Implementing an Order Review and Release System
in a 'T' Manufacturing Plant

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IMPLEMENTING AN ORDER REVIEW AND RELEASE SYSTEM IN A 'T' MANUFACTURING PLANT

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ABSTRACT

This study examines the implementation of an Order Review and Release System (ORR) in a 'T' type manufacturing plant with an existing Drum-Buffer-Rope (DBR) control mechanism. The implementation results suggest that ORR helped alleviate some of the plants problems, but in the end, the greatest benefit to the company resulted from implementing a combination of solutions from DBR, ORR, and Just-in-time (JIT) to improve plant operations both short-term and long-term. After implementation, the need for raw material inventory dropped by 95%, capacity improved by 20%, order accuracy improved by 4%, and lead-time was reduced by 30%.
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INTRODUCTION
The Theory of Constraints classifies manufacturing plants into three categories of 'V', 'A', and 'T'
type plants. The dominant feature of a 'T' plant operation is the existence of divergent assembly
points at the very end of the manufacturing process so that relatively few standard parts can be
assembled into many finished goods. The 'T' plant gets its name because the process diagram
(Figure 1) resembles the letter 'T'. (Umble, 1992) The four distinguishing process
characteristics of a 'T' plant are:

1- Few standardized component parts are assembled into finished goods at the end of the process.
2- The component parts can be assembled into relatively many finished goods.
3- Product routings for manufacturing the component parts are standardized.
4- Products are highly customized during final assembly.

To manage the flow of goods through a manufacturing plant the Drum-Buffer-Rope (DBR)
control system is often proposed. The proponents of DBR propose that it optimizes the process
flow of all three types of manufacturing plants (V, A, and T). This results in higher throughput
with greater profitability of the plant operations (Goldratt and Cox, 1986). However, the
company in this study, called MWI, was not realizing improved performance by using DBR. It
had used DBR for 12 months and found no improvement in due date performance, lead times, or
rising inventory costs.

Because of the disappointing performance, the president of MWI wanted to try a new shop floor
control mechanism using an Order Review and Release system (ORR) system to control the
release and flow of orders through the shop floor. An ORR system is the pooling of orders
released from a Master Production Schedule. The purpose of the pool is to avoid immediate
release of the orders to the shop floor so that additional controls applied to improve flow. Orders can be released based on sequencing rules designed to achieve a number of plant objectives (Melnyk et al, 1985). For example, Earliest Due Date (EDD) rules improve that chance that orders are completed by their due dates. Additional controls allow time to respond to changes in orders, or to increase the average number of completed orders per shift (e.g. Shortest Processing Time). Use of ORR systems has improved performance in a number of plants (Melnyk et al, 1985); however, no study examines the context of the improvements in relation to plant type, i.e. V, A, or T type plants. This issue is important because practicing managers need to understand which control mechanisms work best in various plant types. Otherwise, as in this study, a plant may fail to achieve improved performance. The original purpose of this study was to compare the performance of an ORR system to that of a legacy DBR system, but in the end, improved plant performance involved implementing a combination of solutions from DBR, ORR, and Just-in-time.

LITERATURE REVIEW

The literature on DBR systems propose that they can optimize the performance of V, A, and T type manufacturing plants (Umble, 1992). Despite this proposition, a search of the literature found no empirical studies comparing the performance of DBR to ORR systems in the context of plant type. In this study DBR is described as the use of a bottleneck process to control the release and flow of goods through a manufacturing system (Goldratt and Cox, 1986). An ORR system is described as a pooling of orders released from a scheduling system so that additional controls can be placed on the orders prior to release to the shop floor. The purpose of an ORR system is to use sequencing rules to achieve some business objective. The primary difference between the two control mechanisms is that DBR controls flow based on characteristics of the manufacturing processes, e.g. bottleneck capacity, while ORR controls flow based on order characteristics, e.g. due date.

