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GE Aviation
Inventory Management

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Degree of Bachelor of Science.

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Abstract

Our GE Aviation Inventory Management project tasked us to create an inventory *'faceplate'* tool that is user friendly and enables GE's LMO team to quickly identify and react to material input schedules. The tool utilizes raw and work in progress (WIP) balances linked to cycle times and input schedules and suggests correct input material to fulfill customer schedules while driving inventory balances down.

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Executive Summary

Inventory is the total amount of goods a business has on hand at a given time. It is a vital asset that keeps that business running smoothly, but too large amounts of inventory can lead to exorbitant cost levels. In manufacturing, a substantial amount of raw material inventory must be available to ensure production stays on time. This is why manufacturing companies implement inventory management systems; to control inventory levels to where demand can still be met and costs related to inventory can be minimized. Specifically in the engine manufacturing industry, inventory management is especially important because the costs of the parts being manufacturing can reach upwards of a million dollars. Furthermore, because parts are so large, storing inventory requires additional hefty costs.

General Electric (GE) Aviation's manufacturing plant in Lynn, MA has a large infrastructure in place to deal with inventory management. An important facet of GE's inventory management system is production planning. This involves meeting weekly demand and gauging how much raw material will be needed, how much is already within the system, and how much needs to be ordered. Previously, production specialists used multiple and sometimes contradictory or confusing databases, data gathered from machine operators, and past experience to gauge what was needed to meet production goals. Our Major Qualifying Project proposed to reduce the confusion of this process by creating a *Production Planning Faceplate*. This tool gave production specialists one quick glance source to find all the information they would need to make production decisions. By combining cost, business type, WIP levels, and scheduling information for ship level parts and their bill of material components into one tool, all information needed for production specialists and managers in each business to make decisions is easily accessed in one place. Future automation of our faceplate tool will enable it to be updated Monday mornings so specialists can have the most up to date information at their fingertips. The faceplate tool has the promise to increase inventory turnover ratios in the coming year and reduce inventory and cost levels.

Background Research

Inventory Management is important for all manufacturing industries to implement, but more specifically it is important for different industries to implement the type of inventory management system that best fits their needs. There are eight main types of inventory management systems; although there are many custom alterations made to these basic types made by companies to best fit their needs. The eight main types of inventory management systems are the perpetual system, Just in Time (JIT), Economic Order Quantity based system (EOQ), Safety Stock based system (SS), Last In First Out (LIFO) or First In First Out (FIFO), Vendor Managed Inventory (VMI), the ABC Method, and finally Material Requirements Planning (MRP). MRP is a computerized ordering and scheduling system that uses data generated from the company, like the Bill of Materials, to project what material will be needed in the future. The system keeps track of the parts that production is dependent on and analyzes it to perfect the production schedules. GE Aviation's plant in Lynn most closely follows a Material Requirements Planning system, where it predicts the demand and scheduling week to week, and sets goals for production in each business within the plant. Though MRP is not the ideal system to keep inventory levels low (JIT production would hold this title) it works best for GE Aviation because the production of turbine engines takes time production must begin before demand is placed. Therefore demand must be predicted using expertise, and past demand data. Using the information gained through our background research we were able to understand what the production tool was needed to accomplish.

Methodology

After using our background research to understand GE Aviation's inventory management practices, our project was aimed to assist the Lynn plant in improving their inventory management system and assisting the production specialists with meeting their weekly, quarterly, and yearly production goals. With this in mind, we developed three main objectives to accomplish our goal.

The first objective was to assess current GE Aviation inventory management practices. Our preliminary background research was broken into three main areas; defining inventory management, the main types of systems, and a background look into GE Aviations products and practice.

The second objective was to create a tool to help product specialists according to their needs. The goal of our tool was to aid specialists to make easier production-scheduling decisions by bringing together all the information they need into one easily accessible tool. To reach our second objective, we created prototypes of our faceplate tool, and then interviewed the production specialists and business leaders of each of the eleven businesses within the Lynn plant for feedback as to what they liked about the faceplate and what they thought it was missing. We then finalized the design of the tool by using the interviewing feedback to make the additions thought necessary.

Our third and final project objective was to aid GE Aviation in future development and automation of our production tool. In order to ensure the continued use of our faceplate as a sustainable and standardized tool, automation was necessary but unfortunately out of the scope of our project. We therefore created a process map and step-by-step *recipe book* to aid any future projects into creating an automated system.

Results

Our three main results were the production planning faceplate tool itself, the process map, which give and in depth look at the tool and its components, and the recipe book, which gives step-by-step instructions how and where all the data in the faceplate is to be collected.

After the interviewing process, we created the final faceplate design, seen below in Figure 1.

PRODUCTION PLANNING TOOL

							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Figure 1: Final Design of Our Production Planning Faceplate

The tool starts off by displaying the Ship level part searched for, what engine it is used in, a description of the part, its cycle, and cost (column 1). It then breaks down into all the Bill of Material parts necessary for that part, what type of BOM part it is, the quantity per engine, how much on hand raw material GE has on hand, the material in WIP, and the unit cost of each BOM

part. The next section of the tool is the Schedule/ Promise production planning levels for the ship level part and its components. The schedule section is the number of parts GE plans to manufacture for the week. The promise schedule takes into account demand and is what GE has told its customers it will ship out for that week. The last section is the Need/Action block. This gives the production specialist a quick glance, according to the given data what actions they need to take, such as “order more of part X from vendor Y”.

Conclusions and Recommendations

The production planning tool has the potential to greatly improve the efficiency of production at GE Aviation in Lynn. By creating a faceplate tool for business leaders and productions specialists where all necessary information can be accessed, all confusion between managements goals for production and the complexity of data and how to get the data needed to meet these goals can be eliminated.

For future sustainability, we have also recommended improvements that can be made to the faceplate as well as the business to continue to develop GE Aviation in Lynn. For the development of the faceplate, we suggested adding a filter to the database that sorts parts according to the business unit for quick reference for each business unit’s production specialist. We also suggest adding a column for vendor code for each BOM part. This would make it easy for the reordering of parts because vendor information would already be visible. We also suggest in addition to the WIP column, to add a “nonconforming (NC) parts” column that gives the amount of nonconforming parts in WIP throughout the factory. Currently, there is no easy way to access this information and it is important to know if 90% of what you think is WIP you can use in the week’s production is actually unusable. Our last suggested for the development of the faceplate is to sort BOM parts by level of need action, instead of numerical/alphabetical.

In addition to recommendations for the faceplate, we have made suggestions for further improvements of production not relating to the faceplate. We suggested implementing a *Continuous Improvements Manager* within the plant to be in charge of Lean Six Sigma practices, and sustaining 5S initiatives to keep the plant as safe as possible. After learning about the current problems the Lynn plant has with nonconforming parts, we recommended a *Red Tag System* that will store nonconforming parts both electronic as well as designating a place within the plant to hold the parts. This will give the faceplate an easy place to access information on nonconforming parts and keep the parts from cluttering the work stations throughout the plant. Finally, we

suggest the evaluation of vendors in order to reduce the number of vendors when necessary and add vendors to other areas if also necessary. By implementing the production planning faceplate tool, and taking into consideration our suggestions for further growth, GE Aviation's production specialists will be able to greatly improve the yearly inventory turnover ratio, and meet production cost goals.

Chapter 1: Introduction into Inventory Management

Inventory is the total amount of goods a business has on hand at a given time. It is an imperative asset that keeps that business running smoothly in many ways. First, inventory helps the company meet demand. Customers want products in the shortest amount of time available, and companies often satisfy this demand by keeping final goods inventory on hand.[1] Though this is good customer satisfaction, if too much final goods inventory is kept they can become outdated and therefore never sell. Businesses within industries where the demand is erratic must play a balancing act to get the amount of inventory at the needed levels. Inventory is also important to keep operations running smoothly. In manufacturing, a substantial amount of raw material inventory must be available to ensure production stays on time. In many instances, companies also opt to keep inventory between processes within the manufacturing of a product at decoupling points in order to reduce lead times and reduces the dependency of operations within the plant. This type of inventory is known as WIP, which stands for work in progress. Though it is good to have a designated amount of WIP in between some processes, the unsanctioned buildup of WIP can be an indicator of a production flaw such as a bottleneck. Inventory also helps to reduce the lead-time of placing an order, to when the product reaches the customer; the longer the lead-time, the more inventory a firm must keep on hand. Next, inventory can be used as a buffer for hedging, a customer buying in bulk for a number of reasons, and for when the company decides to buy raw materials in bulk at a discounted price. For both these instances, the money the firm will gain (hedging) or save (buying raw materials in bulk) is greater than the cost of holding excess inventory.[2] Yet despite all this, inventory also represents cash that is tied up and unavailable to the company as well as costs in storage and taxes, and excess inventory can be holding up millions of a company's money. Therefore the company must control and manage its inventory levels at the optimal level.

GE Aviation is one of the three businesses that make up the Technology Infrastructure branch of GE, along with healthcare and transportation.[3] Within GE Aviation, there are 7 worldwide plants. The plant at Lynn, MA is then broken up into 11 business units. Due to the nature and cost of the product GE Aviation in Lynn produces, any amount of inventory can cause the plant

[1] Encyclopedia, Reference For Business. (2011). *Inventory Management*
[2] Ibid.
[3] General Electric. (2011). *GE Aviation Factsheet.*

to not meet its goals for production and profit. It is the 11 business units in Lynn (explained in detail in Chapter 2) that this project aims to aid in improving production, and reducing turnover ratios, cycle times and inventory levels.

Chapter 2: Background

2.1 What is Inventory Management?

Inventory Management, also called Inventory control, is a company's efforts to comprehend the minimal cost and levels of inventory held in which they can still meet demand. Many balancing acts must be constantly addressed and monitored within inventory management. For companies such as GE Aviation, thousands of parts' inventory levels must be maintained, but depending on how often the part is used these inventory levels differ. A tool many firms use to gauge their proficiency at allotting inventory levels is the inventory turnover ratio.[4] The inventory turnover ratio is equal to sales divided by inventory and it represents the amount of times inventory is sold and replaced over a given period of time.[5] While many companies strive to reduce inventory turnover ratios, they must not sacrifice service and lead times in order to do so. Not enough inventory results in back ordering, while too much inventory can result in getting caught with obsolete goods and large expenses.[6]

One of the most important aspects to inventory management is purchase planning and raw material management. The first decision within this is deciding how long the inventory will last. Depending on the raw material and the type of inventory management system the company operates within (methods discussed later), purchase planning can be done on a number of different scales; weekly, biweekly, monthly, tri-monthly, etc. For industries with fluctuating demand, planning and material ordering must be done much more rapidly. The next decision of choosing the level of inventory per order will depend on how often a company receives material shipments.[7] The level of raw material inventory must be adequate to meet the production plan, while accounting for WIP already in the process as well as the potential WIP, defects and/or production holdups that may occur.

