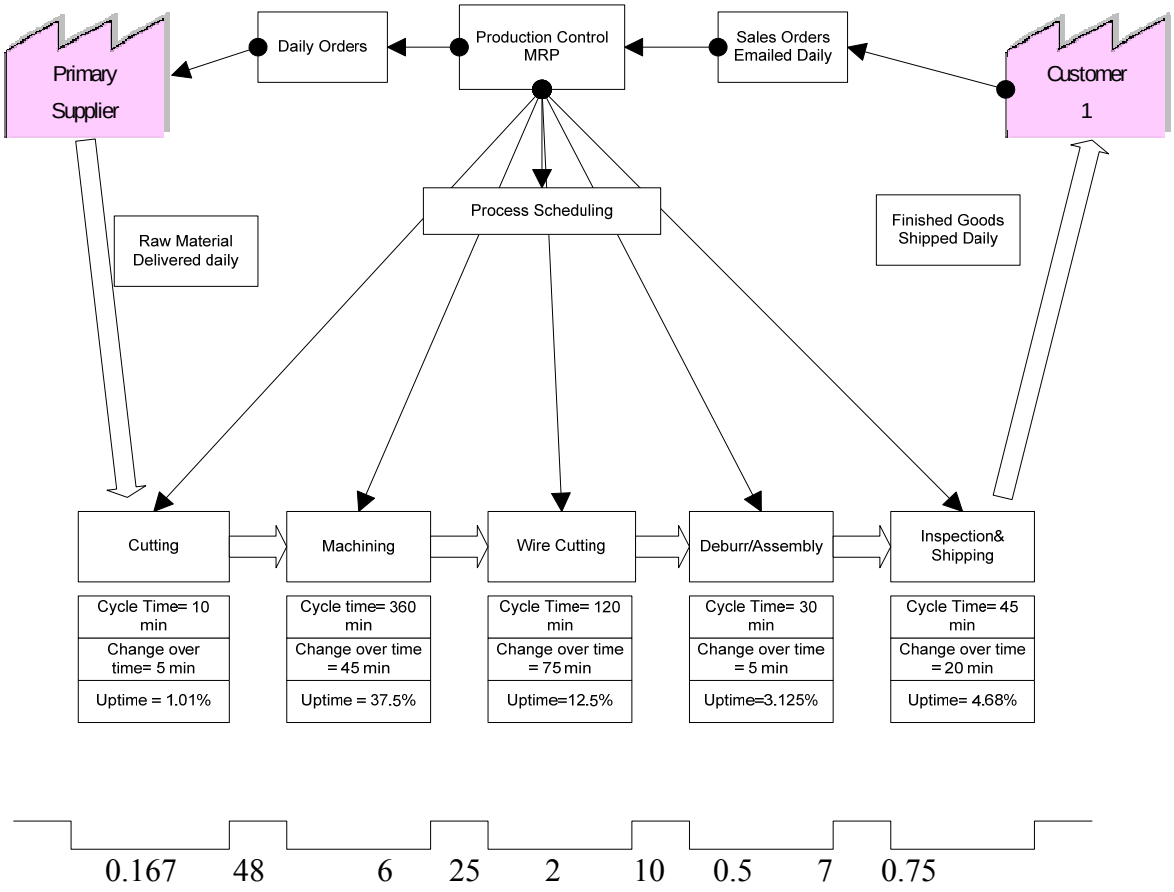


Figure 2: Current State Value Stream Mapping

The CSVSM shown above clearly depicts the production time, value adding time and non-value adding time involved in the processing of the order.

- Production Lead Time = 99.417 hours
- Value Adding Time = 9.417 hours
- Non – value Adding Time = 90 hours

These details provide valuable inputs in constructing an effective and efficient FSVSM.

5.3 Future State Value Stream Mapping

Chitturi et al (2007) suggests a method involving 8 questions to identify the important components of the future state map. The 8 questions are related to various aspects of manufacturing like Takt time, finished goods supermarket, Continuous Flow Processing, supermarket pull systems, pacemaker process, production mixing and process improvement plans. After considering the various factors involved HVLV plants we identified that various factors like involved in the questionnaire are not applicable to the current system.

To identify the improvements for FSVSM, a proactive information gathering is required while the work is in progress. Predictions can be based on past orders for similar products, although not as reliable as a High Volume Low Variability product. The time required for various operations, cycle time, can be derived from previous orders with similar characteristics.

Another important aspect of FSVSM is frequent revision of the existing future value map, enabling the firm to be more proactive in cases of bottlenecks. Work in progress inventories at times become important for the firm when faced with bulk one time orders. For such situations the company can allocate more man-hours into the process thereby avoiding the bottlenecks. These situations happen at random and cannot be planned ahead, but when it occurs the management should be responsible to identify the situation and plan accordingly.

5.4 IT in Supply Chain and Electronic Data Interchange

The growth in IT and data transfer methods can be utilized in a very efficient way to bring together two key elements of the supply chain, supplier and customers. Through the analysis of the inventory at A1 Jays, we explored the opportunities for improving the relationship between supplier and customer. An inventory database accessible by both customers and suppliers can help the firm maintain high levels of service to its customers. The existing system, entirely based on pull system, places the order upon receipt of the purchase order from the customer. The raw materials and standard parts are ordered and according to the specification and processing starts upon delivery. Also an efficient system, the uncertainties in the supply chain attributes to some amount of disruptions in the process. Issues like delay in delivers, delays in secondary supply chains and other situations can lead to delay in production thereby delaying the delivery to customer. The inventory database can lubricate these rare but serious disruptions.

