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Avoiding Stock-Outs with Lean Inventory Prediction

Introduction

Many of us have experienced a situation similar to this: We make a range of products that use a common component, a "widget", that we make in house. There are 12 widgets in stock. The manager of department A wants to run a job requiring 6 widgets and the manager of department B wants to run a job requiring 8 widgets. Both look into their inventory tracking or ERP system and see that there are 12 widgets in stock, so they both issue work orders to make their respective products.

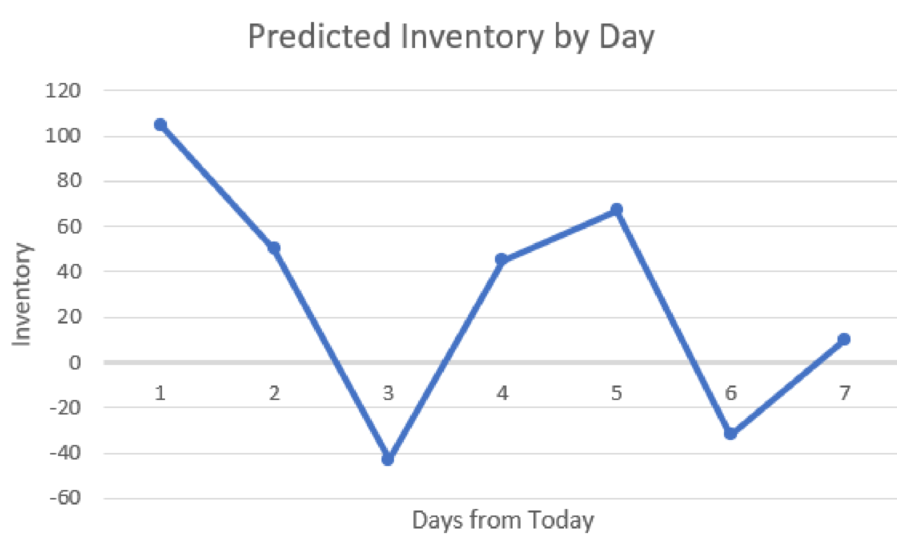
An employee of department A then goes to the stock room and withdraws the 6 widgets needed for their job. As a result, when an employee from department B goes to the stock room, they find that there are only 6 widgets left, instead of the 8 they need, and we have a stock-out that disrupts production until it is resolved.

In this white paper, we look at how to avoid this situation using lean inventory prediction.

Lean Inventory Prediction

Inventory tracking systems and ERP systems track the quantity of physical inventory at each location in each manufacturing plant, stock room, and warehouse.

We can extend this to predict the available inventory on future days, for each part as a time varying sequence.