Over the years inventory management has made many strides, and today there are many different methods to managing a company's inventory, such as MRP or JIT. Because demand, product and

[4] Hedrick, F. D. (2010). Inventory Management.
[5] Investopedia. (2011). *Investopedia- Inventory Turnover Definition*.
[6] Hedrick, F. D. (2010). Inventory Management.
[7] Ibid.

type differ so much industry-to-industry, a method that is best for one company to reduce inventory while increasing service may not be ideal for another company in a different industry. While each system's methods on reaching optimal inventory levels differ, they are all built upon the foundation of constant inventory monitoring and improving, as well as the recording and analysis of past inventory levels compared to business success and units produced/ shipped.

2.1.1 Bill of Materials (BOM) - The Foundation of Inventory/Production Management

One if the most important and fundamental tools to a successful inventory management system is the bill of materials. In manufacturing, the bill of materials details the design and structure of a finished product.[8] Like a *recipe* for the product, a BOM (bill of materials) lists each part and the quantity of that part needed to complete the final product, and within each part listed, a BOM may include smaller, subcomponents of that part. In many cases, the BOM is organized first by '*ship level'* part. Within the ship level it is broken down into the subcomponent parts, their quantities, suppliers (sometimes more than one), costs, etc. Figure 2 is an example of a simple bill of materials for a camera.

Sample Bill of Materials for a Camera

Part Number	Description	Unit of Measure	Part Quantity
NI-15002	Camera casing	Each	1.00
NI-15003	Viewfinder	Each	1.00
NI-15004	Winding lever	Each	1.00
NI-15005	Electronics subassembly	Each	1.00
NI-15006	Film holder	Each	1.00
NI-15007	Electronic flash	Each	1.00
NI-15008	Film advance readout	Each	2.00

Figure 2: Simple Example of a Bill of Materials (Burton and Bragg)

Many inventory tools use the company's BOMs as the basis of their information. For example, a manufacturing plant that runs on a MRP System (Materials Requirement Planning System), explained later in the chapter, multiplies the bill of materials by the production schedule in order to calculate the standardized amount of parts and subcomponents needed for production.[9] The bill of materials will give production managers a standardized quantity so no one product group is ordering too much raw materials.

[8] Burton, E. J., & Bragg, S. M. (2000). *Sales and Operations for Your Small Business.*
[9] Ibid.

2.2 Types of Inventory Management Systems

Why do companies invest so much in finding the perfect inventory management system? Inventory is one of the biggest assets in most companies. When inventory turns increase, so does the companies bottom-line. Since most companies' missions are to generate the greatest profit, managing inventory because a vital part in the success of the company.[10]

All methods of inventory management are designed to accomplish the one goal of having the lowest total cost and the highest service (or product) level possible. This equal balance is something companies tend not to reach, and instead prefer to lean towards one side or the other. There is no universal method that works perfectly for every company. There are two basic types of inventory systems, continuous and periodic, with a numerous variety of methods on each system (Management Sciences, pg. 731). Each company must find the method that works within their operations and adapt it to work perfectly for them. Even after finding a method that works, a company must be up to date with research and new methods that could better improve their system.[11]

2.2.1 Minimum Stock Levels (perpetual system)

The most basic method that companies use to manage inventory is by using minimum stock levels, a type of continuous inventory system (Management Sciences, pg. 731). This method, also referred to as the perpetual system, is an independent system that orders a certain amount on a set schedule. New stock gets ordered once an existing stock has reached a certain level, or a minimum level that is normally set by the company.[12] Though this is one of the simplest ways for a company to managed inventory, there are no special benefits that come with using it.

2.2.2 Just In Time (JIT)

One of the most widely used systems of inventory management is the JIT or Just In Time method. This method looks to deliver the exact needed quantity of inventory to the production floor just in time for when it is needed. The JIT method is highly dependent on the ability of the company and the suppliers to deliver on time. If the company and suppliers were not reliable,

[10] AutoInc. Magazine. (1996, March 3). Can You Profit From Improved Inventory Control?
[11] Hamlett, K. (2011). *Methods for Inventory Control*.
[12] Ibid.

this method would never work. It is also inefficient if the supplier is not located close to the manufacturing facility since the method is so dependent on scheduling.[13]

2.2.3 Economic Order Quantity (EOQ)

The Economic Order Quantity, or EOQ model, attempts to find the balance between too much and too little inventory by looking for the optimal quantity that will deliver the lowest cost of carrying inventory. Since a fixed quantity is being ordered when the inventory reaches a specific level, the EOQ model is known as a continuous inventory system (Management Textbook). A lot of information is needed to use this formula causing it to become a complex method and it can often become unusable. To be successful using EOQ, a company needs to know the usage of units, ordering cost in $/order, annual carrying cost, unit cost in $ and order unit quantity. Without each of these values, the EOQ method is unable to be used. [14] There are assumptions to the model including constant demand, no shortages, constant lead-time and instantaneous order receipts (Management Textbook).

[13] Hamlett, K. (2011). *Methods for Inventory Control*.
[14] Ibid.

A graphical representation of EOQ is seen in Figure 3. The optimal point is when the holding cost equals the ordering cost. The EOQ is where the lowest cost to the company can be found. If holding costs are lower than the EOQ, the ordering costs are higher and the bottom line is also higher, and vice versa.

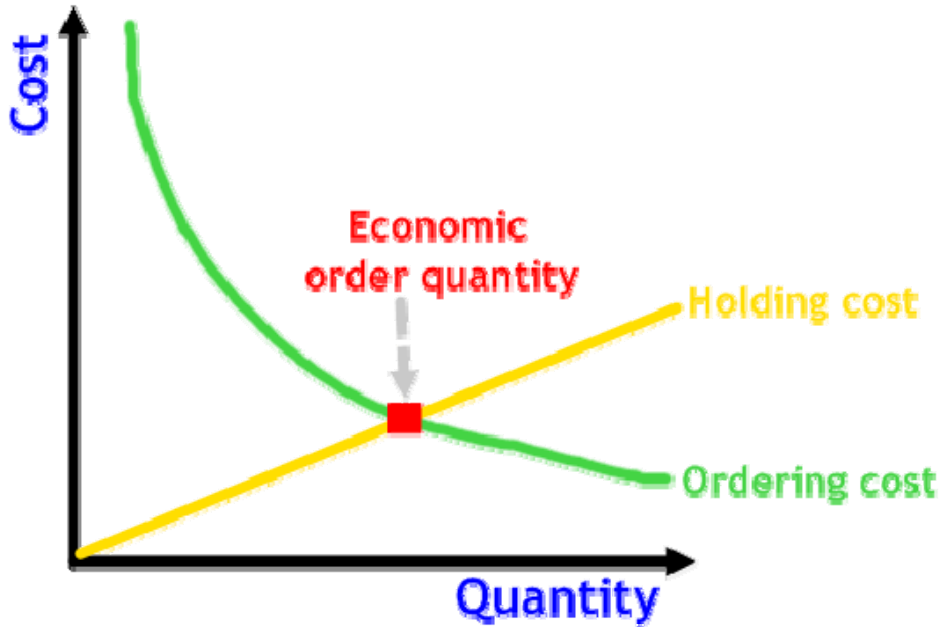


Figure 3: The Economic Order Quantity (University of Portsmouth)

Figure 4 is the most basic EOQ model. Graphed is the level of inventory in relation to time. The horizontal line on the graph is the reorder point or quantity. Once the inventory depletes to that point, a new order is placed. As the order is being filled, the rest of the inventory is depleted up until the new order quantity is ready.

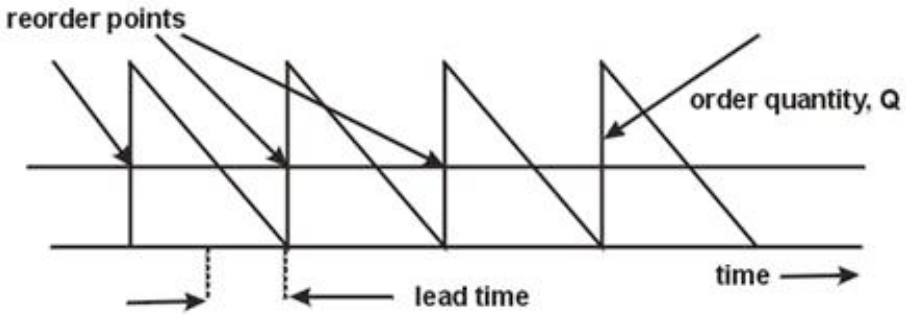


Figure 4: Simple Deterministic Inventory Model Based on Fixed Demand Lead Time (Institute for Working Futures)

2.2.4 Safety Stock (SS)

Safety stock is another common way companies manage their inventory. Companies utilize this by keeping an extra amount of inventory that is carried on top of the normal quantity. This is called the safety stock and it is used as a buffer against uncertainty with situations including supplier performance issues, long lead times and material uncertainty. Finding the perfect safety stock level is difficult due to complex formula that is used to calculate it. For companies on a tight budget, using this method can cause financial harm due to the potential holding cost associated with extra inventory.[15]

It is common for companies to carry a large amount of safety stock for seasonal or cyclical demand. Many companies that see an increase in demand during the holiday season use this method often. By producing and holding inventory during the holiday off-season, they are able to meet the demand during the busy time, but keep their production at the same level all year. Companies will also look to purchase large quantities of inventory to save money causing them to then have excess inventory. They must be careful in doing this that the cost of holding this inventory does not exceed the amount they are saving in purchasing the large quantity (Management Science, pg. 754).

2.2.5 Last in First Out (LIFO) and First in First Out (FIFO)

The best way to explain the method of LIFO would be to think of items on a shelf. The unsold items would be pushed to the back in order to make room for newer items. FIFO is a method that is similar and usually compared with LIFO. This method is one that is commonly seen in grocery stores. Restocking the selves involves taking the items already there and pushing them to the front while stocking the new items behind the older ones.