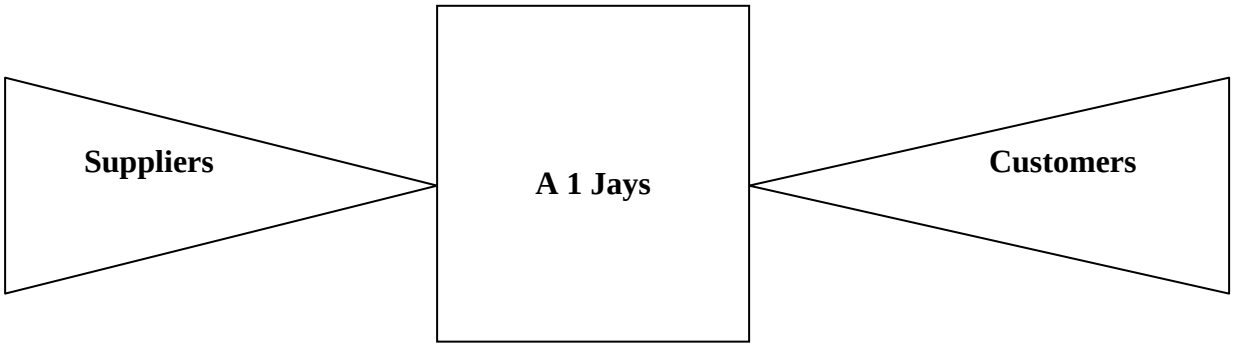


Figure 3: Current Supplier/Customer relations in A 1 Jays for inventory

The above diagram indicates the amount of interaction between the supplier and customers with A1 Jays with regards to the inventory. With the help of an inventory database, the level of interaction between suppliers and customers can be increased

considerably. This will definitely help in bringing a large amount of transparency in operations from the company's perspective. The customers, mostly engineers, can be proactive while designing the required parts with the help of the database. The database will help them choose the readily available materials, resulting in saving a large amount of time with regards to the sourcing. Also for suppliers, the database provides them with enough data to be proactive and help the firm replenish the inventory before they run out of the raw materials.

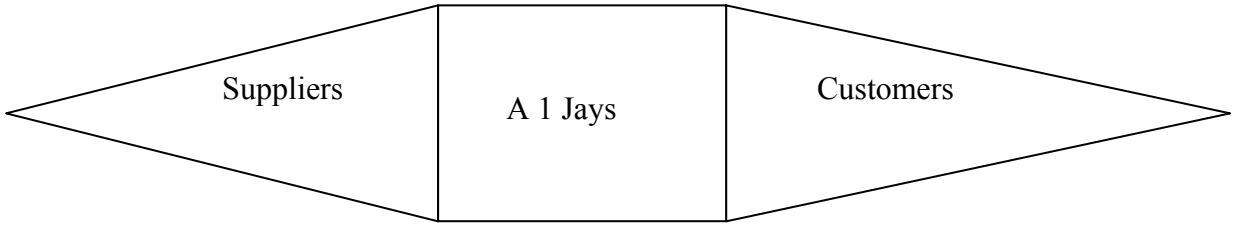


Figure 4: Work relation between suppliers and customers after inventory database

5.5 Value Stream Organization

During the analysis of the process at the firm, we realized that considerable improvement can be brought about by the implementation of cellular manufacturing. Rather than going by the conventional cellular manufacturing methodology, we realized that an implementation of a hybrid cellular structure based on the traditional system based on the process with inlayed lean concepts would suit the organization the best. Various operations like ordering, programming, cutting, lathe, CNC, grinding, assembly and quality etc would be made to work under the guidance of a leader, typically somebody with the longest tenure with the firm. These networks of team-leaders will then co-ordinate the process with the consecutive team members to optimize the utilization of time and resources. Teams that interacts the most, for example programming and CNC, will work together under the guidance of a common team leader to ensure the smooth transition between tasks.(Gumus et al, 2006)

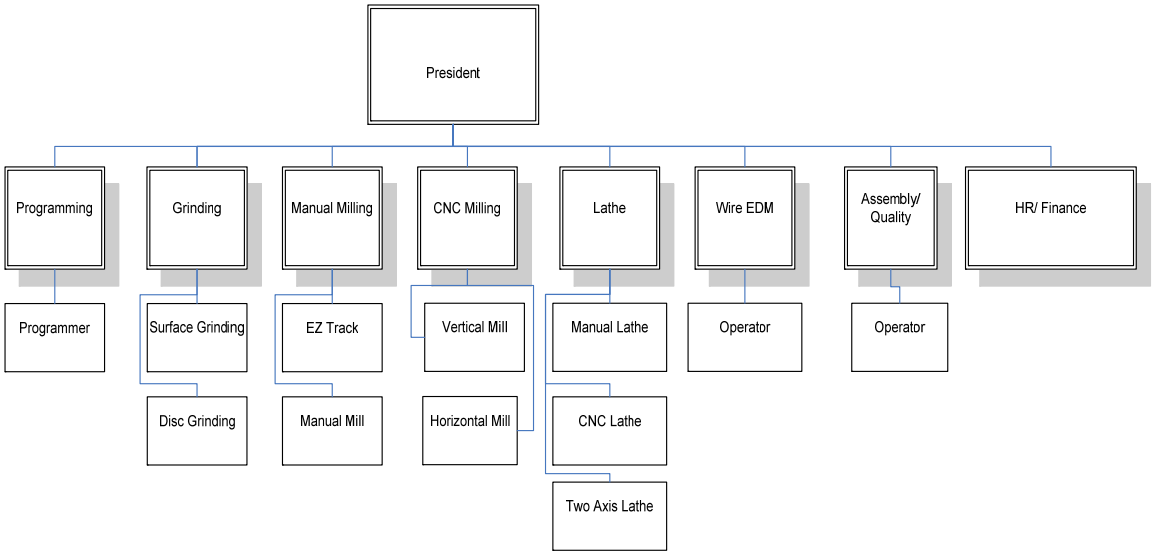


Figure 5: Organizational Structure

5.5 Implementation of Lean Planning

As a part of the implementation of lean ideologies, we suggest the utilization various teams for optimization. The tasks will be distributed between the teams according to the demands of the customer. With the help of teams, a real time of tracking of various operations can be maintained as the process proceeds through time. Under various influential team leaders, the team will work together with other teams towards the most efficient utilization of the equipment time and man-hours. A team meeting at the end of every shift will be conducted on a daily basis to analyze the state of various customer orders.

5.5.1 Visual Aids

The use of various visual aids, separate for each department, will help in identifying the various bottle necks as they occur through the process. Marking boards indicating the status of various processes will be update through out the shift to maintain the most updated status of various processes. Team leaders will be responsible for updating the board on a regular basis. Schemes similar to Ando chords system will help in identifying the bottle necks and can be rectified on a regular basis before the non-conformity travels across the ISCM.