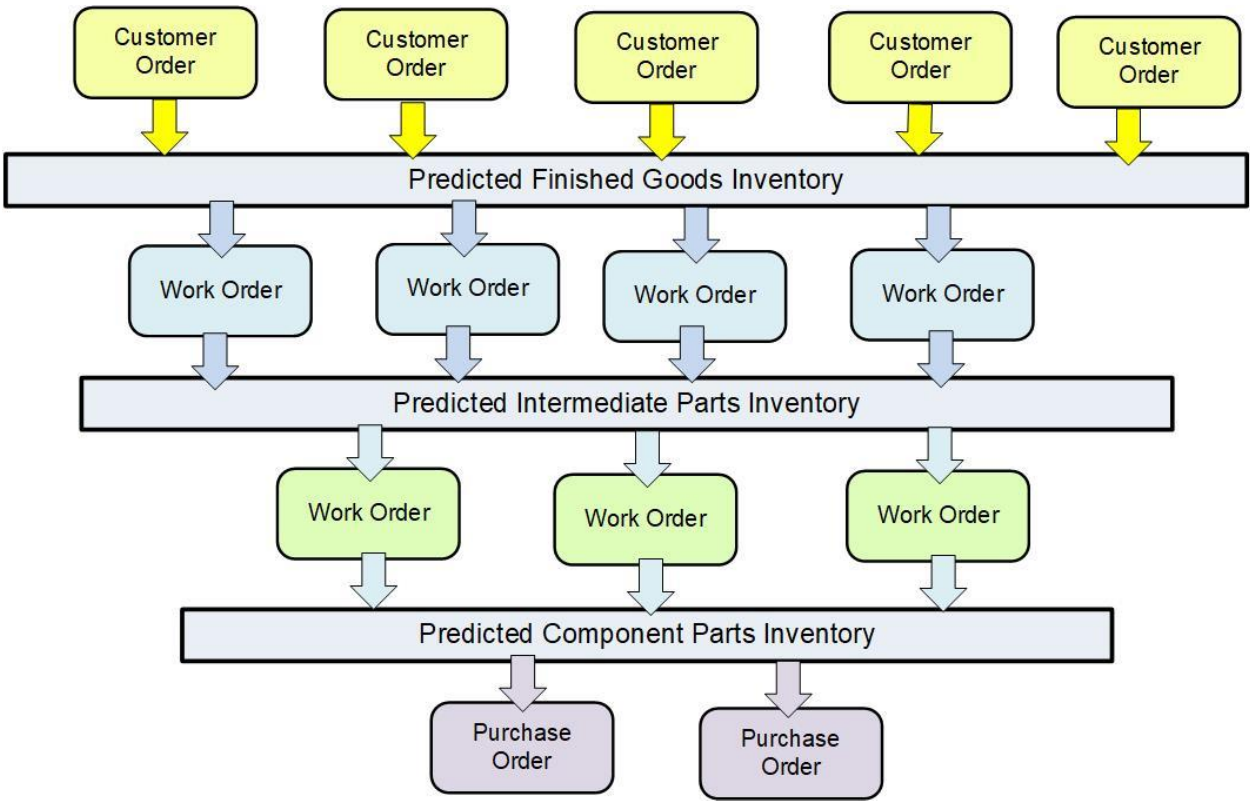


Here we take into account, by day:

1. Parts expected to be received as a result of purchase orders
2. Parts expected to be consumed as a result of work orders for making products

3. Parts expected to be produced as a result of work orders for making products
4. Parts expected to be shipped for customer orders.

Note that this predicted inventory graph changes dynamically over time as new customer orders arrive, purchase, work, and ship orders are created and parts are received, consumed, received, and shipped, with potentially the actions of many different people at multiple locations affecting available inventory.



This can happen at many different levels in the BOM (Bill of Materials) tree for finished products. Thus, the predicted inventory level for widgets may come from many customer orders, with different delivery dates, as well as the work orders issued in response to the inflowing customer orders.

Using the Predicted Inventory Data

When the manager of the widget making department looks at the predicted inventory graph for widgets, they will see days when the predicted inventory goes negative. As a result, they can issue a work order to make more widgets, so the graph does not go negative. As a result of this work order, the predicted inventory of materials needed to make widgets may go negative, as a result of which a purchase order may get created to buy more materials.

In making the decision about what materials to make or buy, the manufacturing or purchasing manager has to take into account the optimal quantity to make or buy, including any safety stock to allow for scrap or wastage, which may be more than is required at a bare minimum.

Also, the run or delivery dates of the work or purchase orders have to be appropriately adjusted to make sure that the materials are there, when needed. Similarly, the department managers of the products that use widgets may need to delay their planned run date because they see that there will not be adequate inventory until a few days later.

Assisting with Work Order Generation

Manual generation of work orders and purchase orders, in response to the incoming flow of customer orders, can require a lot or work and take a lot of managers, planners, and purchasing people's time, including time spent in coordination meetings.

This process can be automated by a computer algorithm that monitors the predicted inventory data and automatically creates work orders and purchase orders, based on a set of criteria incorporated into the rules used by the algorithm. The problem with this is that there may be special situations which are not known to the algorithms used to automatically create work orders and purchase orders.

Some situations, such as parts not being available from the primary suppliers due to a work stoppage, or that the machine normally used to make widgets is down and waiting for a spare part, result in the automated planning algorithms generating impractical plans. The reason for this is that the algorithms only incorporate specific knowledge in the form of rules and do not have the general situational knowledge of people.

An approach that incorporates the benefits of both methods is to use a decision support approach in which each department manager is presented with a list of parts that their department is responsible for, along with a summary of the predicted demand for each part.

