INVENTORY AND PURCHASING AT THE TMI SYSTEMS DESIGN CORPORATION: ANALYSIS USING A LOGISTICS PERSPECTIVE

By

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Staff Paper No. 125
January 1995

ACKNOWLEDGEMENTS

This project was conducted to provide insight into current practices and procedures of the logistical functions of the TMI Systems Design Corporation. This project was made possible through the cooperation of the Upper Great Plains Transportation Institute and the TMI Systems Design Corporation. Specifically, special thanks goes to Deunis Johnson and George Unruh at TMI for their cooperation in this study.

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SUMMARY

TMI has one focus: the customer. This shows in the product they produce and in their commitment to satisfying the customer. This is clearly evident in the production process itself, where the two main sources of information are the production schedule and the materials take-off (MTO). The production schedule is "when" the customer wants the product, while the MTO is "what" they want. However, uncertainty exists among both of these items. This uncertainty has created a multitude of challenges to the existing logistical system. The predominate one is a high level of inventory.

Substantial reductions in inventory could be realized by coordinating the delivery of raw materials with production. This cannot happen unless the actual production schedule is set weeks in advance. However, changing the production schedule changes how all the supporting functions operate. Similarly, if the MTO changes, the wrong materials or incorrect amounts may be ordered. Thus, production is effected. A cause/effect relationship exists where changing one parameter affects the entire system. Quite simply, what is required is an improved set of coordinated procedures which leads to a more organized process. A good logistics process depends on a "flow" of information and materials. This procedure exists at TMI, but it needs to be channeled differently.

The challenge to TMI is maintaining its flexibility to the customer while reducing inventory and total logistics costs. TMI needs to formulate a logistics plan encompassing a multitude of functions including purchasing, sales, production, and transport. Second, a sound logistics plan should address the following:

1. Establishing an "as set as" possible production schedule.
2. Obtaining a more accurate MTO, further in advance.
3. Using the most current and accurate information.
4. Ordering input materials, minimizing their lead time.
5. Negotiation of long term sole source contracts.

TMI can improve inventory management practices by using selected information in order to reduce cost. TMI has a good inventory system in place. Although the information is certainly accurate enough to realize some cost savings, the logistics and inventory processes are under-managed. The purchasing department has neither the time nor the resources available to research the possibilities of reduced inventory levels. One individual should be dedicated to supplier relations, contract and price negotiations. This creates a tremendous opportunity for substantial cost savings.

INTRODUCTION

The purpose of this paper is to evaluate and make recommendations about the current inventory management system at TMI Systems Design Corporation. The goal is to apply a logistics management perspective to current procedures. Logistics is "the process of planning, implementing, and controlling the efficient, cost effective flow and storage of raw materials, in-process inventory, finished goods, and related information from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements".[1] Logistics is important because it provides a company wide perspective on business. It is concerned with the processes and flow of information as well as the interactions of different logistical functions. Additionally, it takes a total system cost perspective into the analysis. At any given customer service level, management should minimize total logistics costs rather than attempt to minimize the cost of individual parameters.[2] In applying this approach, the following topics will be covered in detail:

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[1] Lambert, Douglas M. and James R. Stock, *Strategic Logistics Management.* (Homewood, IL.: Irwin Inc., 1993) p. 4

[2] Ibid. p. 30

- An overview of the current inventory management system, including "green tag" inventory will be presented.
- A complete review of current available inventory management information will be conducted.
- Conclusions and recommendations on the current system including inventory information and cost analysis will be presented.

TMI Systems Design Corporation, located in Dickinson, North Dakota, is a manufacturer of modular laminate casework, cabinetry, and countertops. Primary customers are service businesses, schools, and hospitals. Product distribution is nationwide with 1993 sales of $23 million. They employ 290 full time employees, and during the summer months (peak season) as many as 340. Daily output is approximately $100,000 per day. This is accomplished with two shifts working a combined 18 hours per day. TMI also has an architectural woodworking division (AWD) which builds large and unique, countertops and cabinetry. Ordinarily, these jobs could not be completed as the regular casework. The company owns their own transport company consisting of 21 tractors and 32 trailers. They haul both the finished product and on the back haul raw materials. In the last five years the company has experienced tremendous sales growth.