5.5.2 Cellular Manufacturing

Machine utilization being an important matrix in a job shop environment like A-1 Jays were change over time and set up time could lead to increase in both inventory costs and

work-in-progress inventory. The current layout model being a functional one (machines grouped together according to their functionality), the conventional norms of a cellular manufacturing methodology would involve shifting of the machines according to the product flow. For the current level of operations, our team suggests the entrusting the monitoring of the product flow with the team leaders, which in turn will help in monitoring the Internal Supply Chain throughout the product development cycle. A sample sheet that could be used for scheduling is included in the appendix for this report. The highly flexible format can be modified according to the requirement of the operation.

Some factors that influenced our decision to suggest cellular manufacturing were

- The time required for the movement of parts (WIP) between departments
- The unidirectional push system which moves the parts
- The set-up time to processing time ratio variability.

The hybrid model suggested will utilize the benefits of cellular manufacturing but will utilizing the flexibility of functional layout. The transparency achieved by this model will help the optimization of jobs on the floor.

6. Economic Justification

6.1 Executive Summary

Every company wishes to reduce total cost of production, most famous and traditional way to do it is through reduction in manufacturing costs and labor costs. However, other costs as mentioned in the introduction above cannot be undermined either. A-1 Jay's machining currently caters to more than 15 companies and has over 25 suppliers. Inventory of raw materials and finished goods is one of the cost contributors. The company buys raw materials based on a Just in time (JIT) strategy, as many as 28 orders are made every month for a certain raw material. This means that the company has to spend a great deal over transportation of these raw materials. On the other hand, the company has limited space for storage hence holding cost will grow if more quantity is ordered per order. Thus, it is highly desirable to find an optimal number which would reduce the number of orders without increasing holding costs.

6.2 Business Model

The name of our company will be J&J's Consulting Inc. The details of the company will be discussed through the stretch of the economic justification part. In order to see how our company will operate, it is necessary to provide an example of the current work at A-1 Jay's Machining Inc. Required Investments and annual recurring investments need to be worked out and are shown in this section. We consider A-1 Jay's to be our first client and will justify our investments based on the work done at A-1 Jay's. We will put forth our recommendations to the President of the client Company (A-1 Jay's Machining Inc). The client company is the one who benefits from this effort, they can make the

operational changes suggested in the report without any investments, however, huge savings can be made in the future if the company invests in painting equipment, aluminum cutting saw etc. The question then remains whether the management is willing to make these investments for the future. As a consultant group which does not work for the company, our job is to provide an analysis report which gives the economic justification of each and every recommendation. To show the economic justification, we will demonstrate the savings that can be gained by considering the case of one supplier and one raw material. We will also see how our company, J&J's Consulting Inc plans to do business and earn profit. The business plan and model will also be demonstrated with appropriate economic analysis.

6.3 Market Size and Competitors

The Market Size of the Consulting companies in the area of Supply Chain Optimization can be seen from the fact that there are close to 70 companies in the bay area itself. From The average revenue of these companies is about 5 million. The minimum estimated cost savings from a company like A- 1 Jay's is around $100,000 and if all processes and products are looked at and analyzed, we are looking at savings of close to half a million dollars. If our company handles two projects at a time, then our revenue could be between $250,000 and $ 500,000. Our competitors are consulting companies like J. Andrews Associates and Profit Point Inc.

6.4 Estimated cost savings

The total amount that the company would save after implementing the changes suggested by our project group are very difficult to project at this point in time; however, the order of savings can be seen from the following example. In this part we will be focusing on one supplier and one raw material that are purchased from this supplier. This will show the enormous amount of savings that can be derived from vertically integrating the supply chain.

Aluminum is a metal which is used very frequently in almost all products that the company manufactures. The company uses 6061 grade Aluminum for large variety the products. Most orders for the materials come with the bill of materials which specifies the exact specifications of the metallic sheets, plates or tubes. A-1 Jay's Machining Inc buys pre-milled, Aluminum in the form of sheets, plates and bars from another metal supply company. This company provides Aluminum sheets, plates and rods cut to a specific size as per order. The supplier claims that no cutting charges are applied to any orders.

In order to check whether any savings could be made by changing the aforementioned method, we looked at the problem in two ways.

6.4.1 Approach 1

We contacted another metal supply company from the bay area and requested a quote for the same order as sent to the current supplier. The new supplier quoted exact amount that would be charged for the desired specifications of material and tolerances. The following chart provides a sample of the exact specifications of Aluminum ordered in one month. It

also shows the savings that would be incurred if the material was bought from the new supplier.

Thickness	Width	Length	Weight	No of pieces	Current Supplier (USD / lb)	New Supplier 1 (USD / lb)	New Supplier 2 (USD / lb)
0.25	6.7	7.05	12	10	8.04	4.8	4.71
1.125	3.85	4.25	32	11	4.64	3.6	2.95
0.25	15.2	23.8	10	1	7.18	4.8	4.33
0.375	15.1	23.7	27	2	5.25	4.8	4.63
1.125	3.85	4.25	19	10	5.63	3.6	4.52
1.25	10.2	25.9	166	5	3.69	3.08	4.70
1.25	8.1	17.25	88	5	3.91	3.9	5.12
2	7.1	8.1	58	5	4.27	3.9	6.57
2.75	4.25	10.5	123	10	4.06	3.25	4.81
2.75	8.1	9.7	109	5	3.94	3.25	3.43
0.25	18.6	29.5	69	5	3.95	3.6	4.76
0.25	6.7	7.05	12	10	6.42	3.6	4.37
0.5	8.2	20.7	43	5	4.23	3.6	4.70
0.5	6.35	18.25	53	9	4.14	3.6	4.14
0.75	8.1	12.85	40	5	4.32	3.6	4.72
0.75	2.75	7.4	43	28	4.59	3.6	3.92
0.5	16.75	22.35	19	1	5.69	4	3.83
3	8.4	9.8	124	5	3.88	3.8	3.80
3.5	6.5	7.7	88	5	4.01	3.8	3.75
5	5.25	8.35	110	5	3.87	4	4.24
0.65	18.6	47.75	223	4	3.7	3.6	1.91
1.75	27.5	30.5	147	1	3.77	3.6	0.68
4	26	27.5	286	1	3.68	3	0.60
0.25	3.65	6.95	8	12	10.5	4.8	4.55
0.25	2.2	4.1	2	6	21.9	15.3	6.48
0.25	3.65	5.35	3	6	16.8	11.25	14.33
0.437	8.65	9.3	26	7	7.42	3.6	3.71
0.25	4	20.5	7	3	10.76	5.6	6.67
					8065.69	**6936.63**	**6414.7**