Elements of the ORR system utilized in this system are based on Melnyk et al (1985) and consist of:
1- Order documentation - provides detailed information, needed by the shop, to process the order
2- Capacity evaluation and order dispatching - evaluating whether or not the necessary resources, exclusive of raw material, are available to produce the order and then assigning those resources to process the order
3- Material checking - checking the inventory status of components and raw materials necessary to complete the order, and
4- Order disposition - the activities required to transfer the order, once completed, out of the control of the shop floor

THE COMPANY
MWI was established in 1998 as a manufacturer of residential and commercial storage buildings in Atlanta, Georgia. In 1999, the company consolidated all operations into a single manufacturing and fabrication facility. The facility housed three operations named 'stages 1, 2, and 3' (See Figure 1). Stage 1 is a processing line that utilizes basic raw materials to make component parts for the assembly (kitting) operation. This stage is known as component fabrication. Stage 2 is an assembly operation whereby interchangeable component parts are segregated into 'KITS'. In Stage 3, the kits are customized and assembled into two types. One type is used to stock discount retailers who market them to 'do-it-yourself' customers (e.g. Home Depot) and installation contractors. The second type is for direct sale to commercial customers based on actual orders. The kits can be assembled into three basic styles of units; 'G' (Gambrel shape), 'S' (two gable roof), and 'L' (single gable roof), with options of different sized units based on floor square-feet.

KIT MANUFACTURING
Orders come into the Master Scheduler via the Internet, phone call, or fax machine. Order sizes range from 4' x 4' (16 sq. ft.), to 24' x 24' (576 sq.ft.), in 4' increments. Each unit comprises at least fifty interchangeable component parts produced from the fabrication of eight basic raw materials. The components can then be assembled into over 300 types of finished goods based on a variety of sizes, shapes, and packaging.
The processing is performed in three distinct stages (See Figure 1). Stage 1, the component fabrication stage, involves cutting and drilling operations that convert the eight raw materials into 50 unique component parts. The production routings for the component parts have linear flow without divergent points or additional assembly. Stage 2, the kitting stage, involves compiling the components into general use kits. Stage 3 customizes kits into two basic types meant for retail distribution and those to fill direct customer orders. Occasionally, components may require unique routing for further processing. When this occurs, the routings are highly dissimilar from component to component and completed as a side operation.

RESULTS OF INSUFFICIENT CONTROL SYSTEMS IN A 'T' PLANT
Most of MWI's processing problems were classic for 'T' plants. They included large finished goods and component part inventories, excessive fabrication lead times, unsatisfactory resource utilization, and decoupled fabrication and assembly operations (Umble and Srikanth, 1995). Most of the plant's problems occurred in stage 2 because there were never a sufficient number of the needed component parts for direct customer orders while overall component part inventories grew. This occurred because the plant practiced both assemble-to-stock (to retailers) and assemble-to-order (direct to customers) product strategies; therefore, assemblers would create kits assemble-to-order until all orders were filled and then revert to assemble-to-stock.

Unfortunately, as often happened, an assemble-to-order item would be released to the floor and the component parts were not available because they had been consumed in the previous assemble-to-stock kits. This led to a shortage of critical component parts. The assemble-to-order strategy was initially designed only to be used in case an order could not be filled by available stock. This was supposed to be a rare occurrence. Instead, due to the exhaustive options of kit sizes and shapes, orders could only be filled by stock 25% of the time. The remaining orders, those not filled by stock or expedited, were accomplished using the assemble-to-order strategy.

The shortage of component parts led to another common problem in 'T' plants, excessive inventory. Raw material inventories were kept large to combat poor resource utilization at the bottleneck operation (component fabrication). The DBR control was placed at this stage because it was perceived as the bottleneck process that failed to produce sufficient component parts. However, finished goods inventory was increasing because the assemble-to-stock goods were
rapidly filling warehouses while only 25% of customer orders were actually being filled from them. Even when orders could be filled from stock, they were accurate only 95% of the time while assemble-to-order processes were above 99% accurate.

