TOC in the DC: warehouse management gets a makeover with a manufacturing staple.(distribution centers)

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IN AN EFFORT TO REDUCE ORDER processing cycle time in Intel Corp.'s component distribution centers, industrial engineers developed a new approach to operations management--the novel idea of applying the theory of constraints to warehousing. By implementing the TOC manufacturing process known as drum-buffer-rope in the company's finished goods distribution centers, they created a safer, more agile operation with no increase in operating expense.

[ILLUSTRATION OMITTED]

The DBR implementation relied on adjustments to policies and measures that drove changes in behavior and consequently required no additional investment into the DCs. The objective was to reduce order processing cycle time from when picking begins to when an order is ready for shipping. Results were achieved in a few days, and the process stabilized in weeks.

Five DCs located in five countries have implemented DBR with an average cycle time reduction of more than 60 percent and a standard deviation reduction of more than 70 percent. The new method created a faster, more predictable DC operation, reducing work-in-process by more than 60 percent to create increased inventory availability and potential future inventory reduction. And the work environment is now safer and less stressful.

Laying the foundation

The foundation of TOC is identifying the constraint of a system and managing that constraint to maximize progress to a predefined goal. Most examples of TOC applications are based in manufacturing; therefore, the common understanding is that a constraint is a physical entity. In reality, the constraint is more often a policy that is limiting progress. Typically, several policy constraints must be removed before a physical constraint surfaces.

The five focusing steps represent the process of ongoing improvement:

1. Identify the constraint.

2. Exploit the constraint.

3. Subordinate everything to the constraint.

4. Elevate the constraint.

5. Repeat, and avoid inertia.

Usually, the first time you go through this cycle, the initial constraint is not knowing the goal of the system or, more typically, not having the correct goal. After that first cycle, the next constraint is often the metrics supporting the goal. These steps seem almost trivial, but they are crucial to success. This process was repeated many times during the Intel implementations.

To create the behavioral shift required, a few policy constraints and paradigms had to be addressed. For example, knowledge of the TOC, specifically DBR, was inconsistent. Some people had a good understanding and others knew nothing about it. Among those who did know about TOC, some doubted it could be effectively implemented in a DC. Training classes designed specifically for DC application helped to remove this constraint.

Another constraint was the metrics used to monitor site performance. The main objective of the program was to reduce order processing time, yet there was no existing measure of time in the system. To address this, a cycle time metric was added that tracked time elapsed from when an order was picked until it was completed and ready to ship.

Additionally, an efficiency metric that tracked labor activation was removed. The key term here is activation, meaning that people are working, but they may not be working on the correct orders. The actions required to remove these types of constraints did not occur in series; it was a parallel effort that took quite some time.

Constraints in policy and precedent pose the greatest challenge to a successful implementation. With the training, new metrics, and support of some good managers, the foundation was set for the first implementation.

TOC applied

Identify the constraint. The market is the constraint for many products, and DC execution is rarely the cause of missed orders. But by reducing cycle time, the DCs can help exploit the market by quickly responding to customer demand for internally and externally constrained products. To do this, the DC's internal constraint had to be identified. The physical constraint or control point was identified as the processing operation. The processing stations require the most time of all the operations to complete an order. Thus, the processing stations should dictate the total output capability of the DC. Previous efforts to balance capacity and some order-related attributes caused the constraint to move occasionally. To reduce the movement of the constraint and increase flow, a balanced flow approach was introduced. Staffing was altered to balance the flow and stabilize the location of the constraint. The balanced capacity approach was another policy constraint that had to be removed to increase the flow and reduce cycle time in the DC. With the constraint identified and constant, the focus shifted to exploiting the constraint.

Exploit the constraint. Exploiting the constraint is done by increasing the utilization of available resources. Utilization means that workers are working on the correct orders. Typically, exploiting requires little or no increase in spending. After orders are picked, they must be processed to match customer quantity and packing requirements. This operation is the physical constraint or bottleneck of the DC. To exploit the processing operation, the non-processing-related activities of the operation required scrutiny. For example, operators frequently left their stations to load orders onto the processing lines. The first action to exploit the constraint was to assign a post-pick router to load the lines. Processing operators can now spend more time at their workstations, enabling an increase in output capability. Shift staffing levels were also adjusted by moving a few operators to different shifts. Now the DC can more effectively meet the demand cycles throughout the day and week.

While TOC provides a high-level production method, it lacks specific tools for low-level improvement. To continue to exploit the constraint, standard industrial engineering and lean tools such as methods analysis, time studies, work standards, and standard work sheets are being used as needed. Since the DC output capacity was not as much of a concern as the cycle time, further steps to exploit processing were considered secondary to the subordination step.