Table 1: Samples for aluminum orders to the current supplier

(Source: A-1 Jay's Documents)

The company has purchased 2185 lb of aluminum from current supplier in the past one month with a total cost of $ 9060.2. This means that the cost of Aluminum per pound is $ 4.16. We contacted another supplier in the bay area, and got a quote for the same order

as mentioned above and found that the new supplier quoted $0.58 lesser than the current supplier. The figures quoted by the new supplier are also stated in table 1. From this we can see that total savings for that month would have been $1281.37. In order to calculate further savings, we collected a data for the past 18 months; the following table contains the data for the past 18 months

Month	Amount Spent	Weight	Savings from Supplier 1	Savings from Supplier 2
Jan'08	3000	638.2979	727.6596	900
Feb'08	5521.5	1174.787	1339.257	1656.45
Mar'08	4779.5	1016.915	1159.283	1433.85
Apr'08	6234.2	1326.426	1512.125	1870.26
May'08	11593.2	2466.638	2811.968	3477.96
Jun'08	12527	2665.319	3038.464	3758.1
Jul'08	18517.3	3939.851	4491.43	5555.19
Aug'08	8620.2	1834.085	2090.857	2586.06
Sept'08	30466.3	6482.191	7389.698	9139.89
Oct'08	11775.55	2505.436	2856.197	3532.665
Nov'08	9060.5	1927.766	2197.653	2718.15
Dec'08	699.5	148.8298	169.666	209.85
Jan'09	3266.65	695.0319	792.3364	979.995
$	**126061.4**	**26821.57**	**30576.59**	**37818.42**

Table 2: Projected Savings from Approach 1

If supplier 2 was to be contracted for all the orders, the savings for the past 12 months would have been $ 37818.42. These are the savings only for the orders of Aluminum 6061 plate, the company orders more than 15 different types of metals and alloys, great deal of money can be saved if other options are explored. The projected savings would be even higher if another approach is taken as discussed further.

6.4.2 Approach 2

Instead of buying direct cut material from the supplier, if the company buys Aluminum 6061 in bulk quantity from a wholesaler in plate sizes of 48" X 144" with various thicknesses, the company will save a lot more. The following table shows the analysis for the same. Let us take the example of 0.25" thickness orders for a demonstration of the calculations.

Thickness	Width	Length	Stated Weight (lb)	No of pieces	Current Price (USD lb)	Actual Weight (lb)	Surface area available	Surface area needed	Actual Price (USD/lb)	Difference
0.25	6.7	7.05	12	10	8.04	11.57	48" X 144"	472.35	3.09	60.7287
0.25	15.2	23.8	10	1	7.18	8.86	48" X 144"	361.76	3.09	44.4226
0.25	18.6	29.5	69	5	3.95	67.22	48" X 144"	2743.5	3.09	64.8402
0.25	6.7	7.05	12	10	6.42	11.57	48" X 144"	472.35	3.09	41.2887
0.25	3.65	6.95	8	12	10.5	7.46	48" X 144"	304.41	3.09	60.9486
0.25	2.2	4.1	2	6	21.9	1.33	48" X 144"	54.12	3.09	39.6903
0.25	3.65	5.35	3	6	16.8	2.87	48" X 144"	117.165	3.09	41.5317
0.25	4	20.5	7	3	10.76	6.03	48" X 144"	246	3.09	56.6873
			123			**116.91**	**6192**	**4771.66**		**$410.10**

Table 3: Analysis of a small order to calculate savings

The current supplier as we can see also charges for wastages, but does not show it in the accounts. The actual weight of the parts ordered is 116.91 lb and the stated weight is 123 lb. The supplier currently charges $ 6.59 / lb for the parts of 0.25 thickness, if the company were to use the approach suggested here, the rate would come down to $ 3.09/ lb for 0.25 thickness material. Similarly we calculated for all the orders in the month and found that the supplier charges $ 3.09 / lb on an average for all materials and if our

approach was to be followed, the projected savings on due to this method can be seen from Table 4.

Month	Amount Spent	Weight	Savings from Approach 2
Jan'08	3000	638.2979	1027.66
Feb'08	5521.5	1174.787	1891.407
Mar'08	4779.5	1016.915	1637.233
Apr'08	6234.2	1326.426	2135.545
May'08	11593.2	2466.638	3971.288
Jun'08	12527	2665.319	4291.164
Jul'08	18517.3	3939.851	6343.16
Aug'08	8620.2	1834.085	2952.877
Sept'08	30466.3	6482.191	10436.33
Oct'08	11775.55	2505.436	4033.752
Nov'08	9060.5	1927.766	3103.703
Dec'08	699.5	148.8298	239.616
Jan'09	3266.65	695.0319	1119.001
Total	**126061.4**	**26821.57**	**43182.73**

Table 4: Projected Savings by adopting Approach 2

However, if this approach is to be followed, there will be an investment that would be needed by the company. The investment would be in the form of equipment purchasing, facility modification etc. However, since the orders for this material are bound to increase steadily, this will prove highly beneficial for the company in the long run. Also, the company spends great deal of time and money buying steel from southern California. We spoke to a local supplier and found out that the company could save substantial amount of money by purchasing steel in the bay area itself

The Current direct Cost borne by the company for Aluminum supplies is as follows:

Material	$4.7/ lb
Logistics	$1.3 / mile

Table 5: Cost contributors of Aluminum orders

Actual production can start only 12-48 hours after the company gets the bill of materials from its clients. This is because the company has to wait for the raw material to be procured from the suppliers who need 12-48 hours for processing depending on the order size. At times this could lead to downtime which consumes time, money. It delays the delivery time by even more than time spent waiting for the raw material.

Considering the amount of time and money lost due to this practice is as follows:

	Before	After	Savings
Material	$9,060.00	$4,582.00	$4,478.00
Shipping	$600.64	$133.34	$467.30
Total	$9,660.64	$4,715.34	$4,945.30

Table 6: Expenses incurred over Aluminum for November 2008 and Projected savings

The costs incurred above can be reduced to a great extent if the company decides to stop purchasing the pre-cut Aluminum from current Metal Supplier. Instead the company can buy unprocessed Aluminum from the wholesaler and cut it according to its specifications. This will reduce lead time from 12-48 hours to about 2-5 hours. The reduction in material costs is assured because the Aluminum will be unprocessed. Cost of shipping will

decrease too since the frequency of orders will reduce considerably. Further cost cutting will be seen due to Economy of Scale.