Critical component shortages normally lead to poor due date performance as well (Umble and Srikanth, 1995); however, the company maintained a 14 day lead-time requirement. While most orders could be completed in the 14-day lead time and thus were not technically late, the 14 days was relatively long compared to competitors. This excessive lead-time is another common factor in 'T' plants. Although the 14 day period prevented late orders, it cost the company last sales because competitors could either process faster, or many impulse-buying customers would simply change their mind before the kits could be constructed. Sales estimated that decreasing lead time by 5 days would have an immediate increase in sales of at least 5%.

In many building products companies, capacity and demand are measured in square feet (sq. ft.). The total capacity for the plant is 13,000 sq. ft. per eight-hour shift, excluding changeovers. Both the fabrication and assembly operations require setups between each unique sizes and styles of units. Each setup costs the plant 500 sq. ft. in production capacity even with dedicated setup personnel and adequate preparation. Since the average shift performs six changeovers, this reduces effective capacity to 10,000 sq. ft. per shift. Since all incoming orders were released to the shop floor based on the pace of the bottleneck (stage 2 - component operation), there was no system in place to review the number of required setups. Reducing the effective capacity also contributed to the long 14 day lead-times.

The buildup of inventory and long lead times are exacerbated because the customer demand is not smooth and generally follows a seasonal cycle (Table 1). 60% of all sales occur in the period from March through July; 30% occurs August through November, and 10% occurs December through February. Before the implementation, peak demand periods often exceed the plant's effective capacity of 10,000 sq. ft. In the spring and summer the demand could exceed 12,000 sq. ft. per day. During peak periods, the company would institute overtime to handle the additional demand, but utilizing overtime would cut the already thin profit margins by as much as 50%.
In summary, the dominant problem in 'T' plants is the shortage of component parts at the stage 2 kitting process. This is caused because workers attempt to assemble kits with any available components without regard to whether they were designated for assemble-to-stock, or for direct customer sale. Since the system could not differentiate between components meant for stock versus those for direct orders, it caused workers to continue to produce components until demand for both was satisfied. Due to the shortage of assemble-to-order components, long lead-times and excessive frequent setups were needed to meet the customer demand while maintaining some level of due date performance. A summary of the DBR performance is reported in Table 2.

(Insert Table 2 About Here)

**IMPLEMENTATION OF THE ORDER REVIEW AND RELEASE SYSTEM**

In order to improve MWI's process, a four-step ORR system was implemented along with the plants legacy DBR. The implementation included order documentation, capacity evaluation and order dispatching, material checking, and order disposition. Each stage of the implementation is described next.

**Order Documentation**

Order documentation includes providing the appropriate information in the order release needed by shop floor workers to fulfill the order. For example, before implementation, the company used names such as Estate, Deluxe, etc… to describe its products. The workers had to look up the product descriptions in a book. This created confusion on the shop floor, especially for new workers. In order to improve the system, a new descriptive method was developed that replaced the model names with model numbers that reflected both the style and size of each unit. The new system is common in ORR systems and use descriptors that match styles, such as 1010G (represents a 10' x 10' gambrel unit), or 1216S (represents a 12' x 16' two gable unit), as model names. Using this method, a worker immediately knows the size and shape of the unit without having to refer to any other document. This process helped improve the order accuracy rate to 99%.
Capacity Evaluation and Order Dispatching

MWI follows the lead of many construction fabricators who consider capacity issues in terms of sq. ft. per shift. With this in mind, orders were released in DBR to the stage 2 - kitting operation using an immediate release mechanism- relying on the foreman to track bottleneck capacity and determine sequencing. If no order was pending, the shop would produce assemble-to-stock inventory to keep utilization high.