Both of these methods take different characteristics when talking about the value of inventory and calculating profit on inventory. This is because companies can have different types of products. They can have those that are one-time only where once they are sold, they are gone, or they can have items that they restock when inventory gets low. It is these types of product where LIFO and FIFO come into play when determining the value. It is the companies' choice on which method to pick to improve their profit/loss statement.[16]

[15] Hamlett, K. (2011). *Methods for Inventory Control*.
[16] Harmon, J. (2011, February 11). *What is LIFO and FIFO?*

2.2.6 Vendor Managed Inventory (VMI)

One way to manage inventory and optimize the use of a supply chain is through Vendor Managed Inventory (VMI). With access to the distributor's inventory data, this method is able to generate purchase orders along the supply chain. Normally when a distributor needs a product, they place an order with a manufacturer. With the VMI model, the manufacturer instead receives the distributors' sales and stock level data, and creates the order. With VMI, the manufacturer instead of the distributor generates orders. Figure 5 gives a visual representation of the method. As portrayed, all the information goes through the manufacturer (factory) and orders are generated to the customer locations and warehouses based on that.

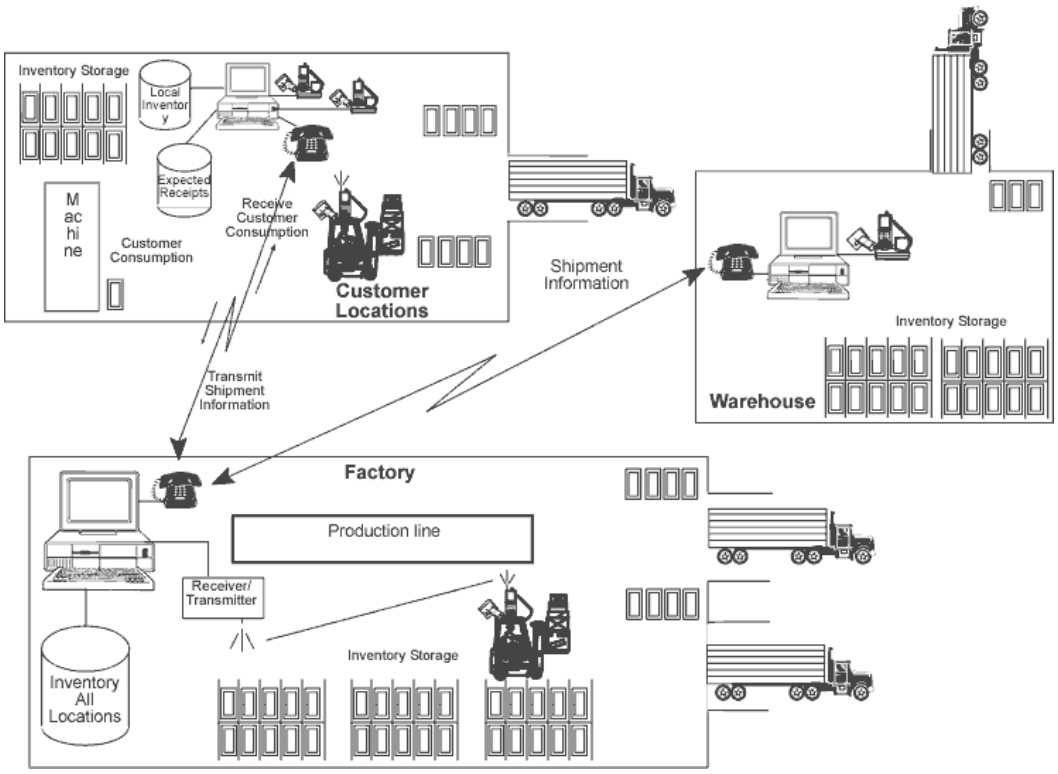


Figure 5: Map of Vendor Managed Inventory System (Current Directions Inc.)

Figure 6 is another flow chart representation of the vendor managed inventory system. In this model, the goods follow the same normal pattern, but you can see the direct route that the orders take, skipping over the retailer and the warehouse.

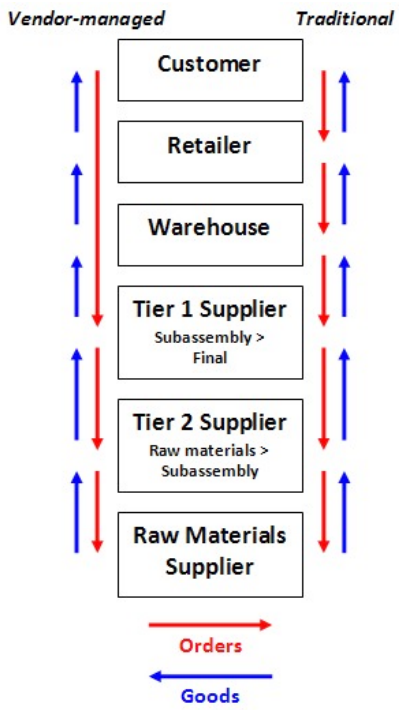


Figure 6: Flow of Orders and Goods in a VMI System (husdal.com)

Benefits of this method are spread between both the distributor and the manufacturer. For a company that is distributing product, they see a decrease in stock-outs as well as in inventory level. They decrease the cost of planning and ordering since they are no longer the ones responsible for it. Because the distributor is not stressed over planning and ordering, they are more focus on other areas of the company and are able to provide better service. Manufacturers see benefits in the visibility of the data. They are able to avoid ordering errors by distributors and are able see potential need for products before they are ever ordered. This allows them to plan ahead for larger orders. Areas where both benefit are in less data entry errors, better timing and an improvement in overall customer service.

With benefits come the potential disadvantages of the VMI method. When implementing this method, there might be resistance from any of the parties involved since it is something that

breaks away from the normal. As always, there is still as risk that the data being sent to the manufacturer could be wrong.[17]

2.2.7 ABC Method

The ABC method of inventory management focuses on categorizing items in terms of their importance to the company.[18] This method is also known as the Pareto Principle which states that 20% of inventory comes from 80% of the overall volume. More simply, a small percent of your products make up the major of your inventory.[19] Items are given rankings to determine this small percent. Higher value items, usually the higher dollar items, are given an 'A' will those least important to the company are given a 'C'. Companies would give items with an 'A' ranking more attention when looking at inventory, such as when ordering is needed. There is a lot of work associated with method since the inventory must be analyzed frequently to stay up to date and successful.[20] Figure 7 shows an example of a graphical representation of the ABC method. It can be seen on this graph that 20% of the total items account for just over 80% of the total company usage.

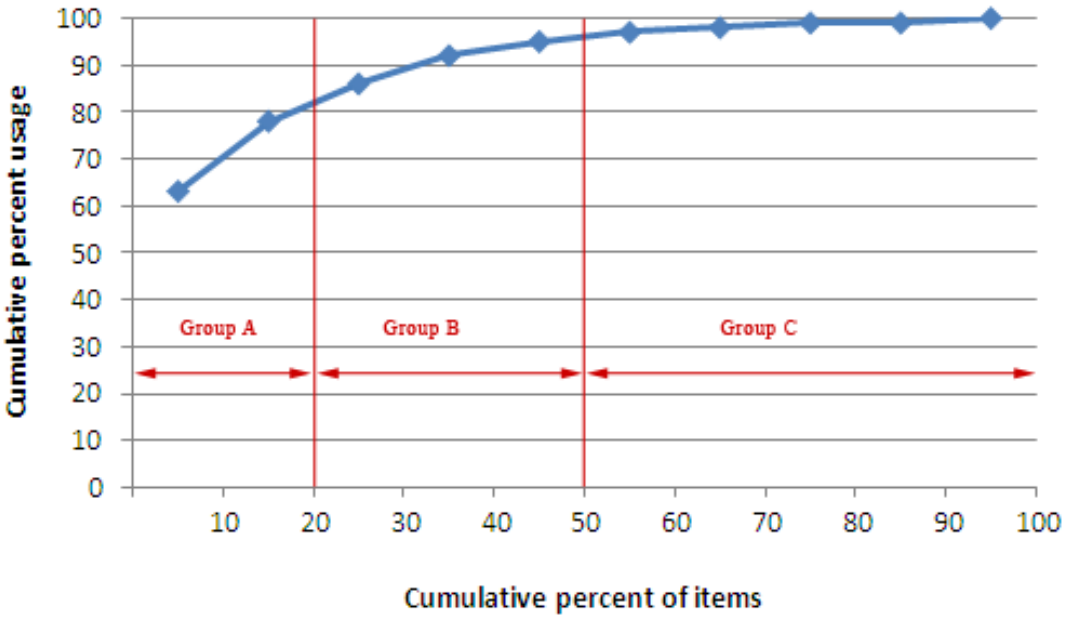


Figure 7: Graphical Representation of ABC Method (Al-Salamah)

[17] Vendor Managed Inventory. (2011). *Definition of Vendor Managed Inventory.*
[18] Barron's Educational Series Inc. (2000). *Abc Method.*
[19] Andrew Goldman for Gaebler Ventures. (2001-2011). *Pareto Analysis: ABC Inventory.*
[20] Barron's Educational Series Inc. (2000). *Abc Method.*

By using this method, companies are able to focus on the products that need the attention. Time spent on the less important products can be used to concentrate on those higher value products that in the long run will help in managing the inventory.[21]

2.2.8 Material Requirements Planning (MRP)

This method inventory control helps to streamline business processes and control order processing. It is a push system that has a sort of backwards system of scheduling. MRP is a computerized ordering and scheduling system that is ideal for the manufacturing and fabrication industries since it uses data generated from the company, like the BOM, to project what material will be needed in the future, how much and exactly when.[22] The system keeps track of the parts that the production is dependent on and analyzes it to perfect the production schedules. The benefits of MRP are that it is able to track the effects of many different variables throughout production. Though it does have a great deal of benefits and can greatly improve the productivity of a company, it is still a system that takes some time to implement. It takes large amounts of data for it to work properly so for a new company with very little information about lead times, usage and productivity, this system is not ideal. Figure 8 is a basic flowchart depicting an MRP system.