The company will have to make the following investments:

Machinery/Capability	$192,690
Personnel training	$8000
Facility	$25,000

Table 7: Required Investments

The company will have to purchase the machinery needed for cutting unprocessed aluminum into the required size and specifications, skilled workers will also be an integral part of it. The investment in facility development will be on the account of creating more storage space and space for the new equipment to be setup. The machinery and facility development cost will be incurred as a one time cost. The cost / mile of shipping seems to increase, the total cost of shipping will not be as much because the frequency of trips will reduce from once a day (Currently) to once-twice a month. The following table demonstrates the savings in total cost if the company decides to implement this idea.

	Before	**After**	**Savings**
Material	$126,061.40	$82,878.67	$43,182.73
Shipping	$7,207.68	$1,600.08	$5,607.60
Total	$133,269.08	$84,478.75	$48,790.33

Table 8: Annual Savings on Material and Shipping

However, it is important to note that the savings shown above are only with respect to materials and shipping. If we consider the total cost of the venture, then the cost of labor, overhead etc must be considered.

6.5 Profitability analysis for J & J's Consulting Inc

Considering that A-1 Jay's accepts our recommendation and adopts Approach 1. The savings that will be incurred over Aluminum 6061 will be $ 37,818.42 per year. By the end of fiscal year 2009, we plan to check all the materials with similar approach and considering there are 15 different materials which can be looked at, A-1 Jay's could save upto $300,000 a year if it accepts our recommendations. According to our contract, we will receive 50% of the savings for the first three years which amount to $150,000 per year for the next three years only from A-1 Jay's

6.5.1 Investment Required

The consulting firm will initially comprise of two members and will aim to complete the project at A-1 Jay's machining Inc by the end of fiscal year 2009. It will gradually start making contacts with other companies to do similar kind of projects. One or two projects per year would be great to begin with since the business depends on reputation. As the time progresses, more employees will be recruited to be able to handle more projects at a time. The investment will mostly comprise more of recurring annual investment since the only one time investment to be made would be the office set-up and installation of different software for complex analytical procedures. Table.8 shows the investment needed.

Lease	$2,000
Furniture	$20,000
Computers	$2,000
Software	$5,000
Transportation (2 cars)	$40,000
Total	**$69,000**

Table 9: Initial One time investment for J & J's Inc

Annual Recurring Investment for the company will comprise of expenses for the maintenance of cars, updating software, maintaining office space, rent, phone and internet lines etc. Table 9 shows the detailed projected annual expenditure.

Rent	$24,000
Utilities	$3,000
Software Updates	$500
Car Maintenance	$1,000
Office Maintenance	$2,000
Office Supplies	$1,000
Employee Compensation	$130,000
Insurance	$4,000
Total	**$165,500**

Table 10: Projected annual expenditure

6.5.2 Cash – Flow Diagram

Now that we have the total investment, we need to figure out how much capital will be needed at what time during each fiscal year. A cash-flow diagram will prove to be the best depiction of this. Considering that our company needs to get a loan for the amount equivalent to the initial investment and the expenses for the first year which is $ 234,000. Considering that some unforeseen expenses may occur, let us consider that the loan amount will be $250,000. The following figure shows the cash - flow diagram.

The assumptions made while computing the cash flow are as follows:

- $250,000 loan is obtained at 15% interest rate
- The loan is repaid in four years time in equal installments
- The annual recurring expenses increase by 5%
- The Income of the company increases by $100,000 after 1st year and $ 50,000 there on
- No new employees are hired until the year 2015
- Two new employees are hired in the year 2015 each with a Salary of $60,000 per year
- The Increment in salary of current employees depends upon the increase in expenses. However, care will be taken that the increment in recurring expenses will not go beyond 5% due to increment in salary.

	2010	2011	2012	2013	2014	2015	TOTAL
Beginning Cash Balance	$0	$109,500	$133,035	$251,456	$464,610	$772,338	
Cash Inflows							
Bank Loan	$250,000	$0	$0	$0	$0	$0	$250,000
Income	$150,000	$250,000	$350,000	$450,000	$550,000	650,000	$2,400,000
Total Cash Inflow	$400,000	$250,000	$350,000	$450,000	$550,000	$650,000	**$2,650,000**
Available Cash Balance	$400,000	$359,500	$483,035	$701,456	$1,014,610	$1,422,338	
Cash Outflows							
Initial Investment	$69,000	$0	$0	$0	$0	$0	$69,000
Recurring Expenses	$165,500	$170,465	$175,579	$180,846	$186,271.70	$311,859.90	$1,190,522
Bank loan Repayment	$56,000	$56,000	$56,000	$56,000	$56,000	$0	$280,000
Total Cash Outflow	$290,500	$226,465	$231,579	$236,846	$242,272	$311,860	**$1,539,522**
Ending Cash Balance	$109,500	$133,035	$251,456	$464,610	$772,338	$1,110,478	

Table 11: Cash – Flow Diagram

Based on the predictions, assumptions and the Cash – Flow obtained, we can see that by the year 2015, the company will start having a sizeable balance even after employing two new employees. This should give the company an opportunity to start marketing aggressively and handle as many projects as possible. This is the time when the company has the resources to start venturing out into new businesses such as other services required by the clients. This can be done by carrying out surveys with current and past clients over the services that they desire from a Consulting company. A profit and loss statement will show put more light on the available resources.

6.5.3 Profit and Loss Statement

We need to calculate the revenue generated, profit earned etc. The profit and loss statement will show us the Net Income after tax in order to see the exact amount that will be available to us by the year 2015. There are certain assumptions that must be made before computing the Profit and Loss statement.

The assumptions are as follows:

- Income tax = 33% of Net Income
- Revenue to increase by $100,000 each year, considering the company gets one project each year.