DISCUSSION

The production process begins well before a job has been secured. Architectural plans for the proposed casework are sent to an estimator who manually estimates the value of proposed casework for the job. The proposal is then submitted to the customer for approval. If the job is awarded to TMI, drafters make computer-aided-design (cad) drawings of the casework, specifying the dimensions and type of unit to be used. Then, drawings are sent to detailers who estimate the quantity, type, and cost of materials needed for the job. This is when a materials take-off order (MTO) is written up. The MTO lists the number and quantity of each part needed to complete a job. At this point materials are ordered.

For some materials, depending on the lead time and reputability of the supplier, materials are ordered optimizing their lead time requirements. Ordering begins approximately six weeks before the job start. The detailer's final task is to make shop orders detailing the actual production process for the casework. The complete production process is shown in Figure 1.

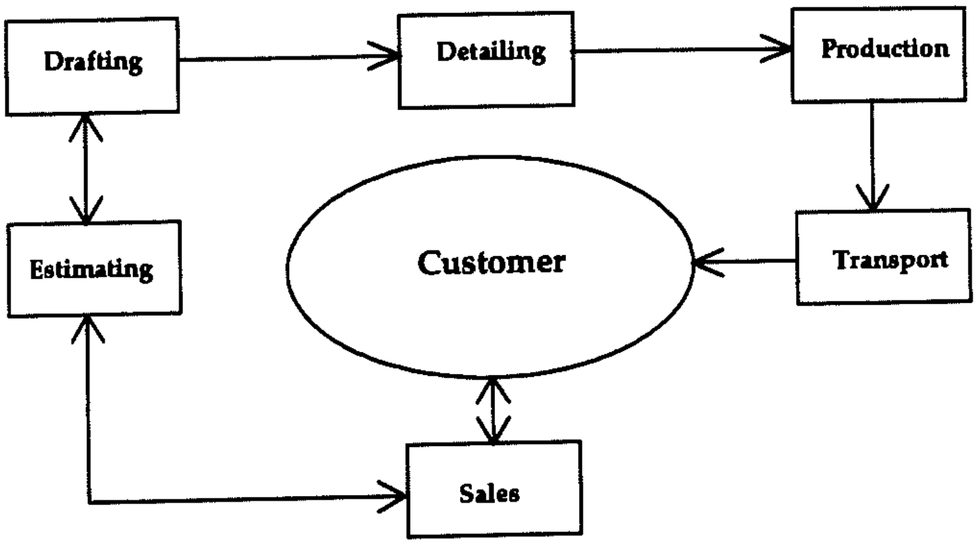

Figure 1 TMI Production Information Flow Diagram

At TMI, all work is considered custom order. Although there are standard caseworks from which to choose from, the numerous dimensions and options available, including pulls, slides, and colors, create millions of different combinations for even the most basic drawer/cabinet set. This in itself creates a formidable task to maintain an adequate stock of these varying input supplies. The current lead time during summer months for manufacture is about 60 days. This is from the time the sale is made to final delivery. It can take the plant up to four days to produce one order depending on the size of the job. The plant is designed so many different orders can be worked on at one time and finished the same day.

A computer database contains all of TMI's inventory information. Individual reports can be generated from the information. The following is a list of frequently used reports:

1. Inventory master file
2. Detailing file
3. Materials requirements by part number
4. Purchase order entry/update
5. Daily receiving entry and report
6. Daily issuing entry and report
7. Weekly and month end reports

The purchasing department relies on two main sources of information. First is the computer generated list of material requirements by part number. Under each part number, job numbers are listed with the quantity of that part required. The list is generated by compiling all of the MTO's of pending or current projects. As a new job is MTO'd, its material requirements are added to the list. Also, as jobs are completed, they are removed from the list. A sample of the list is shown in Figure 2. Also shown is the quantity on hand (408), on order (280), and net amount left (406) for that period. This is calculated by adding the number on hand and on order (688), then subtracting the quantity required (282), yielding the difference (406).