Subordinate to the constraint. Possibly the most difficult aspect to implement is subordination. People are comfortable in their own local optimums and often struggle with the initial steps of subordinating their work in support of the constraint operation. The primary subordination in this application activity is the picking operation. Picking usually has the capacity to flood the floor with orders. If pickers try to remain busy, as dictated by local efficiency, then high work-in-process levels are the result. High WIP levels increased the search time of the post-pick routers as they tried to find the priority orders. This delayed priority orders from getting to the processing lines, and it allowed cherry picking so the easy orders were frequently worked on first.

[FIGURE 1 OMITTED]

Inventory in WIP cannot be used for other orders until the units are back in storage. Since many orders can be assigned to one box of a product but only one of those orders can be processed at a time, high WIP levels reduce inventory available for other orders. To control WIP levels, it was crucial to limit the amount of work released to picking and thus to the processing operation. A WIP buffer tool was created to restrict the number of orders on the floor at any given time. The ground controllers monitor the WIP levels and make decisions to release more orders based on the WIP buffer levels. The buffer tool ensures that there is sufficient work to keep the lines working but not so much work that the DC is flooded with orders. It has an added advantage of determining when additional pickers are necessary or when there are too many pickers. This allows resources to move to other operations as needed and increases the labor utilization in the DC. The WIP buffer tool is simple and easy to use. Because it is used to manage the buffer, it is now crucial to the performance of the DC.

Elevate the constraint. Elevating the constraint means to spend money to increase the performance of a given operation. At this time, the DC does not need to elevate the physical constraint. As demand changes this may become necessary, but there are still opportunities to exploit it to gain capacity. In the event that a more significant increase in capacity is needed, then elevating can be done with precision due to the previous step of constraint identification.

Results

The main objective of this implementation was to reduce the physical order processing cycle time in the DCs. At the first site, cycle time was quickly reduced by 50 percent within days of starting the implementation. Over the next 10 weeks, as the method became the standard, cycle time continued to drop and then stabilized, yielding a 68 percent reduction. The standard deviation followed a similar pattern and stabilized at a 78 percent reduction. DBR delivered a faster, more predictable process.

Figure 1 shows the shift in cycle time that occurred after the implementation. At data point 30, DBR was implemented. At data point 40, the system stabilized and has been consistent since that time. The other four sites witnessed the same series of events. The main difference between sites was in the time required to stabilize the system.

The main driver of the cycle time improvement is the reduction and control of WIP levels. WIP levels in the DCs are not actually tracked in a manner that facilitates a precise calculation of WIP reduction. However, using Little's law we can approximate the reduction in WIP. Little's law states that at every WIP level WIP is equal to the product of throughput (Th) and cycle time (CT); that is, WIP = Th X CT. As a result of the implementations, output was similar or slightly higher; therefore, WIP was reduced by almost the same percentage as cycle time, typically more than 60 percent. This estimate is validated by shop floor observations and feedback from operators and supervisors. By limiting WIP, there is less searching for priority orders and less cherry picking of easy orders.

When orders are picked, inventory is locked up even if only part of a box is assigned to the order. By keeping the inventory in a storage location until it can be processed, inventory is made available for other orders. In the past, ground controllers spent a significant amount of time canceling orders or forcing a lower priority order to be processed so that inventory would be made available for a higher priority order. A noticeable reduction in these activities occurred when WIP was reduced.

Along with the work force productivity gains, the WIP reduction created two other benefits: a reduction in operator stress level and a safer workplace. High WIP levels create unnecessary work hazards. At times there was so much WIP that people had to walk in the lanes designated for powered industrial trucks.

In addition to several other benefits from the implementation, the more consistent flow of work to the shipping dock allows freight carriers to complete their work in small batches. In the past, a large batch of work was often delivered to them at the end of the day, which caused them to rush to complete a large batch of work in a short period of time. It is always interesting to see the number of collateral benefits that appear when an operation becomes faster and more agile.

Conclusion

The preceding case study demonstrates that DBR is an effective method to manage and improve distribution center operations. The concept and the actions taken are simple and relatively easy to implement. With minimal investment, significant improvements can be made. The first constraint is often overcoming resistance to change, but increasing the TOC knowledge base will help mitigate this resistance.

The DCs that have made the change to DBR have increased performance and become safer, more relaxed work environments. The success of this implementation is driving new standards and goals to ensure that continuous improvement is sustained. Exploration into how to expand the methods into other areas is ongoing.