	2010	2011	2012	2013	2014	2015
Revenue	$150,000	$250,000	$350,000	$450,000	$550,000	$450,000
Costs						
Fixed	$56,000	$56,000	$56,000	$56,000	$56,000	$0
Variable Costs	$165,500	$170,465	$175,579	$180,846	$186,271.70	$311,859.90
Total Costs	$221,500	$226,465	$231,579	$236,846	$242,272	$311,860
Net Operating Income (Loss) without tax	($71,500)	$23,535	$118,421	$213,154	$307,728	$138,140
Tax	0	$7,766.55	$39,078.93	$70,340.72	$101,550.34	$45,586.23
Net Income (Loss) after tax	($71,500)	$15,768	$79,342	$142,813	$206,178	$92,554
Cumulative Net Income (Loss)	($71,500)	($55,732)	$23,611	$166,423	$372,601	$465,155

Table 12: Profit and Loss Statement

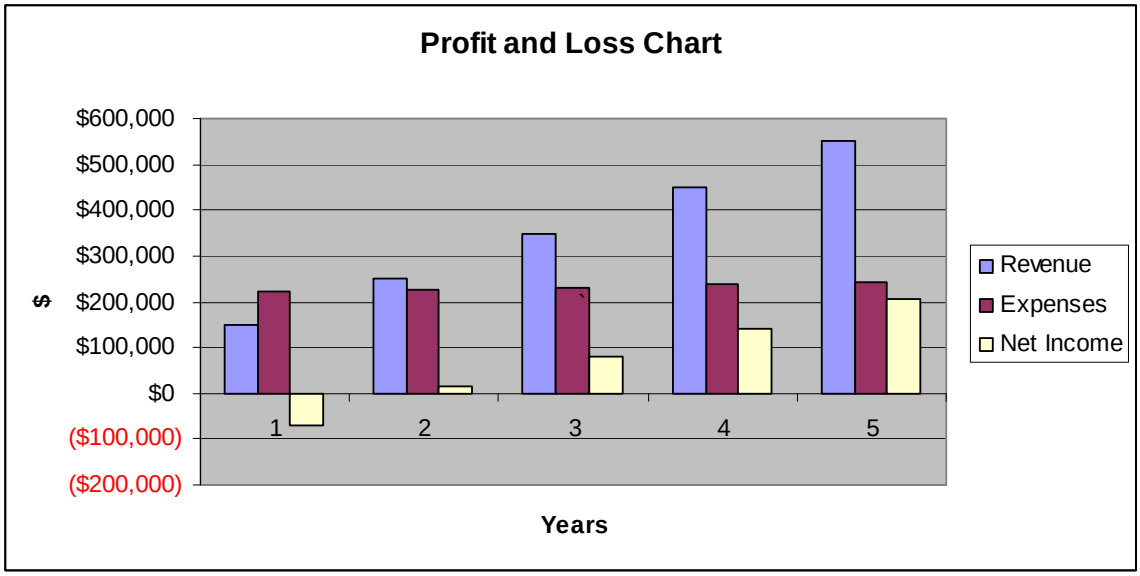


Figure 7: Profit and Loss Chart

6.5.4 Break Even Analysis

The following plot shows the break –even analysis for the investment proposed above. It takes into account the following

- Initial Investments
- Annual Recurring Costs
- Profits earned by the company amounting to the revenue
- The amount to be repaid along with interest for the loan that will be taken

From the plot below, we can see that the break-even occurs after a period of two and a half years which is around the tenth quarter. The break-even analysis was done considering that the company gets business from at least one other client during the next two years.

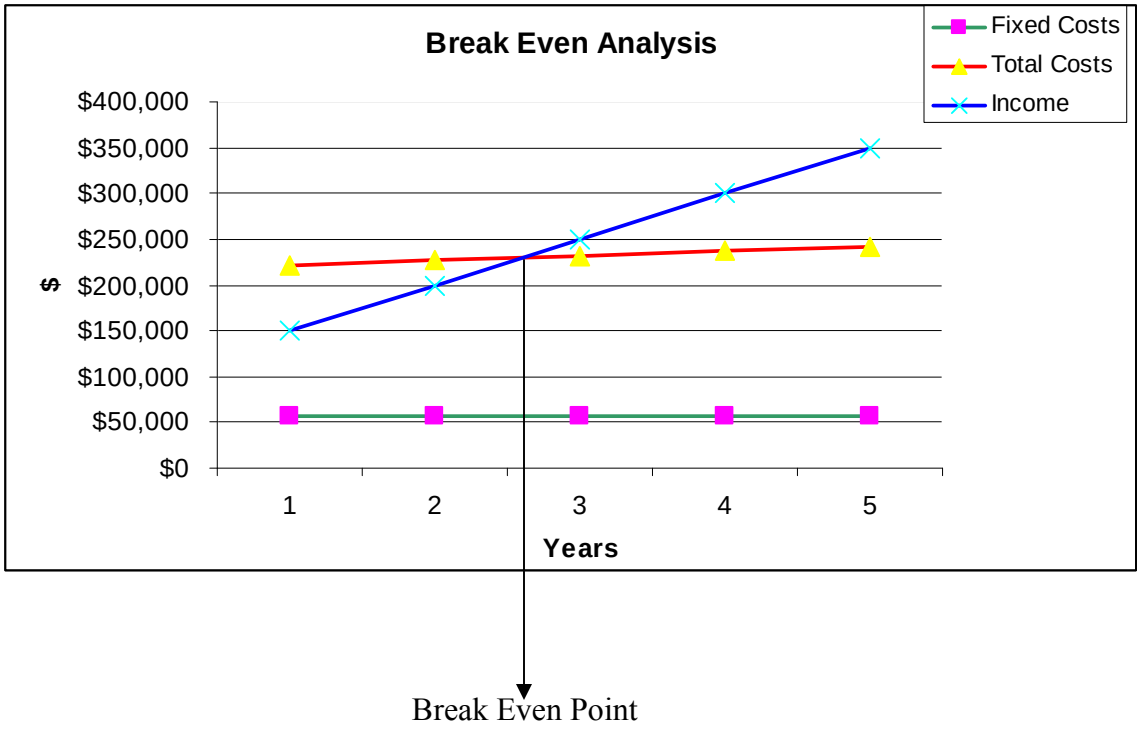


Figure 6: Break Even Analysis

6.6 Return on Investment

$$\text{Return on Investment (ROI)} = \frac{\text{(Total Revenue – Total Cost)}}{\text{(Total Cost)}}$$

Year	Total Cost ($)	Revenue ($)	ROI (%)
2010	221500	150000	-0.3228
2011	226465	250000	0.103923
2012	231579	350000	0.511363
2013	236846	450000	0.899969
2014	242272	550000	1.270176

Table 13: Return on Investment (ROI)