Part #	Description	Period Requested	Job #	Qty. Required	On hand	On Order	Difference
2-100-489	1 3/16" Particle Board.		8938	1			
			5931B	1			
			8910	6			
		8/14/94 to 8/28/94	Total	282	408	280	406

Figure 2: Material Requirements by Part #

The second printout used is the order report for minimum stock items. This is a listing of input materials for which a minimum stock amount is desired. It consists of "bulk" or common items that the plant uses large amounts of or in many different orders. A sample stock order report is shown in Figure 3. Part numbers are listed with a description, followed by the unit of measure (U/M), the total measure (M/F), cost per unit ($U/M), minimum stock, and quantity on hand. For the 1 3/16" particle board, the unit of measure is "SF" meaning square foot. The sheet is 4 x 8 feet and therefore has total measure of 32 square feet. It costs $0.5568 per square foot with a minimum stock of 80 sheets and the quantity on hand is 268 sheets. For the hex bolt, it is purchased "EA" or each at $0.0555 per. For the items on this listing, if the quantity on hand drops below the minimum, a warning flag appears on the right hand side showing how many short of the minimum the supply is. This indicates to the purchasing manager to order more of that product. The minimum stock number is based on previous usage and lead time of the supplier.

Part #	Description	U/M	M/F	$U/M	Min. Stock	Qty. on Hand
2-100-489	1 3/16" Particle Brd.	SF	32	0.5568	80	268
4-000-201	5/16-18 x 1" Hex Bolt	EA	01	0.0555	500	1500

Figure 3: Minimum Stock Report

To keep better track of inventory, a "Green Tag" program was instituted several years ago. A small removable green tag is placed on some of the input items used and states the part number, a description of the item, and quantity in the package. The idea behind the program is when someone in the plant needs one or more of an item that is green tagged, the sticker is removed and later entered into the computer inventory system and credited to a certain job. Green tags were initially on bulk hardware items such as pulls, slides, staples, hinges, guides, screws, etc. The tags are not on the individual items but on the respective container or package the materials arrived in. The problem this created was when a job required, for example, 35 of a certain type of hinge and they were received in boxes of 25, two boxes were issued out. This meant inventory reflected a decrease of 50 hinges when there would actually be 15 left over that could be used on the next job. This artificially increased the long term inventory levels, since short run inventories would indicate a usage of 50 hinges. TMI would reorder based on this count without compensating for the amount left over.

Another problem occurred when boxes of items were taken and the green tag was not removed. This was a recurrent problem in the hardware room. It had the opposite affect as above in that inventory would indicate an adequate number of an item, when in fact a shortage existed. The hardware room problem has been curtailed since two full time people have been added and a counter installed. Many supplies are now issued out in job specific quantities, or for bulk materials, they are issued to a dummy job number as miscellaneous hardware supplies. The addition of the two hardware people, has eliminated green tags from several hardware items such as hinges and slides. These are now manually counted out and exact numbers are issued. Additionally, the accuracy of the inventory information has improved.

Another important input item green tagged is PVC plastic banding or edging. Banding is used to cover the exposed particle board edges and is a unique input into TMI's manufacturing process. It is used in nearly all jobs, primarily on the sides of countertops, drawers, and doors. It is shipped in rolls of 300, 600, or 1000 foot and is in either 3 mm or 1 mm widths. In recent years there has been a trend to match the banding color with the countertop color. This has meant having to order and stock hundreds of different colors of banding. Although each job only requires a certain linear footage of banding, problems arise when entire rolls are issued out by green tags. For example two feet may be needed but a 300 foot roll is issued and recorded. The inventory management system then shows a roll has been used when, in fact, 298 feet are left over and can be used on the next job.

Keeping track of banding usage, in order to have adequate supply, is a challenge. When a job is MTO'd, an estimate of banding required is known; however, it is not a truly accurate count. Although the MTO is a close estimate of materials required, requirements frequently change from the time of MTO to manufacture. Compounding this is the fact that an uncertain number of re-cuts exist on nearly all jobs. Additionally, there are many reasons that require a job to be re-banded. With all these potential problems, the situation has become quite uncertain. Because of this uncertainty, some banding must be held as inventory. Further complicating the process, banding suppliers have a six week lead time. Standard colors such as black, gray, and white are always stocked, but nonstandard colors must be ordered according to the MTO. All banding is issued non-job specific.

Particle board, laminate, liner, and glue are all under the direction of the cutting foreman. This individual will receive a "lay up" order for each job. This shows the number and type of board and laminate required for a particular job. However, if all the laminate is not available for a job, the entire cutting job may be put on hold. In this case, the next job order on the list is brought up. However, when a job is moved up in the production schedule the materials for this a job are required earlier than expected. In this case, materials designated for another job may be used. That job is "shorted" and perhaps delayed until the materials arrive. One alternative is ordering input materials further in advance. Consequently, this raises inventory levels and costs. If the job is very large, and only a few pieces are not present, the job will probably go ahead anyway. This is at the discretion of the cutting foreman. When each board and laminate used in a particular job is pulled out of stock, it is issued to that job and recorded in the inventory system. This procedure is performed daily.