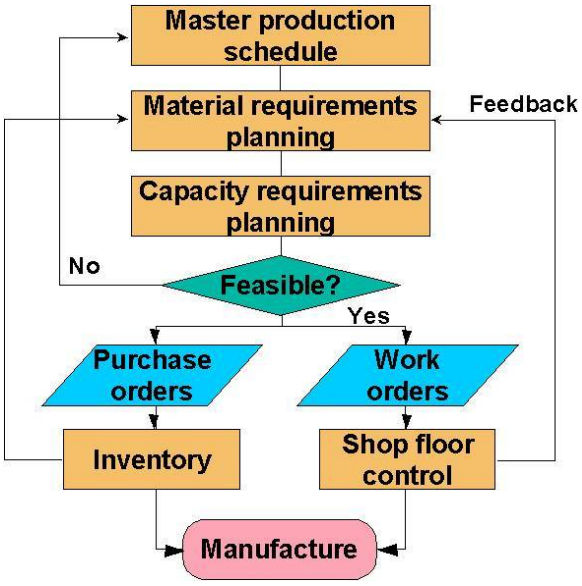


Figure 8: Flow of a MRP system (Finntrack)

[21] Andrew Goldman for Gaebler Ventures. (2001-2011). *Pareto Analysis: ABC Inventory.*
[22] BusinessDictionary. (2011). *Material Requirements Planning (MRP-MRP-I).*

The improvement upon the MRP system is the system of ERP that has been referred to as the big brother of MRP. ERP or Enterprise Resource Planning is an MRP system that has been expanded from just production activities into the entire company supporting multiple users at once.[23] It is good to know that with the discovery of one beneficial planning tool that there is another tool stemming from it to help companies even more.

2.3 GE- Aviation

General Electric, GE, is divided into five main branches: NBC Universal, GE Capital, Home and Business Solutions, Technology Infrastructure, and Energy. GE Aviation is one of the three businesses that make up the Technology Infrastructure branch of GE, along with healthcare and transportation.[24] The products and services of this business include jet engines, aerospace systems and equipment, replacement parts and maintenance services for commercial aircraft, military aircraft, and executive and regional aircraft.[25] These are sold worldwide to airframe manufacturers, airlines, and government agencies. Since creating the first turbo supercharger for an aircraft engine for the United States Army during World War I, GE has led the aviation industry in the pursuit and development of new technology. These achievements include: the creation of the first U.S. jet engine and turboprop engine, the first variable stator engine, the first Mach 2 engine, the first high bypass engine, the first variable cycle turbofan engine, the first un-ducted fan engine, the first 30:1 pressure ratio engine, and setting the world record in steady-state thrust with the GE90-115B at 122,965 pounds.[26]

There are 34 engines produced by GE for different types of aircrafts, which are grouped by use into business and general aircraft, commercial aircraft, marine aircraft, and military aircraft. No matter what engine is being produced however, they all share the same basic structure. At the front of the engine is the fan, which is composed of many carbon fiber and titanium blades. The fan rotates and draws in great amounts of air and creates thrust. Behind the fan is the low-pressure compressor, which is made up of another series of rotating blades that squeeze the air drawn in by the fan and push it against stationary blades to increase pressure, temperature, and energy. The air then flows into the high-pressure compressor where the pressure, temperature

[23] Keasler, C. (2011). *Definition of ERP Systems.*
[24] General Electric. (2009). *2009 Annual Report.*
[25] General Electric. (2011). *GE Aviaiton Factsheet.*
[26] General Electric. (2011). *Engines 101.*

and energy are increased again. Next is the combustor, which is a metal casing, ringed with fuel injectors, located after the compressors capable of withstanding temperatures in excess of 1500 degrees Fahrenheit. Air enters the combustor from the compressors, is slowed, and then mixed with the jet fuel. The air then ignites, forcing exhaust gas rapidly toward the rear of the engine, which spins the high-pressure turbine. This turbine is attached to a driveshaft, which powers the compressor. The final part of the engine is the low-pressure turbine, which is powered by the exhaust gas after it passes through the high-pressure turbine. The low-pressure turbine is also attached to a drive shaft, which powers the fan at the front of the engine, pulling in more air that is then fed back into the turbines.[27]

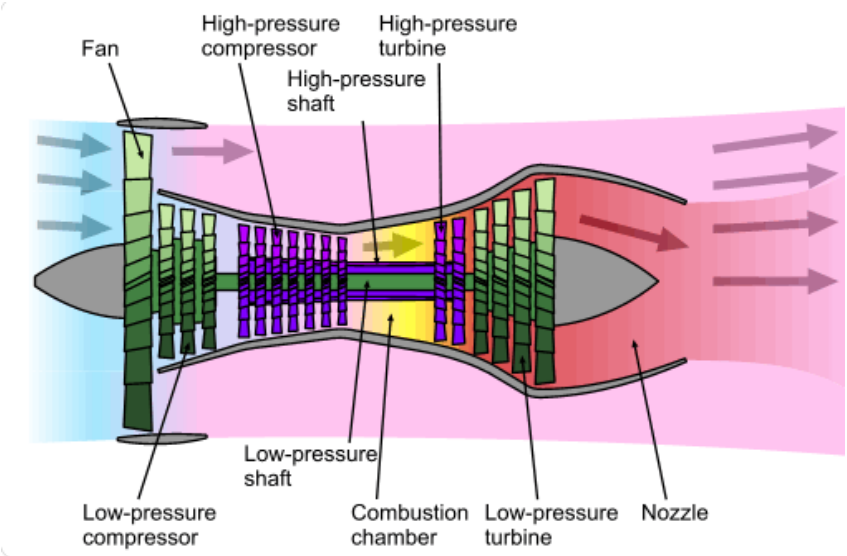


Figure 9: The Basic Structure of a GE Engine (Draganfly Innovations Inc.)

GE Aviation has ten manufacturing facilities in the United States, and one of these facilities is in Lynn, Massachusetts. This plant is made up of over twenty buildings across 225 acres, and employs 3,800 people[28]. Production is divided into two different groups, Lynn Plant 1, which makes the rotating parts, and Lynn Plant 2, which manufactures combustors. Each plant consists of multiple buildings. Lynn Plant 1 includes 7 different business units: disks and spools (RPMO), frames (TEPM), shafts and discs (TPMO and MEMO), rings and bushings (SPMO), seals and cooling plates (TPCE), and spools and shafts (TC64). Within Lynn Plant 2, there are 4 individual business units: large combustors (LCMO), small combustors (SCMO), HIRSS, and mixed

[27] General Electric. (2011). *Engines 101.*
[28] Pantazopoulos, John (2010). Optimized Welcome To GE Lynn

products (MPMO). At this particular location, rotating parts and combustors are made for over 26 different types of engines[29].

The mix of products produced in Lynn is evenly split between military and commercial engines. About 52% of production is military, while 48% is commercial[30]. The total manufacturing output is $730 million, with $215 million (29%) being from combustion and $184 million (25%) from rotating parts[31]. In 2009, the technology infrastructure branch of GE made $42,474 million in revenues. GE Aviation brought in $18,728 million, or 44% of the total revenues for this group of businesses, and 12% of the $156,783 million in revenues brought in by GE as a whole.[32]

General Electric is the top manufacturer in the world of turbofan engines, followed by Rolls-Royce and Pratt & Whitney (based on market share).[33] GE engines power the Boeing 747, 767, and 777, the Airbus A330, and the GEnx engine was developed for the Boeing 747-8 and 787. Their F110 engine also powers 80% of the United State's Air Force's F-16 Fighting Falcons, and the F404 and F414 engines power the Navy's F/A-18 Hornet and Super Hornet. Out of the 34 different engines GE manufactures, 16 of them are for military use. GE focuses on the military section of the turbofan engine market; however they also power a significant part of the commercial aircrafts as well. Rolls-Royce, second behind GE as a manufacturer of aircraft engines, powers mostly commercial aircrafts such as the Airbus A380. Pratt & Whitney engines power some Boeing and Airbus aircrafts, as well as the U.S. Air Force's F-22 Raptor and the F-16 Fighting Falcon, however the newer Falcons have the option to use the GE F110 engine instead. General Electric also has a joint venture with Snecma, a French company, called CFM International. In terms of market share, CFM International would replace Pratt & Whitney as the third largest manufacturer of turbofan engines in the world. The CFM56 engines power the Boeing 737, Airbus A340, and Airbus A320 families.[34]

[29] Pantazopoulos, John (2010). Optimized Welcome To GE Lynn
[30] Ibid.
[31] Ibid.
[32] General Electric. (2009). *2009 Annual Report.*
[33] World News Network. (2011). *Turbofan Engine.*
[34] Ibid.

Chapter 3: Methodology

This project was aimed to assist GE Aviation in improving their inventory management system and assisting the Lynn, MA plant production specialists with meeting their weekly, quarterly, and yearly production goals. We accomplished our goals by conducting scholarly research, assessing GE Aviation in Lynn, MA's inventory management practices through observation and onsite research, and assessing the needs of their production specialists through interviewing. These methods helped us create a tool that will aid them in better reaching production goals.

Our Project Objectives were as follows:

- Assess current GE Aviation inventory management practices
- Create a tool to help production specialists, according to their needs
- Aid GE Aviation in future development and automation of our production tool.

In order to complete these objectives and reach our project goals, many key attributes were addressed. Figure 10 diagrams the approach we used in meeting our objectives.

Figure 10: Methodology Flowchart Illustrating the Goals and Process of Our Project

The project took place from October 1, 2010 through March 5, 2011. The following sections show how we achieved our objectives.

3.1 Assess Current GE Aviation Inventory Management Practices

This section refers to our first objective. Our background research helped us understand the different types of inventory management systems that are used by different industries. We organized our research into three main categories, defining inventory management, looking at the different types of systems used in all facets of business, and background research into GE

Aviation's product, business structure, and practices. By first identifying how each system works, we were able to then identify what type of system GE Aviation in Lynn, MA most commonly used.

3.2 Create a Tool to Help Production Specialists, According to Their Needs

This section refers to our second objective. In order to better control inventory levels and meet production time and cost goals, we created a tool to help business leaders and production specialists make production-scheduling decisions. This production planning tool brings together information from several different sources to give a complete picture of current inventory information as well as production and order scheduling. With all of this information available, this tool then highlights any individual parts within a certain business unit that the production specialists need to look at more closely. From there the production specialists will use their knowledge and experience to determine what action needs to be taken with that specific part. This tool will help maximize the effectiveness of the inventory system by allowing production specialists to focus only on parts that might be negatively affecting inventory levels or might prevent a promised order from being shipped.

3.2.1 Development and 'Prototypes'

The first prototype of this tool that was created included only very basic inventory and production information. It shows the top five ship level parts for each business unit, the bill of materials (BOM) for each of those parts, the unit cost of each individual part, and the production and ordering schedule for the next eight weeks. An example of this tool for the HIRSS business unit is shown in Table 1.