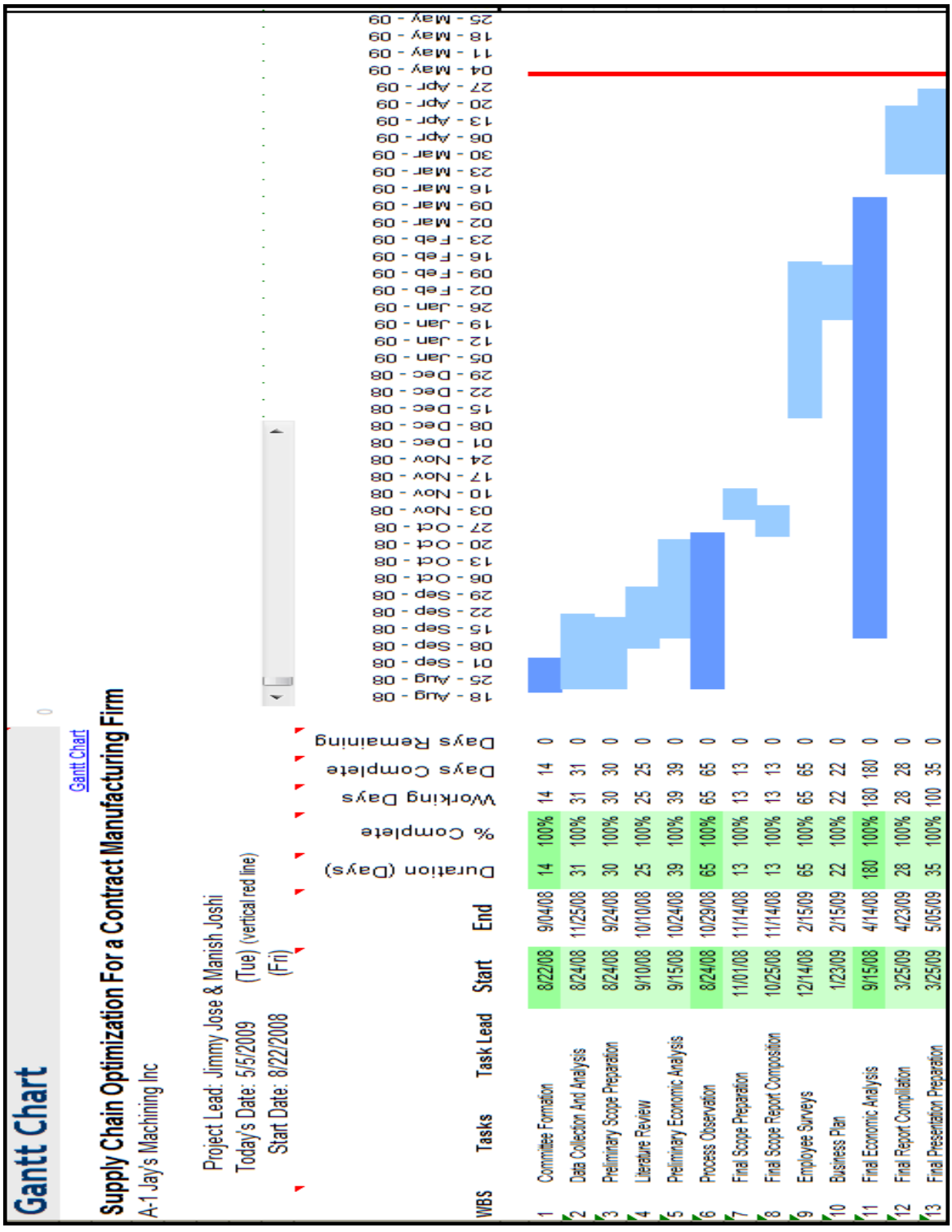
6.6 Exit Strategy

We have two options when adopting an exit strategy for our company

- Sell it to a bigger player in the market
- Go public

The decision on whether to sell it completely or allow sale of certain percentage of shares in public will depend on the way the company does business. It will also depend on whether the firm makes profit and how much value will the company earn over the next five years. The first strategy would be a good option in case if the company is doing good gains enough potential to be sold at a price which will recover the investments and be greater than the revenue that would be generated in the next two years. However, looking at the economic analysis done above and the fact that both the owners actually want to expand the business further, going public would be a better option.

7. Project Schedule



8. Committee Structure

- **Team**
    - Manish Joshi
        - Background: Pursuing MSE Engineering Management at San Jose State University.
        - Responsibilities: Develop linear programming techniques according to requirements, project documentation, and attend meetings with project committee.
    - Jimmy Jose
        - Background: Pursuing MSE Engineering Management at San Jose State University
        - Responsibilities: Perform economic analysis and analyze the financial documents, project documentation, and attend meetings with project committee
- **Committee**
    - Mr. James Machathil : Industrial Sponsor (A1- Jay's Machining Inc.)
        - Background: President of A1 Jay's Machining Inc.
        - Responsibilities: To analyze and review the team's work and provide required technical and economic assistance. Industrial Advisor also verifies the technical content before the submission of each report.
    - Dr. Jack McKellar: Faculty Advisor (San Jose State University)
        - Background: Full time Faculty 100W and 200W, SJSU

- Responsibilities: To make sure that the project report generated follows the guidelines of the APA format and meets the expectations of the University's standards for a Master's Project.

9. Conclusion

Refinement of preliminary scope was the major objective that was achieved during the completion of this report. A careful analysis of the time and resources at hand was necessary in order to allocate these in a proper way. Optimization of Inventory is our main objective for this project. Our group began with as many as six different objectives to be achieved and we narrowed it down to the one which is a key to achieve all other objectives. The economic analysis shown in this report is a sample of the analysis that our project group will be performing for A-1 Jay's Machining Inc. Our aim is to look at all the processes that contribute towards increased lead time, slower response time, high costs and high downtime. Our future work will involve analyzing the costs involved with other raw materials. Customer and employee survey is the next step on the agenda. Based on our findings, our group plans to make recommendations to the company which if implemented will result in heavy savings in the near future. The most important aspect of this project was the launching of J & J's Inc. The brainstorming done for the resources needed and the strategy adopted along with the Economic Analysis put forth in the form of Profit & Loss Statement, Break-even analysis, Cash – Flow chart etc. will go a long way to help us implement the idea practically in the future.