Item #	On-Hand	Alloc	On Order	Avail	Needed	Type	Create
P101	220	110	100	10	50	Purchased	Work Order **PO**
BP103	5	25	20	0	10	Made Here	Work Order **PO**
GR112	300	400	0	-100	50	Made Here	Work Order **PO**
CR39	19	0	100	119	50	Purchased	Work Order **PO**

From this screen managers can then issue the needed work orders and purchase orders, including selecting between make or buy for specific parts. These work orders and purchase orders are typically filled out with default values from the automated algorithms but can be overridden by the manager using this screen.

Comparison with MRP Algorithms

In classical Materials Requirement Planning (MRP) algorithms, ERP system start with projected sales, for several months into the future, and then plan what materials to make and buy to support this demand, and when.

Typically, MRP planning algorithms are used by make-to-stock operations, which make large quantities of finished product and then store this in a warehouse from which they incrementally ship finished products; which is not very lean.

Planning based on predicted inventory is typically used by rapid turnaround, make-to-order manufacturers, who strive to have lean inventories at every level of the end-product BOMs. Here, the intermediate materials are made and raw materials are ordered in a Just-in-Time (JIT) materials planning methodology, spread across the organization, rather than centralized MRP planning group.

What about Scheduling?

One thing that MRP did was to determine when intermediate parts needed to be made, as well as in what quantities. This worked fine, as long as all the assumptions on which the static MRP plan was based, still held, which, in my experience, was never true.

In a dynamic, predicted inventory planning environment, work orders can be dynamically scheduled through each work center, based on their priority, materials required, and delivery dates by a system like BellHawk to ensure that materials are available before work orders are started.

What can go wrong?

As predictive-inventory based planning and scheduling is a real-time process, it is important that the data on which it is based is collected as soon as possible. This is typically done using barcode and RFID based data collection methods, using data collection and materials tracking systems such as BellHawk, which also check the data, as it is entered, to minimize errors.

This is in contrast to typical ERP systems usage, where the data is captured on the shop-floor using paper forms and spread-sheets and then typically entered the next day into the ERP system by office staff. Here, delays in entering changes to physical inventory can result in major planning errors.

Predictive inventory planning can fail if managers of the departments that make intermediate parts or that order raw materials do not look at their virtual inventory status at least on a daily basis. To help counter this problem, a system like BellHawk can send text message or email alerts to managers to alert them when materials need to be ordered or made.

Commentary

Properly used, predictive inventory tracking, such as is supported by systems like KnarrTek's BellHawk real-time data collection, job and materials tracking system, can be an ideal basis for planning the purchase of raw materials and the making of component, intermediate, and finished products.

Whether to automate the planning process is a more difficult question, as this depends on how predictable the process is and how much the planning needs to depend on people's experience and judgement. Please note that different methods can be used at different levels in the BOM tree, so that generating work orders to make finished products can possibly be automated but making widgets may need a decision support approach and purchasing may be totally manual.

Authors

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Dr. Peter Green serves as the Technical Director of KnarrTek Inc. Dr Green obtained his BSC (Hons) in Electrical Engineering and his Ph.D. Degrees in Electronics and Computer Science from Leeds University in England. Subsequently Dr. Green was a senior member of technical staff at Massachusetts Institute of Technology and a Professor of Computer Engineering at Worcester Polytechnic Institute.

Dr Green is a Systems Architect who is an expert in using real-time artificial intelligence methods to implement real-time Inventory Tracking and Operations Management systems for Industrial Organizations. He has led the implementation of over 100 such systems over the past decade. Dr Green also led the team which developed the BellHawk job and materials tracking software as well as the MilramX decision support and intelligent information integration software platform.

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Eric Green serves as the Director of Support of KnarrTek Inc. Eric Green obtained is bachelor's degree from UMASS Dartmouth in Operations Management and Management Information Systems. Eric has been a part of 40 plus implementations of operations management systems over his 8 years of experience in this field. This includes receiving, production, inventory management, shipping, order management, as well as integrations with a number of ERP systems and a range of different manufacturing equipment.

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