Currently, updating inventory, including green tags, is a key punch task performed by a number of people throughout the company. This task is performed daily. Quantities on hand, on order, and required are updated as orders are placed and received, as material issued are keyed in, and as MTO's are completed. A master inventory list is tabulated every Friday and the two printouts described previously are produced. Items that indicate shortages or outages are then ordered. Inventory on hand is compared to future job requirements and orders are placed accordingly with overages included to cover uncertainty in the manufacturing process.

Green Tag Analysis

Green tags are somewhat effective as an inventory ordering tool; however, they do not provide any incentive for cost savings. It is useful for the person who performs key punching, reminding them what has been issued out. The major drawback, however is that they issue out based on respective package size. As mentioned previously, the inventory count would be inaccurate resulting in shortages or overages. It should be noted that exact counts are perhaps impossible and even unnecessary in bulk items such as screws, staples, bolts, etc. These bulk items are ordered based on minimum values and are not substantial contributors to inventory values. Therefore, green tags function well with these items. However, an inventory management system should reflect the most accurate count possible of all items.

Some hardware items that have green tags are being converted to specific issuing by job. Some bulk items still are and will continue to be issued by the package. The possibility exists of issuing by a smaller quantity, and thus reflecting a more accurate count.

Currently, banding is issued by the roll, non-job specific, to the dummy job number 9930. A future consideration has been to issue banding job specific, but with the uncertainty involved and lack of accurate count, the task would be difficult. Keeping an accurate count would be the first challenge. A rough usage could be tabulated from the edging requirements sheets. By using these requirements, the inventory could be updated as it passes through the plant. Complicating the process, there are five banding machines. Each one may do part of a job, and potentially, this could result in false counts if part of a job is processed and another part is not. One possible exact method is by counting banding as it comes off the roll, possibly, an expensive endeavor. With some ingenious automation it could happen, but requires serious study as to its benefits versus the costs.

A bar code added to the green tags could provide a potential testing ground for an automated inventory system. Since the tags are already affixed to hardware items, they could be tabulated using the hardware room's scanner. This would present a test of the efficiency and challenges involved in starting an automated inventory system.

Purchasing and Inventory Analysis

A purchasing and cost analysis of minimum stock items was performed. There were two objectives. The first was to calculate an economic order quantity (EOQ), safety stock, and reorder point, and the second, to compare the theoretical values to the actual values. The intent of this analysis was to present a method based on statistical probability for comparison to the actual minimum stock values used. Possibly more non-stock items could be converted to minimum stock items; however, evaluation and testing of this method is required before implementation.

The cost of carrying inventory has a direct impact on the profitability of a company. It is among one of the highest costs to a firm, ranging from 30 to 70 percent of current assets. This only amplifies the need to accurately calculate and interpret its significance to the company. A reliable carrying cost will include the following: capital costs, inventory service costs, storage space costs, and inventory risk costs.[3] The best estimate of the inventory carrying cost at TMI is approximately 25 percent. This includes 20 percent for the opportunity cost on lost capital as well as five percent to cover taxes and risk cost. This is a conservative estimate and represents TMI's cost to hold inventory.

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[3] Robeson, James F. and Robert G. House. *The Distribution Handbook*. (New York, NY: The Free Press, Macmillan, Inc.), p. 619.

A conservative estimate of $5 was used for the order cost. This includes a number of individual costs. Figure 4 shows the parameters used in the analysis. Assumptions were made concerning wage rates and times of job tasks. Emphasis was placed on the analysis itself rather than exact determination the individual parameters.