The company calculated that the maximum capacity per shift was 13,000 sq. ft. of floor space. When changeovers were factored-in, they reduced the effective capacity to 10,000 sq. ft. per shift (Table 1). Under the DBR system, the foreman was responsible for the bottleneck process and the assemble-to-stock (to retailers), while the Master Scheduler was responsible for releasing the direct customer orders. In theory, this should not matter under DBR as long as the bottleneck process produced products to meet demand, but in reality it created confusion in what should be immediately produced and what should be reserved for later - in that no single manager had responsibility for all production orders. This meant that the bottleneck was not always producing the most urgent orders. Table 3 lists an actual sequence of in-coming orders and their release to the floor. In the release system, three changeovers would be necessary to complete the Table 3 schedule at a cost of 1,500 sq. ft. of capacity.

(Insert Table 3 About Here)

To increase capacity, the new ORR system was developed based on only the assemble-to-order (ATO) strategy. Since 75% of current orders were already being completed with ATO strategy, the workers was already used this process. The new ORR system placed incoming customer orders into queues rather than releasing them immediately to the shop floor. The foreman organized the orders by product type (size and shape). Next, he separated orders into smaller batches of 6,000 sq. ft., instead of the 10,000 sq. ft. batches under the DBR system. In essence he was following the Just-in-time principle of producing in smaller batches to improve flow. Then, he queued a computer program that calculated and ordered the necessary raw material via e-mail (including delivery dates), distributed required information (also via e-mail) to purchasing, and accounting/billing, etc., and (if requested) sent e-mail notices to custom orders.
that the order has started processing. By using ATO, all orders were initiated from the Master Schedule – even those designated for stock.

By creating a pool of orders prior to release, orders could also be sequenced to avoid setups, i.e. sequenced by style. Since style changes drive the need for setups more than size changes, releasing them together by style (e.g. by G, S, or L type) reduced the number of setups by 60%. The queue was designed to hold an incoming order for up to 48 hours in order to achieve a 6,000 sq. ft. batch. To prevent due date deterioration, the order was released after 48 hours regardless of its batch or sequence. Table 4 reports the results from re-sequencing the jobs shown in Table 3 using the new ORR technique.

(Insert Table 4 About Here)

Using the Table 4 scenario, ORR reduced the number of setups from 3 to 1. Since the average setup costs the company 500 sq. ft. of capacity, the new system added 1000 sq. ft. capacity per shift, for a total of 2,000 sq. ft. This system reduced changeovers by an average of 60%, thereby increasing effective capacity from 10,000 to 12,000 sq. ft.

**Inventory**

Under the DBR system, raw material safety stock was held prior to the bottleneck as a 'buffer'. Since no standard method existed to calculate how large the DBR buffers should be, they were based on the Economic Order Quantity (EOQ) principle. This was sufficient to keep the bottleneck busy, regardless of demand variance but created excess inventories. Under the new system, inventory was ordered to fill only the orders in the ORR pool. The EOQ system kept the lines from running out of material, but it was expensive to maintain the levels of inventory at $380,000. While sufficient to meet the requirements of the bottleneck it created stock piles at non-bottleneck processes (Chakravorty, 1998). Abandoning the EOQ system led to higher material costs. To avoid this, MWI agreed to pay suppliers within 10 days of order receipt. If a delivery was late, incomplete, or required replacement due to poor quality, the suppliers agreed to wait 45 days for payment. The company maintained an inventory buffer of four hours at the fabrication level, and four hours at the component level. In this way, a total of eight hours of
protective inventory could keep the plant running in case of a supply problem. Over a period of 90 days, this system reduced inventory levels from $380,000 to an average of $20,000. As an added precaution, web cameras were placed at the raw material storage bins at the stage 1 and stage 2 areas. These areas could be viewed by any employee with an internet connection. This allowed the Master Scheduler, Foreman, Purchaser, GM, etc. to view the inventory levels, even from home.