HIRSS													
				Schedule									
Ship Level	BOM	Type C or 2 Bin	Unit Cost	DLQ	46	47	48	49	50	51	52	53	Total
3063T65G02	17A166-540G02	#N/A	$1,021.5250	0	6	10	0	16	14	18	4	68	136
F404	17A190-404G02	#N/A	$238.0100	0	0	36	0	90	96	48	0	270	540
FLAMEHOLDER	17A190-538G01	#N/A	$1,526.3600	0	0	0	0	0	6	15	0	21	42
	17A190-657P01	#N/A	$595.4580	0	20	0	0	32	34	15	0	101	202
	17A190-658P01	#N/A	$474.9100	0	20	0	0	20	28	15	0	83	166
	17A190-659G01	#N/A	$26.0050	0	0	57	0	131	0	111	0	299	598
	17A190-659G02	#N/A	$26.0600	0	0	102	0	124	0	156	0	382	764
	17A190-660P01	#N/A	$7.9060	60	0	0	0	717	142	772	0	1691	3382
	17A190-661P01	#N/A	$9.8740	12	0	0	0	65	73	85	0	235	470
	17A190-662P01	#N/A	$6.5470	20	0	0	0	25	269	40	0	354	708
	17A190-662P02	#N/A	$6.5130	0	0	63	0	96	6	106	0	271	542
	17A190-665G01	#N/A	$26.0390	0	139	64	0	324	0	228	0	755	1510

Table 1: Example of the HIRSS part spreadsheet

The ship level parts for each business unit are located in a spreadsheet called **Top_Parts_for_BOM** that ranks each ship level part by their value in the individual business unit. The BOM for each of these parts as well as their unit cost is added from the **sox76_LMO_201009** file. This information was modified to only include parts that are bought from other suppliers, not ones that are made in the LMO facility, as well as exclude any parts that were Type C or 2 BIN parts. Finally, the production and ordering schedule is located in the LMO Supplier Materials Input Report (**SMIR**). This file includes the most recent scheduled receiving quantities for the BOM of each ship level part along with any parts that are delinquent from the supplier. Combining all these different sources of information into one place provides the base for the final production-planning tool.

3.2.2 Interviewing

The next step was to meet with the materials manager John Pantazopoulos and each of the business leaders and/or production specialists to discuss the usefulness of the production planning tool and what information should be added. We first gave them a background into what our goals for the tool are; help control and minimize excess inventory, making the tool automated so it is available with new information on a weekly basis, and to provide each business with the action needs to be taken with their specific inventory. We then provided each business leader with the prototype example of our faceplate tool and asked each for feedback on what it is missing, what they like about it, if it is easy to read and understand, and if they would find it useful.

3.2.3 Editing the Tool According to Specialist Feedback

From the interviews, it was determined that the quantity per engine (QPE) of each part, the on-hand raw balance (O/H Raw), and the number of parts in WIP should be included in the production-planning tool. Table 2 is an example of the final tool for the ship level part

“2110M69G06”.

PRODUCTION PLANNING TOOL																
							Schedule/Promise									
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24

Table 2: Our "Faceplate" tool for Part 2110M69G06

It includes the new information in addition to the ship level part, BOM, unit cost, and schedule from the original version. The “Type” column refers to whether the part is a C part, 2 BIN, or SMIR. Since our tool does not want to include 2 BIN or C parts, the values in this column should all be “SMIR”, which indicates the parts are bought from suppliers. The quantity per engine (QPE) of each part is located in the **sox76_LMO_201009** file along with the BOM for every part. The O/H Raw balance is the number of parts still in raw inventory, and the WIP column shows any parts that are somewhere along the production line. For this tool, both of these pieces of information were taken from the GE Aviation **Cognos** reports. The schedule data in this version is similar to the original design, however it includes the production schedule for the ship level part as well. Including the number of ship level parts promised to be shipped each week, the number delinquent, and the number scheduled to be produced each week is important in helping production specialists make informed decisions. The production schedule for the ship level parts is also exported from the GE **Cognos** reports into Excel, which is then imported into the production tool.

The final addition to the production planning tool is a section that provides production specialists the information that is most useful to them quickly and easily. Table 3 highlights this section of the faceplate.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 3: Highlighted is the 'Quick Look Need for Action' Section for Production Specialists

This part of the tool shows any action that might need to be taken to ensure promised production levels are met or to avoid extra inventory for every single BOM part in each business. The "Need" column uses the schedule and promise data for the ship level part to determine if the current orders placed to the suppliers for BOM parts will be enough to produce all of the promised ship level parts. If it is not, a positive number will appear in the "Need" column indicating to the production specialist that production goals may not be met. If the order schedule indicates there will be extra parts in inventory, the "Need" column will display a negative number. This indicates that specific part order is not needed and can be delayed, or "pushed", out to the next week without affecting production goals. The "Action" column provides the production specialists with a suggestion for any actions that may need to be taken for each part. These are only suggestions however; each production specialist must use their knowledge and experience to make final production planning decisions. The goal of this tool is to provide them with the information they need quickly and easily.

3.3 Aid GE Aviation in future development and automation of our production tool.

This section refers to our third and final objective. Because the span of our project was only 21 weeks, it was impossible for the faceplate tool to continue to be manually updated on a weekly basis, but automating the tool was also out of the realm of our project. We therefore have addressed this objective by creating a process map that illustrates what each section of the tool refers to, where the information can be found, and how to access it. Our intention in creating the process map is to make it as easy as possible for a GE IT Co-op, or future MIS MQP group to understand and access all the information the production specialists need. The most detailed *'recipe book'* process map can be found in Chapter 4: Results and Analysis.

Chapter 4: Results and Analysis

Our two major deliverables were the process map, which describes each aspect of the production planning faceplate, and the step-by-step recipe book, which maps out the exact steps to accessing the needed data to create the faceplate. Both are shown in this chapter.

4.1 Production Planning Tool: Process Mapping

Our final faceplate tool is designed to provide production specialists with a quick-glance spread of information that will give them all the necessary information for them to make important production, ordering, and inventory decisions. The following process mapping illustrates where each section of the production tool comes from and how it can be accessed. Not only was it important for us to understand how to access the data, but also for future improvement and automation of the faceplate our process map will make it much easier for an outside source to automate the data. The below sections outline the in-depth details of each category. Appendix A provides a more step-by-step analysis.

4.1.1 Column 1: Ship Level

PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 4: Production Planning Faceplate, Column 1

This first column within the production-planning tool is used to display information about the ship level part. It allows the production specialist, to easily see that they have located the right part and have the entire general information readily available to them. The first piece of information is the ship level part number or codes, which in this case it is "*2110M69G06*". This information is pulled from the **Top_Parts_for_BOM** spreadsheet. The **Top_Parts_for_BOM** spreadsheet lists the most important parts to each business, as well as the company, based on the capital associated with them. Next piece of information being pulled in is what engine the ship

level part belongs to. In this case it is the "*GE90*". This information is also found within the spreadsheet **Top_Parts_for_BOM** under the program column. The next piece of information is the description of what the ship level part is since the part number doesn't tell exactly what it is. For the example above, that would be "*COMB ASSY"* which is an abbreviation for combustor assembly. Again the information for this is found in the **Top_Parts_for_BOM** spreadsheet. The total cycle time is next after the part description. This is measured in weeks so in the example above, it would be a cycle time of 2 weeks. The cycle is calculated to include the cumulative cycle time of the part. The production specialists provide this information in their sum of planned cycles. An example of how GE looks at their cycle times can be seen in Figure 11.

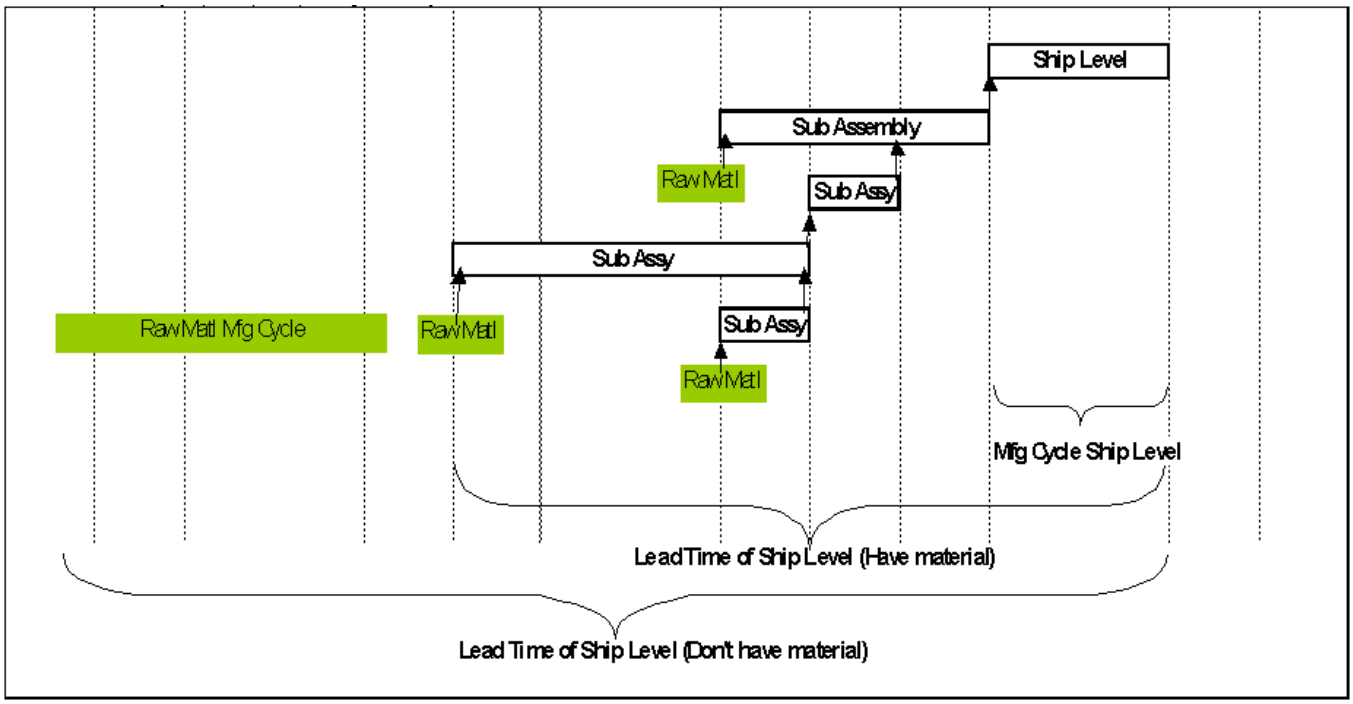


Figure 11: Breakdown of the Cumulative Cycle Time for a Part

The last piece of information contained in this column of the faceplate is the unit cost of the ship level part. The example (part number 2110M69G06) shown in Table 4 has a unit cost of *$131,074.30*. This piece of information is found under the **sox76_LMO_201009** report under the unit cost column. The **sox76_LMO_201009** report contains a large amount of information so this value is slightly confusing to locate due to the spreadsheet layout. The data being pulled from the 'sox report' is in the unit cost column and for this specific part, is in the row with the part number called '*2110M69G06 total*.' This is true for all part unit values that a production