Ordering Cost	Cost	Time (minutes)	Wage rate
Phone Call/Fax	$1.00	1	
Order Processing	$0.13	1	$8.00
Purchase Order	$0.15		
Receiving	$2.50	15	$10.00
Checking Inventory	$0.33	2	$10.00
Receipt Processing	$0.13	1	$8.00
Accounts Payable	$0.20	1	$12.00
Postage	$0.30		
Total	$4.75		

Figure 4: TMI's Estimated Cost to Place one Order

The EOQ model minimizes the inventory carrying cost and the ordering cost. The equation is shown in Figure 5 where (P) is the ordering cost, (D) the annual demand, (C) the annual inventory carrying cost percentage, and (V) the value of one unit in inventory. These values used represent yearly totals. The annual demand was taken from a straight line average of usage.

$$EOQ = \sqrt{2\frac{PD}{CV}}$$

Figure 5: The EOQ Model

A value of safety stock (S') was calculated. The safety stock represents the amount of inventory necessary to cover one standard deviation (84%) of the replenishment cycle and usage.[4] Figure 6 shows the equation where (R) is the average replenishment cycle (lead time), (σR) is the standard deviation of the replenishment cycle, (S) is the average usage, and (σS) is the standard deviation of the usage.

$$S' = \sqrt{R\,(\sigma S\,)^2 + S^2\,(\sigma R\,)^2}$$

Figure 6: Safety Stock (S')

Using the value of safety stock, a reorder point (*ROP*) can be calculated. Figure 7 shows the reorder point equation where (D) is the average usage, (LT) is the lead-time of the supplier, (S') is the safety stock, and (Z) is the normal distribution corresponding to in-stock probability. The value of Z is a factor chosen to provide a certain amount of probability for the safety stock to cover the possibilities of out-of-stock. A copy of this table is given in the Appendix section. For this analysis, a 99.98% in stock probability was used which corresponds to a value of Z of 3.49. Note, for all three equations, the time units must be consistent. The EOQ analysis was performed using yearly values while the safety stock and ROP equations used daily values.

$$ROP = D \bullet LT + S' \bullet Z$$

Figure 7: Reorder Point (ROP)

Results of the analysis are shown in Figure 8. Reorder point values are substantially lower for both the #6 Phillips flathead and the multi-groove dowels, 91.2% and 62.9% respectively. However, the ROP for the #8 Phillips flathead was 185.3% lower than TMI's value. Large differences in part may be caused by the assumptions in the standard deviations of both usage and replenishment cycle. Also, the assumption of annual demand as a straight line average may not

4 Lambert and Stock p. 417

capture a true usage, since currently, production is at its peak.

Part #	#4-000-012	#4-000-043	#4-000-810	#4-998-600	#4-102-306	#4-823-050
	#6 x 7/16" Phillips Flathead Zinc	#8 x 3/4" Phillips Flathead Zinc	10mm x 38mm Multi-groove Dowels	PVC Black 3mm 15/16"	Powder Chrome Hinge 327-PC27	Blum 500mm Drawer Slide (white)
Order Cost	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
Annual D.	100836	1600000	3560000	216000	107076	47413
Carrying Cost %	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
Price/unit	$0.0073	$0.0057	$0.0101	$0.1721	$1.6476	$2.2348
Ave. Order Cycle	21	14	9	45	21	21
Std. Dev. Ord	7	7	7	15	10	10
Ave. Usage	280	4015	7234	600	298	132
Std. Dev. Usage	140	2000	3500	200	150	75
In Stock level	3.49	3.49	3.49	3.49	3.49	3.49
EOQ	23506	105963	118739	7085	1612	921
Safety Stock	2062	29084	51715	9099	3058	1364
Reorder Point	13078	157714	245592	58757	16931	7532
TMI Min. Stock Value	25000	450000	400000	None	None	None
% Difference	91.2%	185.3%	62.9%			

Figure 8: Results of Minimum Stock Analysis

CONCLUSIONS & RECOMMENDATIONS

TMI is a cutting edge company. They are market driven, building what their customers dictate. This is consistent with a progressive logistics approach; however, TMI needs to take its logistics management one step further. Considering that input material should "flow" the same as outbound product, TMI is lagging. This is reflected in TMI's high level of inventory. The opportunity cost of this inventory represents a loss of capital that could be invested in other parts of the company.

"What do we need?" and "when do we need it?" are the two key questions asked in order to produce finished product. These are answered at TMI by the MTO and the production schedule.

Viewing the entire logistical process, any changes or improvements start with these two items. Certainly individual functions can be improved with the system itself; however, substantial improvements start at the beginning of the process. In the macro view, the ultimate challenge to TMI is maintaining its flexibility to the customer while reducing inventory and total logistics cost.