Resource Utilization
Under DBR, the bottleneck process was utilized as much as possible; however, when attempting to operate above 90% the system produced a greater percentage of defective parts and exponentially higher system and maintenance costs. Therefore, experiments were conducted using several levels of utilization and compared with the ORR system based on the sequencing rule 'Earliest-Due-Date' with batch sizes of 6,000 sq. ft. The results of the experiment show that at less than 70% utilization, the DBR and ORR system performed identically to a system with no controls, i.e. a system where orders were released to the shop floor without consideration for the bottleneck process, shop conditions, or order pooling. This occurred because the reduction in setups increased capacity by 2,000 sq. ft., thus eliminating the bottleneck process at stage 2. There was no longer a true "Drum" on which to base the DBR system.

Order Disposition
Finished goods were housed in a warehouse until picked up by a customer or contractor in approximately five days. Because orders were routinely late, contractors were not contacted until the order was complete, which further delayed pickup and payment. Tracking and housing the products was expensive and the company had to routinely lease additional space to store the goods. Under ORR, contractors were contacted to arrange pickup when the order was released to the pool. As an added incentive, the contractor was given a price break of 2% for each unit picked up on time. The additional capacity, along with renewed confidence in supplier performance, allowed the company to reduce lead time to 10 days. Table 5 reports a summary of the process improvements gained through the ORR system as of 04/15/2005.
THE MODEL

The relationship between the programs implemented and the observed outcomes is shown in Figure 2. The ‘+’ signs represent a positive relationship between the implementation and the outcomes. This means that as one variable increased, the other variable also increased. The ‘-’ sign means that as one variable increased, the other decreased.

DBR was associated with increased utilization of the bottleneck process as long as average utilization was between 70% and 90%. Outside of these ranges, DBR had no effect at lower utilization or a negative effect at higher utilization. The positive relationship between ORR and JIT led to negative relationships with lead time and inventory. This means that as the use of ORR and JIT increased, lead time and inventory decreased. A direct effect of ORR on lead time reduction was also found before JIT was implemented, but additional reduction was found after JIT was added. This suggests both a direct and indirect effect of ORR on lead time reduction. The use of ORR reduced the number of setups by allowing similar styles to be processed sequentially. Along with DBR, this reduction led to increased capacity utilization, which further reduced lead time because the bottleneck was working on actual orders rather than producing to stock. However, not shown in the model is the fact that at ranges outside of 70%-90% utilization, no mechanism worked well to improve performance.

CONCLUSIONS AND IMPLICATIONS FOR PRACTICING MANAGERS

There are four general conclusions and implications regarding the implementation of an Order Review and Release system in a 'T' plant manufacturing operation. First, no single improvement mechanism was able to address all of the company’s problems. The ultimate solution involved implementing a number of principles from the DBR, ORR, and JIT control and improvement programs. The DBR system kept the bottleneck operating to produce the needed parts during the short-term while the plant had insufficient capacity; however, contained no mechanism that differentiated stock items from direct customer orders. In addition, when capacity was increased,
releasing orders based on the bottleneck provided no benefit to the company. When utilization of the bottleneck was below 70% it provided no benefit greater than releasing the jobs immediately to the shop floor. When utilization exceeded 90% performance deteriorated at an exponential rate. This suggests that DBR helps control ‘T’ plants only when utilization was between 70% and 90%. Outside of this range, it did not perform well.

Second, adding the ORR order pooling system allowed consideration for the order characteristics (i.e. due date) in addition to shop characteristics when making sequencing decisions. In addition to DBR, this allowed the orders to be sequenced based on similar characteristics and thus reduced the number of setups per shift and increasing capacity by 20%. This improved flow through the shop and reduced lead time from 14 to 10 days. However, like DBR, once the capacity was increased sufficiently to eliminate the bottleneck operation and plant utilization dropped below 70%, ORR did not perform better than immediately releasing the orders to the shop floor without consideration for DBR or ORR.