specialist will need. Table 5 is a screen shot of ship level part within the **sox76_LMO_201009**. Highlight is the line of the *2110M69G06 total* and an arrow points to the unit cost. It is important to note that the data being pulled into the production tool does not match the current unit cost on the sheet because the tool and spreadsheet are from different time periods so the unit cost has changed.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :	September-2010					
2	U	Measured Part Numbe	Bill of Materials	Dest Pla	QPA	Total Quantity	Total Cost	Current Unit Co	Prior Unit Cost	Extended Variar	Make Bu	OvrC D	LGUC Monti	sorter cell
597	7344	1862M99P01	17A166-849P01	999	1.000	151.0000	$3,457.5980	$22.8980	$22.8970	$0.1510	B	2	201005	1862M99P01999
598	7344	1862M99P01 total				151.0000	$5,856.2400	$38.7800	$38.7900	($1.5100)				1862M99P01999total
599	7344	1878M41G08	17A190-133G04	999	60.000	120.0000	$22,707.7200	$189.2310	$189.2310	$0.0000	B	2	201005	1878M41G08999
600	7344	1878M41G08	1878M21P01	999	1.000	2.0000	$8,687.7120	$4,343.8560	$4,343.8560	$0.0000	B	2	201005	1878M41G08999
601	7344	1878M41G08	1878M29P01	999	30.000	60.0000	$4,586.7000	$76.4450	$76.4850	($2.4000)	B	2	201005	1878M41G08999
602	7344	1878M41G08	1878M30P01	999	30.000	60.0000	$5,107.8000	$85.1300	$85.1410	($0.6600)	B	2	201005	1878M41G08999
603	7344	1878M41G08 total				2.0000	$53,682.2100	$26,841.1100	$25,259.9000	$3,162.4200				1878M41G08999total
604	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170	$2.5180	($1.0800)	B	2	201005	2110M69G06DEA
605	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180	$1.0210	($3.2400)	B	2	201005	2110M69G06DEA
606	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740	$61,259.8010	($841.7430)	B	2	201004	2110M69G06DEA
607	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690	$4,701.8500	($349.0290)	B	2	200912	2110M69G06DEA
608	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900	$32,540.2640	($1,081.5660)	B	2	201002	2110M69G06DEA
609	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350	$12,355.4330	$0.0180	B	2	201005	2110M69G06DEA
610	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270	$1,270.5260	$0.0180	B	2	201005	2110M69G06DEA
611	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530	$192.1640	($8,159.9400)	B	4	201006	2110M69G06DEA
612	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000	$131,651.7100	($18,078.3900)				2110M69G06DEAtotal
613	7344	2254M78G01	17A137-947G03	999	1.000	2.0000	$1,007.8740	$503.9370	$503.9090	$0.0560	B	2	201005	2254M78G01999
614	7344	2254M78G01	17A190-579P01	999	1.000	2.0000	$4,519.2720	$2,259.6360	$2,244.6720	$29.9280	B	2	200910	2254M78G01999
615	7344	2254M78G01 total				2.0000	$7,381.5200	$3,690.7600	$3,337.3300	$706.8600				2254M78G01999total

Table 5: Line with Part 2110M69G06 within the sox76_LMO_201009 Report.

4.1.2 Column 2: Bill of Materials (BOM)

PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 6: Production Planning Tool, Column 2: BOM

The BOM column highlighted in Table 6 displays the part number for every part in the Bill of Materials (BOM) for the ship level part shown in column 1. In this case, the part "17A190-543G02" (column 2, row 3) is the first part in the BOM for the ship level part "2110M69G06". This information is taken from the **sox76_LMO_201009** file, which is organized by ship level part. This column only includes parts that are bought from suppliers, not any which are made in

the LMO facility. The BOM is what tells the production specialists every part that is needed in order to produce each ship level part. These are the parts whose order schedules have a direct impact on inventory levels and meeting production goals.

4.1.3 Column 3: Type

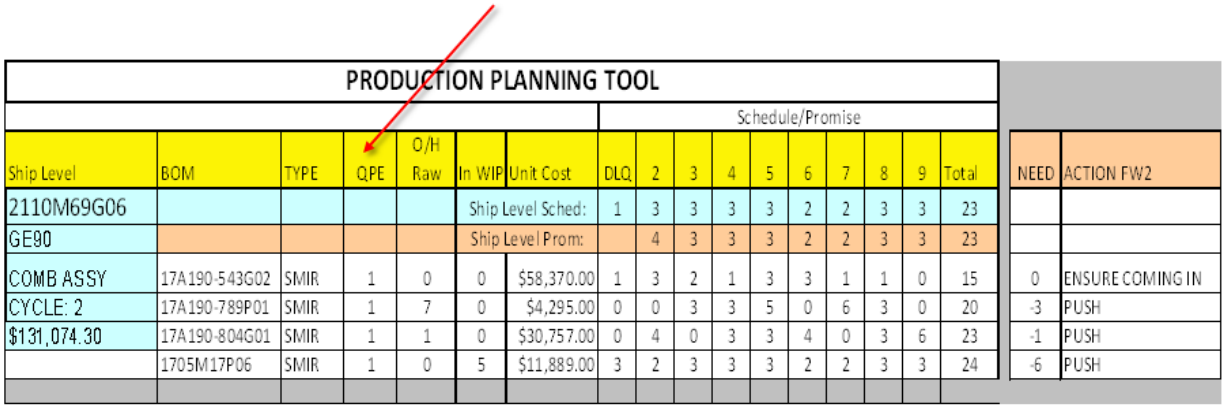
PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 7: Production Planning Tool, Column 3: Type

The ‘Type column’ for the production planning tool is used to sort out the BOM parts to just the parts production specialists want to focus on (**Error! Reference source not found.**). Though it looks simple on the faceplate, this column is one of the most difficult to understand and create. The complexity is based off the fact that the different types of part have scheduling pulled in from different spreadsheets because they are either brought to LMO in a different way or are made within LMO. It contains a filter so that those looking at the tool can either look through all the parts of the BOM or can just see the type they want. The main type this tool will ultimately be used for is the SMIR parts, which is the default of the filter. We are looking mainly at these SMIR parts because they are the parts purchased from outside suppliers and ones that have a large impact on production. We do not want to focus on parts being made in-house, LP4 parts, but the option is part of the filter if someone looking at the tool was curious what parts LMO made for the ship level parts. Other bought part types include 2BIN and C parts. We do not want to focus on these since they come from the SDC, the central GE Warehouse. The 2BIN parts arrive in batches and bins with no SMIR schedule attached to them. They tend to be smaller parts such as screws and washers that are essential for assembly but things with a small unit price. The C parts are from another shop or warehouse that tripped an order to LMO for parts. First to determine whether the part is make or buy for LMO, we must compare the part number to the

make/buy column on the **sox76_LMO_201009**. If make, then the part is labeled LP4, if it is bought then it is filtered through the next spreadsheet. In order to determine if these parts of the BOM are 2BIN or C parts, the part numbers from the BOM column of the production-planning tool need to be compared to the **Sept YTD SDC** spreadsheet. More specifically within that sheet, we want to look at the *column E* for the part number, and if it is there, it is either a 2BIN or C part. If the part number that is being pulled in by the BOM is either of these parts, then it is labeled by its respected type and then shown with that type in the production tool. If it is not a made part and is not present in the **Sept YTD SDC** spreadsheet, then it is most likely a SMIR report part and should remain on the production-planning tool under the type "*SMIR*".

4.1.4 Column 4: Quantity per Engine (QPE)

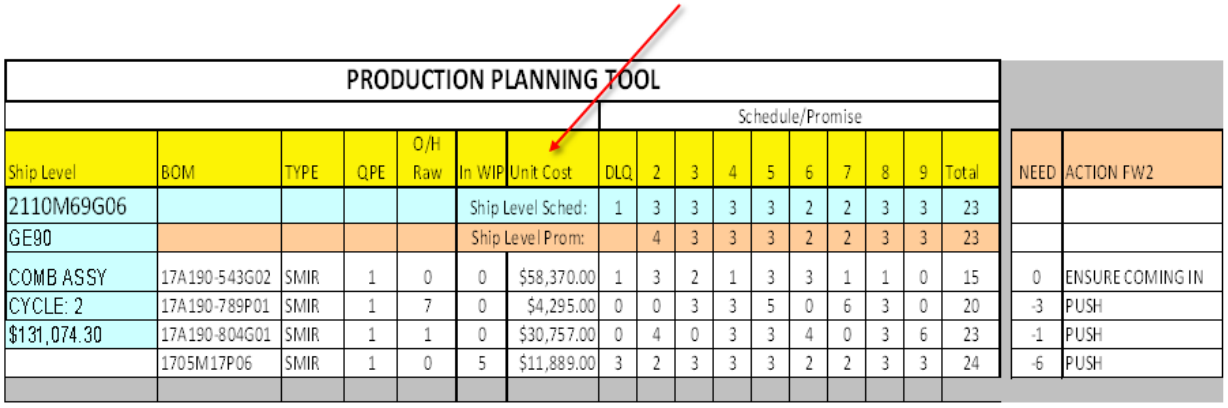


PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 8: Production Planning Tool, Column 4: QPE

The QPE column (Table 8) displays the quantity of each BOM part needed to produce the ship level part. In this example, only one of each of the parts shown in the BOM is needed to produce one ship level part number "2110M69G06". This information is located in the **sox76_LMO_201009** file under the "QPA" (Quantity per Assembly) column. The **sox76_LMO_201009** file is organized by ship level part, and the "QPA" is shown for each BOM for a ship level part. This information is used to help make order and production schedules. If a part requires more than one unit to produce a ship level part, this will increase the amount ordered from the supplier.