Breaking this analysis down further, TMI has three challenges to improving its logistical process. The first one is addressing their information base. It is not simply inventory management, but rather *information* management. The current inventory management system provides a good "ballpark" weekly estimate of inventory. Although it is possible to obtain reports daily or even hourly, this information would not aid the purchasing department in ordering. Most materials are ordered based on the job specific requirements. Since TMI builds to order, inventory on hand should be minimal most of the time. However, TMI faces considerable uncertainty throughout its manufacturing process. As a result, inventory slowly accumulates over time. The difficulty lies in balancing inventory on hand with future requirements while still ordering an accurate amount of materials. The challenge is not with tabulating in stock inventory, but with obtaining a more accurate estimate of the future requirements.

The current inventory management system has information distributed throughout the company. Three individual plant units (cutting, pre assembly, and hardware) receive and issue their own input materials. Purchasing, however, performs the entire ordering function. There are benefits and drawbacks from this structure. One benefit is that all three units know the materials they are receiving. Who knows better about stacking and sorting laminate than the cutting foreman? A second benefit is that efficiencies in issuing can be exploited. Knowing where the materials are stored facilitates quicker turnovers and faster issuing. A drawback is that the process is disjointed. The materials management function is handled by several different groups. Although this promotes sharing of information and responsibility, in reality, each unit still functions individually, not realizing their effects on the rest of the system. The only device of communication is the inventory database. While this information is shared among all units, no one person is responsible for coordinating the flow of information between them.

All of the groups have a common goal- shipping finished product as cheaply, efficiently, and quickly as possible. The disjointed structure does not promote cooperation among the groups but competition. Competition by the plant groups to ensure they have enough material, and competition by the purchasing department to supply raw materials as cheaply as possible. The plant's main concern is having enough material at production time. Purchasing cares about ordering and keeping total inventory cost at a minimum. The two are in conflict. While the information may be shared and the common goal the same, the individual objectives are quite different. Furthermore, it isn't wrong for both of these groups to be concerned about their own welfare, they are simply doing their job. However, it is counterproductive to TMI's overall goal- to maximize profitability.

The second challenge to TMI's logistics process is the uncertainty involved in the manufacturing process. A variety of reasons exist for this such as:

1) Recuts during processing
2) Production schedule changes

Several reasons require boards to be recut during the manufacturing process. These include: bad board, bored wrong, machined wrong, damaged, scratched, detailed wrong, etc. Even a mistake in a small drawer piece requires an entire board to be laid up, laminated, and recut. This is very expensive. Not only are additional materials involved, but also there is the cost of labor and time lost. Over the last three years, the average cost of recuts for June was about $13,000. The result is carrying increased inventory in order to cover the possibilities of recuts. The larger question remains- why does TMI recut?

The production schedule is one of the driving forces at TMI. This is "when" the customer wants their product. The production schedule can change for a number of reasons. The first, and probably the most common, reason is when a customer will "exercise their muscle" and request their job be moved up. Even though the customer is the primary concern in logistics, this situation is more political in nature and as a result difficult to predict or manage. A second reason a job may be passed over is if required materials are unavailable. In this case the next job that is ready for manufacture will be brought up. The result of changing the production schedule is carrying increased inventory. The realization is that the schedule changes from time to time and so it requires that some inventory be held.

The third challenge to TMI is developing relationships both inside and outside the company. Logistics is characterized by a flow of both information and materials. Materials management is part of this philosophy. This encompasses four basic functions.[5]

1. *Anticipating Materials Requirements.* This task is already performed at TMI. It comes directly from the MTO. However, as mentioned previously this is not an exact account of the requirements. Inventory is the result. Examples include changes in color of laminate from time of MTO to detailing. This results in the laminate originally ordered to be inventoried. Materials ordered that sit in inventory waiting for use cost money and are a sunk cost.[6] For TMI to improve, it is necessary to obtain an MTO further in advance, but more importantly, closer to the actual requirements. For larger jobs, TMI may want to consider having a detailer and a CAD technician or one cross-functional individual on site and also meet with the architect in order to get more accurate information. This would also speed up the process tremendously as well as break down some communication barriers.

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[5] Ibid. pp. 450-456.

[6] Bowersox, p 101.

One of the most valuable and overlooked sources of "in house" purchasing information is in the plant. Many of the operators have an intuitive feel for the requirements for a job. Using some of their insight could provide a more detailed picture of the future requirements.

Bringing both plant and purchasing people together could bridge the information gap between them. This could be done by simply meeting once a week or by even placing one of the purchasing people out in the plant. If nothing else, they may become more aware of each others role in the materials management function, thus, reducing the competing effect between the two groups.