Third, eliminating the assemble-to-stock product strategy in favor of assemble-to-order for all orders allowed raw material to be ordered only as needed. This Just-in-time (JIT) technique reduced the amount of raw material inventory and finished goods by notifying contractors of firm order completion dates and giving financial incentives for same day pickups. This virtually eliminated the finished goods inventory.

Fourth, many of the traditional activities of a Master Scheduler and Purchaser were automated. MWI takes incoming orders, stated in capacity units, evaluates them immediately for completion date, release sequencing, and raw material. Once this is done, queuing software automatically builds pools of orders and queued them for release based on due date and effective capacity. This eliminated the need to continually track capacity unless major changes to equipment or personnel were made.

Lastly, the implementation of ORR, DBR, and JIT alleviated many of the problems associated with ‘T’ plants. While DBR was beneficial to keep the bottleneck process utilization high during capacity constrained periods, it did not resolve all of the plants problems. Once the internal
constraint was eliminated the DBR system provided little benefit; however, when combined with ORR and JIT excessive lead-time and large inventories were reduced, order accuracy and capacity was increased. This suggests that improvement in ‘T’ plants, and perhaps other manufacturing processes, may require a combination of control and improvement techniques to achieve improved performance due to the complexities involved in real-world systems. Currently, no theory exists that fully explains the phenomena observed in this study.

WEAKNESSES AND EXTENSIONS
The major weaknesses of this study are that it was conducted in a single plant in one industry. It is possible that the principles applied here are not applicable in all manufacturing environments, firm sizes, or industries. It is possible that the improvements were context specific and not generalizable. Since the researchers were actively involved in the implementation, and workers were aware that they were being scrutinized, that some level of Hawthorne Effect contributed to the results. It is important for more empirical studies validate our model and mathematical models developed to better describe the complex relationships between the variables and outcomes.

References

Tables

Table 1 - Demand Cycles

<table>
<thead>
<tr>
<th></th>
<th>Demand per day</th>
<th>Range sqft.</th>
<th>Changeovers</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>March - July</td>
<td>11,200</td>
<td>9,500- 12,000</td>
<td>6</td>
<td>10,000</td>
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<tr>
<td>August - Novem.</td>
<td>9200</td>
<td>7,500- 11,000</td>
<td>6</td>
<td>10,000</td>
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<td>Dec.- February</td>
<td>1250</td>
<td>300- 8,000</td>
<td>4</td>
<td>10,000</td>
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Table 2 - Summary

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<th>Category</th>
<th>Level</th>
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<tr>
<td>Inventory</td>
<td>$380,000 total Finished Goods and Raw Material</td>
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<td>Lead time</td>
<td>14 days</td>
</tr>
<tr>
<td>Capacity</td>
<td>10,000 sq.ft./shift</td>
</tr>
<tr>
<td>Order Accuracy Rate</td>
<td>95%</td>
</tr>
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<td>Disposition</td>
<td>Pickup From Finished Goods Inventory</td>
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</table>

Table 3 - Incoming orders and releases to shop

<table>
<thead>
<tr>
<th>Time Received</th>
<th>Model</th>
<th>Requires</th>
<th>Changeover</th>
<th>Time Released</th>
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</thead>
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<td>04/15/06</td>
<td></td>
<td></td>
<td></td>
<td>04/15/06</td>
</tr>
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<td>1212G</td>
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<td></td>
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</tr>
<tr>
<td>7:03am</td>
<td>1012S</td>
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<td></td>
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</tr>
<tr>
<td>7:05am</td>
<td>1216S</td>
<td>No</td>
<td></td>
<td>7:22am</td>
</tr>
<tr>
<td>7:15am</td>
<td>808G</td>
<td>Yes</td>
<td></td>
<td>7:25am</td>
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<tr>
<td>7:40am</td>
<td>812G</td>
<td>No</td>
<td></td>
<td>7:42am</td>
</tr>
<tr>
<td>8:00am</td>
<td>1620GS</td>
<td>Yes</td>
<td></td>
<td>8:03am</td>
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Table 4 - Results of queuing