4.1.5 Column 7: Unit Cost

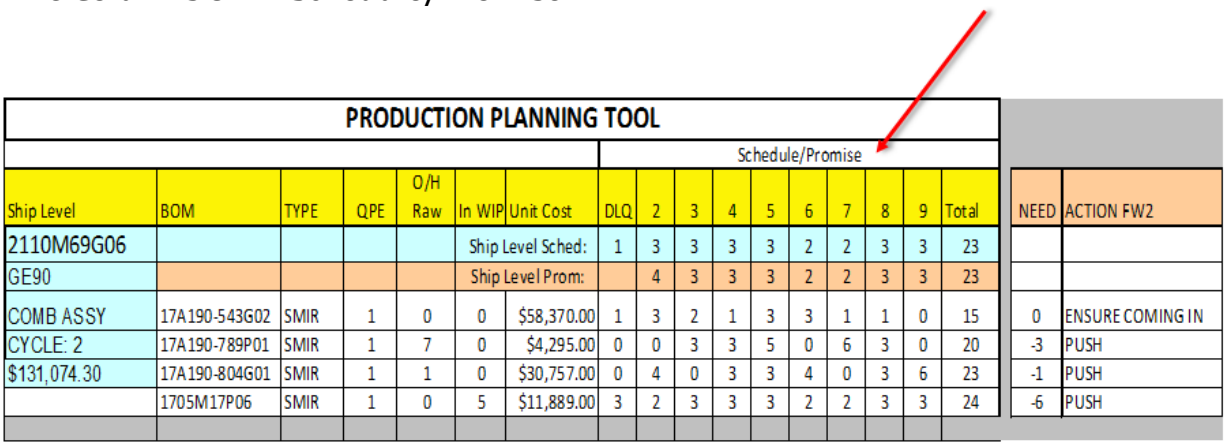


PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 9: Production Planning Tool, Column 7: Unit Cost

The 'Unit Cost' column (Table 9) displays the unit cost for every part in the BOM of the ship level part. In this case, the cost for one part with the number "17A190-789P01" is $4,295. This information is located in the **sox76_LMO_201009** file in the column labeled "Current Unit Cost". This file is ordered by ship level part, and the unit cost is displayed for every sub-level part. This file also displays previous unit costs for each part, but this production-planning tool will use the current cost levels. The unit cost tells the production specialist how much each part costs to purchase, or on the other hand how much they will save if they do not need to order this part.

4.1.6 Columns 8-17: Schedule/Promise



PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 10: Production Planning Tool, Columns 8-17: Schedule to Promise

The ‘Schedule/Promise’ column in the faceplate (Table 10) shows the planned production of the ship level part (“Ship Level Sched:”), as well as the promised number of parts to be shipped (“Ship Level Prom:”), for the current week and the next 7 fiscal weeks. The ship level schedule is taken from a query run in **Cognos**, which imports this information into **Excel**. This information can then be imported into the production-planning tool. The promised shipments of the ship level parts are calculated based on the ship level schedule and the number of parts delinquent (DLQ). This “Schedule/Promise” column also shows the scheduled receipts from suppliers of the BOM parts for those same weeks. In this example, LMO is scheduled to receive 4 units of part number “17A190-804G01” in the current week (fiscal week 2). This information is located in the most recent **SMIR report** (Supplier Materials Input Report), which is organized by business unit and part number. The production-planning tool will update this information on Monday of every week. The current week will always be furthest to the left, and the schedules for the next seven weeks will follow. The number of parts delinquent will also update each week. This scheduling information is the most important for production specialists to make accurate decisions. Based on the number of ship level parts promised, orders for individual can be confirmed or delayed to minimize inventory.

4.2 Step-by-Step *Recipe Book*: How to Make the Production Faceplate

Another deliverable to GE Aviation was the *recipe book*, a step-by-step look into how to create the faceplate tool. Though it is similar to the process map, where the process map describes what each column is and why it is important, the recipe book describes exactly how to access all the information needed to create the faceplate. This will jump start the future development of the faceplate into a fully automated database.

4.2.1 Column 1: Ship Level

The first column in the faceplate is the ship level part number. Also under the Ship Level column is the engine name the part belongs to, a description of the part, the part’s cycle time, and the unit cost of the part.

4.2.1.1 Row 1. Ship Level Part Number

1. Go to **Top_Parts_for_BOM** file located in:
   Z:\RPCoE-Ln\Inventory\WPI Inventory Project Oct’10 – Apr’11
2. Select the ship level part number in the **“Part Number”** column.

	A	B	C	D	E	F	G	H	I	J
1	Team	Part Number	Program	Description	2010 Total Qty	2010 SCO	2010 Mat'l	Rank	Cum Output	% Cum Output
2	LCMO	2110M69G06	GE90	COMBUSTOR ASSY	152	$22,370,387	$21,557,710	1	$22,370,387	5%
3	LCMO	2256M26G03	CFM56P	COMBUSTION LINER	656	$22,219,142	$13,479,689	2	$44,589,529	10%
4	LCMO	2255M71G01	F110	SLEP COMBUSTOR	386	$16,797,271	$11,571,980	3	$61,386,801	14%
5	SCMO	6080T13G08	T700P	COMB LINER	1526	$16,077,587	$9,034,084	4	$77,464,387	17%
6	LCMO	L38640G04	LM2500	COMBUSTOR ASSY	22	$5,823,884	$5,623,646	5	$83,288,271	19%
7	TEPM	1933T73G03	T700P	MF/FF KIT	518	$10,109,671	$5,584,201	6	$93,397,943	21%

Table 11: Top_Parts_for_BOM Part Number Column

3. Link the ship level part number from this file to the first cell in the Ship Level column of the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
								Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 12: Production Planning Faceplate, Column 1, Row 1

4. Do this for every ship level part for each business.

4.2.1.2 Row 2. What Engine the Part Belongs to

1. Go to **Top_Parts_for_BOM** file.
2. Locate the **"Program"** column.

	A	B	C	D	E	F	G	H	I	J
1	Team	Part Number	Program	Description	2010 Total Qty	2010 SCO	2010 Mat'l	Rank	Cum Output	% Cum Output
2	LCMO	2110M69G06	GE90	COMBUSTOR ASSY	152	$22,370,387	$21,557,710	1	$22,370,387	5%
3	LCMO	2256M26G03	CFM56P	COMBUSTION LINER	656	$22,219,142	$13,479,689	2	$44,589,529	10%
4	LCMO	2255M71G01	F110	SLEP COMBUSTOR	386	$16,797,271	$11,571,980	3	$61,386,801	14%
5	SCMO	6080T13G08	T700P	COMB LINER	1526	$16,077,587	$9,034,084	4	$77,464,387	17%
6	LCMO	L38640G04	LM2500	COMBUSTOR ASSY	22	$5,823,884	$5,623,646	5	$83,288,271	19%
7	TEPM	1933T73G03	T700P	MF/FF KIT	518	$10,109,671	$5,584,201	6	$93,397,943	21%

Table 13: Top_Parts_for_BOM Program Column

3. Link the value in this column to the cell beneath the ship level part number in the Ship Level column of the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 14: Production Planning Faceplate, Column 1, Row 2

4. Do this for every ship level part for each business.

4.2.1.3 Row 3. Description of Ship Level Part

1. Go to **Top_Parts_for_BOM** file.
2. Locate the **"Description"** column.

	A	B	C	D	E	F	G	H	I	J
1	Team	Part Number	Program	Description	2010 Total Qty	2010 SCO	2010 Mat'l	Rank	Cum Output	% Cum Output
2	LCMO	2110M69G06	GE90	COMBUSTOR ASSY	152	$22,370,387	$21,557,710	1	$22,370,387	5%
3	LCMO	2256M26G03	CFM56P	COMBUSTION LINER	656	$22,219,142	$13,479,689	2	$44,589,529	10%
4	LCMO	2255M71G01	F110	SLEP COMBUSTOR	386	$16,797,271	$11,571,980	3	$61,386,801	14%
5	SCMO	6080T13G08	T700P	COMB LINER	1526	$16,077,587	$9,034,084	4	$77,464,387	17%
6	LCMO	L38640G04	LM2500	COMBUSTOR ASSY	22	$5,823,884	$5,623,646	5	$83,288,271	19%
7	TEPM	1933T73G03	T700P	MF/FF KIT	518	$10,109,671	$5,584,201	6	$93,397,943	21%

Table 15: Top_Parts_for_BOM Description Column

3. Link the value in this cell to the cell beneath the cell with the engine the ship level part belongs to in the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 16: Production Planning Faceplate, Column 1, Row 3

4. Repeat this for each ship level part.

4.2.1.4 Row 4. Cycle Time

1. Collect the cycle time for each part from the Production Specialist in charge of that specific business unit.

2. Add that cycle time to the **“Ship Level”** column below the description of the ship level part.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 17: Production Planning Faceplate, Column 1, Row 4

4.2.1.5 Row 5. Unit Cost of Ship Level Part

1. Go to the **sox76_LMO_201009** file.
2. Locate the **“Total Cost”** column.

	A	B	C	D	E	F	G	H
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :
2	Unit	Measured Part Number	Bill of Materials	Dest Plant	QPA	Total Quantity	Total Cost	Current Unit Cost
789	7344	2110M69G06	2110M69G06	DEA	1.000	9.0000	$12,358.2780	$1,373.1420
790	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170
791	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180
792	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740
793	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690
794	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900
795	7344	2110M69G06	17A190-817G01	DEA	1.000	9.0000	$10,315.7550	$1,146.1950
796	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350
797	7344	2110M69G06	2110M68G04	DEA	1.000	9.0000	$26,373.1860	$2,930.3540
798	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270
799	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530
800	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000
801	7344	2254M78G01	2254M78G01	999	1.000	2.0000	$1,854.3840	$927.1920

Table 18: sox76_LMO_201009 Total Cost Column

3. Locate the value under the **“Measured Part Number”** column that matches the ship level part and is followed by ***“total”*** (example: “2110M69G06 total”).