2. *Sourcing and Obtaining Materials*. Supplier uncertainty is a major reason for carrying inventory. "What if the truck doesn't come in?" This is a common response by purchasing people. These people should be concerned about it. The consequences of out-of-stock are enormous. However, the chance of out-of-stock increases with the number of suppliers. More suppliers means more uncertainty, more orders to keep track of, more transportation to arrange, and more room for error.

An efficient sourcing function requires research of the suppliers, quality of product required, lead time, and level of service. This is the most important and complicated part of implementing a sound materials management system. The relationship to the supplier dictates the flow of material and ultimately the flow of finished product. *TMI will never be any faster or achieve any higher quality than what its suppliers can*. Steps toward minimizing inventory levels involve sole sourcing, shorter lead times, and smaller and more frequent shipments. This requires not simply negotiation but a true relationship. Traditional lines, playing one supplier against the other and looking solely at cost, are obsolete.

The rationale for sole sourcing is to develop a relationship with supplier that facilities long-term reductions in inventory while ever increasing the quality of the product purchased and produced. Sole sourcing can not only reduce inventory cost, but can help achieve some discount purchasing power. Because of purchasing from single sources, transportation discounts can be realized from larger quantity shipments. Further still, having sole suppliers can be coupled with EDI (electronic data interchange) reducing lead time and order costs.

A relationship can be drawn by comparing TMI's inventory to the inventory at one of its suppliers. The supplier holds inventory because it does not know exactly what TMI is going to do (i.e. When will I get their order?, How much are they going to order?). TMI simultaneously holds inventory because they don't know how much they need or if the supplier will have what is needed, and when it is needed. However, TMI has an estimate of both of these from the MTO. Examining Figure 9, between the supplier and TMI, the value chain has a total of (ab) and (cd) in inventory. A great deal of both (ab) and (cd) are due to uncertainty caused by the lack of communication between TMI and its supplier. In a close or sole source relationship this uncertainty is reduced, therefore reducing (ab) and (cd) exponentially.

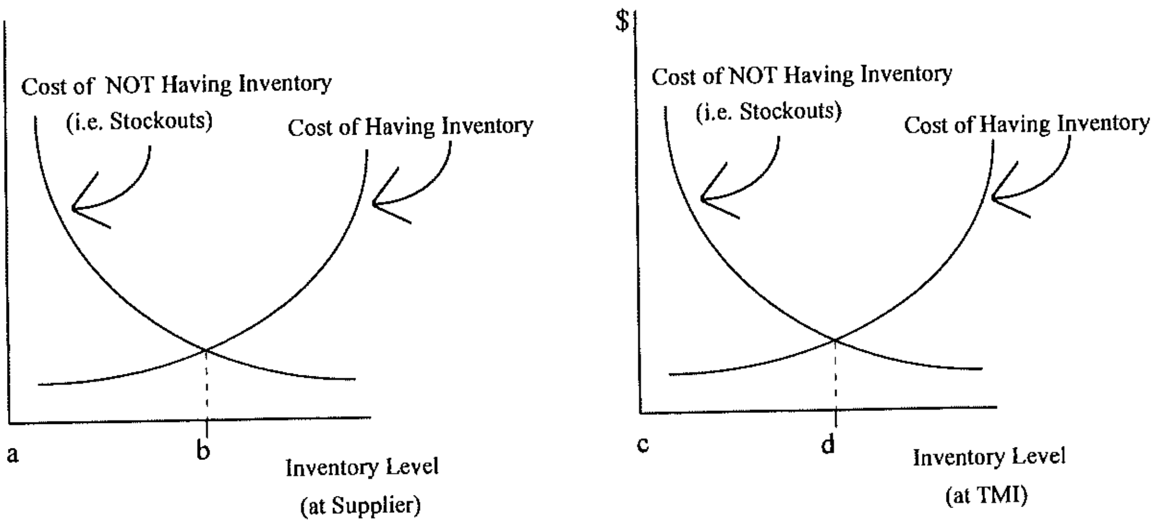

Figure 9: Inventory Supply/Cost Relationship

Sole sourcing will have a dramatic effect on the entire logistics process. It requires the purchasing agent be able to judge quality.[7] This directly affects production. The quality should be the same or superior to prior used materials. Care needs to be taken when sole sourcing items such as banding and hardware. Changes in these may affect product differentiation or variation. This has direct impact on sales. One could draw the conclusion that sole sourcing will reduce customer choice and eventually sales. However, does the customer really demand "X" different brands of pulls, or slides from company "Y", or is this what TMI *thinks* the customer wants? This comes back to the very heart of logistics- the customer. Sometimes one can get into the "guessing game" of trying to predict what the customer wants. If one source can provide the same variation and quality of multiple suppliers then why would the customers demand more?