<table>
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<tr>
<th>Time Received</th>
<th>Old Model</th>
<th>New Model</th>
<th>Time Released</th>
<th>Changeover</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/15/00</td>
<td>1212G</td>
<td>808G</td>
<td>04/17/00</td>
<td>No</td>
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<tr>
<td>7:00am</td>
<td>1012S</td>
<td>812G</td>
<td></td>
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</tr>
<tr>
<td>7:05am</td>
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<td>1212G</td>
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<td>No</td>
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<td>7:15am</td>
<td>808G</td>
<td>1616S</td>
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<td>Yes</td>
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<td>7:40am</td>
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<tr>
<td>8:00am</td>
<td>1616S</td>
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</table>
Table 5- Process Improvements

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<th>Category</th>
<th>Old</th>
<th>After</th>
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</thead>
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<tr>
<td>Inventory</td>
<td>$380,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Lead time</td>
<td>14 days</td>
<td>10 days</td>
</tr>
<tr>
<td>Changeovers</td>
<td>avg. of 6/shift</td>
<td>avg. of 2/shift</td>
</tr>
<tr>
<td>Capacity</td>
<td>10,000 sq.ft./shift</td>
<td>12,000 sf./shift</td>
</tr>
<tr>
<td>Accuracy Rate</td>
<td>95%</td>
<td>99%</td>
</tr>
<tr>
<td>Disposition</td>
<td>Pickup from FG Inv.</td>
<td>Pickup in 2 hours from line</td>
</tr>
</tbody>
</table>

FIGURES

FIGURE 1 - ‘T’ PLANT PROCESS

Stage 1
Component Fabrication

Stage 2
Components Separated into Kits

Stage 3
Kits Assembled Based on Orders

Stage 3
Kits Assembled Into Stock Items

Customized Units

Raw Material Inventory
FIGURE 2 - THE IMPLEMENTATION MODEL

DBR

+ -

Capacity Utilization 70%-90%

Setups

Lead Time

ORR

+ -

Inventory

JIT

Order Accuracy

+ -
Founded in 1892, the University of Rhode Island is one of eight land, urban, and sea grant universities in the United States. The 1,200-acre rural campus is less than ten miles from Narragansett Bay and highlights its traditions of natural resource, marine and urban related research. There are over 14,000 undergraduate and graduate students enrolled in seven degree-granting colleges representing 48 states and the District of Columbia. More than 500 international students represent 59 different countries. Eighteen percent of the freshman class graduated in the top ten percent of their high school classes. The teaching and research faculty numbers over 600 and the University offers 101 undergraduate programs and 86 advanced degree programs. URI students have received Rhodes, Fulbright, Truman, Goldwater, and Udall scholarships. There are over 80,000 active alumnae.

The University of Rhode Island started to offer undergraduate business administration courses in 1923. In 1962, the MBA program was introduced and the PhD program began in the mid 1980s. The College of Business Administration is accredited by The AACSB International - The Association to Advance Collegiate Schools of Business in 1969. The College of Business enrolls over 1400 undergraduate students and more than 300 graduate students.

**Mission**

Our responsibility is to provide strong academic programs that instill excellence, confidence and strong leadership skills in our graduates. Our aim is to (1) promote critical and independent thinking, (2) foster personal responsibility and (3) develop students whose performance and commitment mark them as leaders contributing to the business community and society. The College will serve as a center for business scholarship, creative research and outreach activities to the citizens and institutions of the State of Rhode Island as well as the regional, national and international communities.

The creation of this working paper series has been funded by an endowment established by William A. Orme, URI College of Business Administration, Class of 1949 and former head of the General Electric Foundation. This working paper series is intended to permit faculty members to obtain feedback on research activities before the research is submitted to academic and professional journals and professional associations for presentations.

An award is presented annually for the most outstanding paper submitted.