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Appendix

1. Price Quote from a Local Supplier for Aluminum 6061 T6

Metal Supermarkets SantaClara
705 Comstock
SANTA CLARA, CA
95054

Phone: (408) 654-9177
Fax: (408) 654-9669

The Convenience Stores For Metal®

Printed on 27-Apr-2009 09:57

QUOTE 106307

Date 27-Apr-09

Bill to:
JIMMY JOSE
Shipment to: JIMMY JOSE

P.O.#	Shipment	Terms
	Pick-Up	CREDIT CARD

Sales Rep: Bill

Qty	Product	Lgth Unit	Unit Price	Comment	Total
10	APplsi/250 Al. PLATE 6061T651 .250	0.33 SQ FT	17.2334	10 @ 6.7"X 7.05"	$56.53
11	APplsi/1125 Al. PLATE 6061T651 1.125	0.11 SQ FT	75.3367	11 @ 3.85"X 4.25"	$94.47
1	APplsi/250 Al. PLATE 6061T651 .250	2.51 SQ FT	17.2342	1 @ 15.2"X 23.8"	$43.29
2	APplsi/375 Al. PLATE 6061T651 .375	2.49 SQ FT	25.1380	2 @ 15.1"X 23.7"	$124.94
10	APplsi/1125 Al. PLATE 6061T651 1.125	0.11 SQ FT	75.3391	10 @ 3.85"X 4.25"	$85.89
5	APplsi/1250 Al. PLATE 6061T651 1.250	1.84 SQ FT	85.0279	5 @ 10.2"X 25.9"	$780.13
5	APplsi/1375 Al. PLATE 6061T651 1.375	0.97 SQ FT	92.9074	5 @ 8.1"X 17.25"	$450.60
5	APplsi/2750 Al. PLATE 6061T651 2.750	0.40 SQ FT	191.0220	5 @ 7.1"X 8.1"	$381.09
10	APplsi/2750 Al. PLATE 6061T651 2.750	0.31 SQ FT	191.0208	10 @ 4.25"X 10.5"	$592.16
5	APplsi/250 Al. PLATE 6061T651 .250	0.55 SQ FT	17.2347	5 @ 8.1"X 9.7"	$47.05
5	APplsi/250 Al. PLATE 6061T651 .250	3.81 SQ FT	17.2333	5 @ 18.6"X 29.5"	$328.29
10	APplsi/500 Al. PLATE 6061T651 .500	0.33 SQ FT	34.2788	10 @ 6.7"X 7.05"	$112.43
5	APplsi/500 Al. PLATE 6061T651 .500	1.18 SQ FT	34.2761	5 @ 8.2"X 20.7"	$202.06
9	APplsi/750 Al. PLATE 6061T651 .750	0.81 SQ FT	52.2225	9 @ 6.35"X 18.25"	$378.35

Partial Selection is subject to relvid / Subject to availability at time of order This quote is valid for 1 Days ONLY

Metal Supermarkets SantaClara
705 Comstock
SANTA CLARA, CA
95054

Phone: (408) 654-9177
Fax: (408) 654-9669

Printed on 27-Apr-2009 09:57

QUOTE 106307

Date 27-Apr-09

Bill to:
JIMMY JOSE
Shipment to: JIMMY JOSE

P.O. #	Shipment	Terms
	Pick-Up	CREDIT CARD

Sales Rep: Bill

Qty	Product	Lgth Unit	Unit Price	Comment	Total
5	AP6061/750 AL PLATE 6061T651 .750	0.72 SQ FT	52.2199	5 @ 8.1" X 12.85"	$188.77
28	AP6061/625 AL PLATE 6061T651 .625	0.14 SQ FT	42.7275	28 2.75" X 7.4"	$168.69
1	AP6061/4000 AL PLATE 6061T651 4.000	2.60 SQ FT	277.9101	1 @ 16.75 X 22.35	$722.57
5	AP6061/750 AL PLATE 6061T651 .750	0.57 SQ FT	52.2193	5 @ 8.4" X 9.8"	$149.35
5	AP6061/2000 AL PLATE 6061T651 2.000	0.35 SQ FT	138.9313	5 @ 6.5" X 7.7"	$241.74
5	AP6061/250 AL PLATE 6061T651 .250	0.30 SQ FT	17.2276	5 @ 5.25" X 8.35"	$26.19
4	AP6061/250 AL PLATE 6061T651 .250	6.17 SQ FT	17.2332	4 @ 18.6" X 47.75"	$425.18
1	AP6061/250 AL PLATE 6061T651 .250	5.83 SQ FT	17.2335	1 @ 27.5" X 30.5"	$100.39
1	AP6061/500 AL PLATE 6061T651 .500	4.97 SQ FT	34.2760	1 @ 26.0" X 27.5"	$170.18
12	AP6061/250 AL PLATE 6061T651 .250	0.18 SQ FT	17.2347	12 @ 3.65" X 6.95"	$36.40
6	AP6061/500 AL PLATE 6061T651 .500	0.06 SQ FT	34.2857	6 @ 2.2" X 4.1"	$12.96
6	AP6061/4500 AL PLATE 6061T651 4.500	0.14 SQ FT	317.4040	6 @ 3.65" X 5.35"	$259.00
7	AP6061/1000 AL PLATE 6061T651 1.000	0.56 SQ FT	4.7468	7 @ 8.65" X 9.3"	$18.57

Partial Selection is subject to rebid / Subject to availability at time of order **This quote is valid for 1 Days ONLY**

Metal Supermarkets SantaClara
705 Comstock
SANTA CLARA, CA
95054

Phone: (408) 654-9177
Fax: (408) 654-9669

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Add'l Cost

Sub TOTAL	$6,197.28
Add'l Costs	$0.00
Taxes	$511.28
TOTAL	**$6,708.56**

jimmy.jose@students.sjsu.edu
PLEASE ALLOW 3 - 4 DAYS ARO
ALL CUTS +0.060/-0.000

Partial Selection is subject to rebid / Subject to availability at time of order **This quote is valid for** 1 **Days ONLY**

2. Scheduling Sheet based on the new team structure.

SCHEDULING SHEET

ORDER NUMBER :

CUSTOMER :

DELIVERY DATE :

MATERIALS :

OPERATIONS REQUIRED :

PROJECT PHASE	START DATE	END DATE	SIGNED BY	COMMENTS
Phase 1				
Phase 2				
Phase 3				
Phase 4				
Phase 5				
Checkpoint				