3. *Introducing Materials into the Organization.* The process of receiving, storing, and inventorying inbound materials is often an overlooked process. Many times critical information is mishandled or lost completely once delivery is made. This is in fact the ideal opportunity to begin the inventory management process. The actual task of receiving and issuing is performed quite well at TMI. The amount received and issued is performed daily and updated on the computer inventory system.

TMI may want to consider instead of issuing job specific, *receiving* job specific. While laminate and board are sorted by color and size upon receiving, they could be sorted and stored according to the job. This procedure would require a substantial amount of coordination; however, it would have a number of benefits. First, the board and laminate would be handled one time resulting in fewer scratches and damages. Second, since the items are purchased by the job, they are now assigned to a job. Once all the materials have arrived, the job is now a "go". Having designated areas for jobs could be coordinated with hardware as well. Hardware items and

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7 Gitlow, Howard S. and Shelly J. Gitlow. *The Deming Guide to Quality and Competitive Position,* Englewood Cliffs, NJ.: Prentice-Hall, Inc. 1987 p. 54.

banding required could be placed in the bin as well. Once the job is ready for production, all of the materials would be pulled out and then issued job specific. One drawback is if the production schedule changes. The result would be robbing a bin for materials and thus shorting that job.

4. *Monitoring the Status of Materials as a Current Asset.* Tracking is one of the most challenging tasks of materials management system. As the frequency of shipments increase the requirement for faster and accurate information becomes imperative. As the information requirements increase, their complexity increases as well. The importance is on the flexibility of a system to change as the company changes and to have the ability to handle the unexpected surges in information.

One method for better tracking of inventory used is by tabulating inventory based on the job orders, component lists, and cutting lists. Since these already contain available information such as item and quantity required, they could be tabulated daily by part number and the usage can be reflected in the inventory system.

If a goal of TMI is developing an automated inventory system, then the physical function of the system needs to be defined first. Automation is usually associated with replacing a human function with a machine. However, moving towards an automated purchasing or materials management function may not necessarily be related to technology at all.[8] It begins with restructuring the process, and then incorporating technology into it. Key questions need to be answered. Why do we want or need such a system? What do we want the system to do for us? What information will it contain? What are the goals of such a system? How will we measure its performance? All of these questions should be answered before any system is considered.

At TMI, the purchasing department tracks the physical inventory, but the cost of such

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[8] Bowersox, Donald J., [et. al.], *Logistical Excellence: It's not business as Usual.* (Burlington, MA: Digital Equipment Corporation, 1992 pp. 104-105.

materials is tabulated by the accounting department. This is a further disjointing of the materials management system. A purchasing responsibility is cost reduction, not necessarily in the individual purchases, but in regards to total logistics cost. Logistics costs include inventory carrying cost, lot quantity costs, transportation costs, warehousing costs, and information processing costs.[9] A sharing of information by purchasing and accounting can help both make informed decisions about minimizing the total logistics cost.

Unfortunately, TMI has grown much faster than the personnel and information management system. At present, the purchasing department lacks both time and personnel in order to research suppliers, analyze inventory cost data, and judge the quality of inbound materials.

The need exists at TMI for a full time logistics person with a "company-wide perspective" to not only facilitate implementation but to be able to measure the impacts and have the ability to evaluate and make changes to the existing logistical system. A logistics person not only looks at the individual parts of a system, he/she would look at the processes themselves.

Each individual part of TMI including: purchasing, accounting, transport, production, etc., has individual tasks they are responsible for; however, no one person is responsible for coordinating these individual efforts. A logistics person requires the knowledge and skills to not only look at the whole system, but be able to change and adjust individual parameters within the system. A logistics person does not work aside from the people involved but with them. People within individual parts of the company spend most of their time "fire-fighting", going from problem to problem while not having enough time to analyze the whole process. A person with the necessary skills may already be employed at TMI. They may simply require redirecting of job focus or title.

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[9] Ibid. p. 107.