	A	B	C	D	E	F	G	H
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :
2	Unit	Measured Part Number	Bill of Materials	Dest Plant	QPA	Total Quantity	Total Cost	Current Unit Cost
789	7344	2110M69G06	2110M69G06	DEA	1.000	9.0000	$12,358.2780	$1,373.1420
790	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170
791	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180
792	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740
793	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690
794	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900
795	7344	2110M69G06	17A190-817G01	DEA	1.000	9.0000	$10,315.7550	$1,146.1950
796	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350
797	7344	2110M69G06	2110M68G04	DEA	1.000	9.0000	$26,373.1860	$2,930.3540
798	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270
799	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530
800	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000
801	7344	2254M78G01	2254M78G01	999	1.000	2.0000	$1,854.3840	$927.1920

Table 19: sox76_LMO_201009 Measured Part Number and "totals" Column

4. Link the value in the **"Total Cost"** column that corresponds with the row from the **"Measured Part Number"** column to the Ship Level column in the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
								Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 20: Production Planning Faceplate, Column 1, Row 5

4.2.2 Column 2: Bill of Materials (BOM)

1. Go to the **sox76_LMO_201009** file.
2. Locate the **"Bill of Materials"** column.

	A	B	C	D	E	F	G	H
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :
2	Unit	Measured Part Number	Bill of Materials	Dest Plant	QPA	Total Quantity	Total Cost	Current Unit Cost
789	7344	2110M69G06	2110M69G06	DEA	1.000	9.0000	$12,358.2780	$1,373.1420
790	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170
791	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180
792	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740
793	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690
794	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900
795	7344	2110M69G06	17A190-817G01	DEA	1.000	9.0000	$10,315.7550	$1,146.1950
796	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350
797	7344	2110M69G06	2110M68G04	DEA	1.000	9.0000	$26,373.1860	$2,930.3540
798	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270
799	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530
800	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000
801	7344	2254M78G01	2254M78G01	999	1.000	2.0000	$1,854.3840	$927.1920

Table 21: sox76_LMO_201009 Bill of Materials Column

3. Link the values in this column corresponding to the correct ship level part number in the **"Measured Part Number"** column to the **"BOM"** column in the Production Tool, beginning in the same row as the description of the ship level part.

PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 22: Production Planning Faceplate, Column 2

4.2.3 Column 3: Type

1. Go to the **sox76_LMO_201009** file.
2. For each part from the **"BOM"** column in the Production Planning Tool, locate the value in the **"Make/Buy"** column.

	A	B	C	D	E	F	G	H	I	J	K	L
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :	September-2010			
2	Unit	Measured Part Number	Bill of Materials	Dest Plant	QPA	Total Quantity	Total Cost	Current Unit Cost	Prior Unit Cost	Extended Variance	Make Buy	OvrC D
789	7344	2110M69G06	2110M69G06	DEA	1.000	9.0000	$12,358.2780	$1,373.1420	$1,320.6820	$472.1400	M	2
790	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170	$2.5180	($1.0800)	B	2
791	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180	$1.0210	($3.2400)	B	2
792	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740	$61,259.8010	($841.7430)	B	2
793	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690	$4,701.8500	($349.0290)	B	2
794	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900	$32,540.2640	($1,081.5660)	B	2
795	7344	2110M69G06	17A190-817G01	DEA	1.000	9.0000	$10,315.7550	$1,146.1950	$1,463.0620	($2,851.8030)	M	2
796	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350	$12,355.4330	$0.0180	B	2
797	7344	2110M69G06	2110M68G04	DEA	1.000	9.0000	$26,373.1860	$2,930.3540	$3,515.0570	($5,262.3270)	M	2
798	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270	$1,270.5260	$0.0180	B	2
799	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530	$192.1640	($8,159.9400)	B	4
800	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000	$131,651.7100	($18,078.3900)		

Table 23: sox76_LMO_201009 Make or Buy Column

3. If the value in the **"Make/Buy"** column is:
    a. **"M"**: label that BOM part **"LP4"** in the **"TYPE"** column of the Production Planning Tool.
    b. **"B"**:
        i. Go to the **Sept YTD SDC Input** file, located in: Z:\RPCoE-Ln\Inventory\Material_input\2010 Input\September 2010 (**IMPORTANT**: Always use the most recent month's file)
        ii. Locate the BOM part number in the **"Ship Part Number"** column. If it is not there, label that BOM part **"SMIR"** in the **"TYPE"** column of the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 24: Production Planning Faceplate, Column 3

    iii. If it is there, locate the corresponding value for the BOM part number in the **"TYPE C OR 2 BIN"** column.

	E	F	G	H	I	J	K	L	M	N	O
	SHIP PART NUMBER	SHIP QTY	SHIP UNIT COST	SHIP EXT COST	RCD TYPE	TRANS TYPE	BILL TO ADN	DOCUMENT NUMBER	SHIP DATE	PL	TYPE C OR 2 BIN
	1316M84G01	166.00	104.648	17,371.568	QTYCST	INT		C57987158	30-Dec-09	F1	C
	1561M47P02	322.00	4.351	1,401.022	QTYCST	INT	734452PDLP2P	2N1201761	17-Dec-09	F1	2
	1561M47P02	300.00	4.351	1,305.300	QTYCST	INT	734452PDLP2P	2N1202370	05-Jan-10	F1	2
	1561M47P02	300.00	4.351	1,305.300	QTYCST	INT	734452PDLP2P	2N1202700	13-Jan-10	F1	2
	1561M47P02	622.00	4.351	2,706.322	QTYCST	INT	734452PDLP2P	2N1202697	13-Jan-10	F1	2
	1561M47P02	322.00	4.351	1,401.022	QTYCST	INT	734452PDLP2P	2N1202698	13-Jan-10	F1	2

Table 25: Sept YTD SDC Input, Type C or 2 Bin Column

    iv. Link this label (either **"C"** or **"2"**) to the **"TYPE"** column for that BOM part in the Production Planning Tool.
4. Add a filter to this column. Be able to filter by type of part (**"LP4", "SMIR", "C",** or **"2"**).

4.2.4 Column 4: Quantity per Engine (QPE)

1. Go to the **sox76_LMO_201009** file.
2. Locate the **"QPA"** column.

	A	B	C	D	E	F	G	H
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :
2	Unit	Measured Part Number	Bill of Materials	Dest Plant	QPA	Total Quantity	Total Cost	Current Unit Cost
789	7344	2110M69G06	2110M69G06	DEA	1.000	9.0000	$12,358.2780	$1,373.1420
790	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170
791	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180
792	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740
793	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690
794	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900
795	7344	2110M69G06	17A190-817G01	DEA	1.000	9.0000	$10,315.7550	$1,146.1950
796	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350
797	7344	2110M69G06	2110M68G04	DEA	1.000	9.0000	$26,373.1860	$2,930.3540
798	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270
799	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530
800	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000
801	7344	2254M78G01	2254M78G01	999	1.000	2.0000	$1,854.3840	$927.1920

Table 26: sox76_LMO_201009 QPA Column

3. For each BOM part, link the value from the **"QPA"** column to the **"QPE"** column of the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 27: Production Planning Faceplate, Column 4

4.2.5 Column 5: O/H Raw (On-Hand Raw Material)

1. Open **Cognos**.
2. Export the On Hand Raw Balance information for the current week to **Excel**.
3. Link the On Hand Raw Balance values for each BOM part to the **"O/H Raw"** column in the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 28: Production Planning Faceplate, Column 5

4. This column should update every Monday to display the most current values.

4.2.6 Column 6: In WIP

1. Open **Cognos**.
2. Export the In WIP information for the current week to **Excel**.
3. Link the WIP values for each BOM part to the **"In WIP"** column in the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 29: Production Planning Faceplate, Column 6

4. This column should update every Monday to display the most current WIP values.

4.2.7 Column 7: Unit Cost

1. Go to the **sox76_LMO_201009** file.
2. Locate the **"Current Unit Cost"** column.

	A	B	C	D	E	F	G	H	I	J	K	L
1	SOX76-R1 Internal Transfers Detail Cost for LMO-LYNN PLANT 1 & 2							Cost period :	September-2010			
2	Unit	Measured Part Number	Bill of Materials	Dest Plant	QPA	Total Quantity	Total Cost	Current Unit Cost	Prior Unit Cost	Extended Variance	Make Buy	OvrC D
789	7344	2110M69G06	2110M69G06	DEA	1.000	9.0000	$12,358.2780	$1,373.1420	$1,320.6820	$472.1400	M	2
790	7344	2110M69G06	J334P08A	DEA	120.000	1080.0000	$2,718.3600	$2.5170	$2.5180	($1.0800)	B	2
791	7344	2110M69G06	1639M26P02	DEA	120.000	1080.0000	$1,099.4400	$1.0180	$1.0210	($3.2400)	B	2
792	7344	2110M69G06	17A190-543G02	DEA	1.000	9.0000	$550,496.4660	$61,166.2740	$61,259.8010	($841.7430)	B	2
793	7344	2110M69G06	17A190-789P01	DEA	1.000	9.0000	$41,967.6210	$4,663.0690	$4,701.8500	($349.0290)	B	2
794	7344	2110M69G06	17A190-804G01	DEA	1.000	9.0000	$291,780.8100	$32,420.0900	$32,540.2640	($1,081.5660)	B	2
795	7344	2110M69G06	17A190-817G01	DEA	1.000	9.0000	$10,315.7550	$1,146.1950	$1,463.0620	($2,851.8030)	M	2
796	7344	2110M69G06	1705M17P06	DEA	1.000	9.0000	$111,198.9150	$12,355.4350	$12,355.4330	$0.0180	B	2
797	7344	2110M69G06	2110M68G04	DEA	1.000	9.0000	$26,373.1860	$2,930.3540	$3,515.0570	($5,262.3270)	M	2
798	7344	2110M69G06	2110M72P01	DEA	2.000	18.0000	$22,869.4860	$1,270.5270	$1,270.5260	$0.0180	B	2
799	7344	2110M69G06	2253M78G01	DEA	60.000	540.0000	$95,608.6200	$177.0530	$192.1640	($8,159.9400)	B	4
800	7344	2110M69G06 total				9.0000	$1,166,786.9600	$129,643.0000	$131,651.7100	($18,078.3900)		

Table 30: sox76_LMO_201009, Current Unit Cost Column

3. For every BOM part, link the corresponding value in the **"Current Unit Cost"** column to the **"Unit Cost"** column in the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 31: Production Planning Faceplate, Column 7

4.2.8 Columns 8-17: Schedule/Promise

4.2.8.1 Row 1. Ship Level Schedule

1. Open **Cognos**.
2. Export ship level schedules to **Excel**.
3. Link the schedule for the ship level part to the **"Ship Level Sched"** row of the Production Planning Tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 32: Production Planning Faceplate, Column 8, Row 1

4. Do this for the current week, as well as the next 7 fiscal weeks.
5. Automate this so that each Monday, this row updates so that the current fiscal week is always the first shown.
6. Link the number of delinquent parts from the **Cognos** data to the **"DLQ"** column in the Production Planning Tool.

PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 33: Production Planning Faceplate, Columns 8-17

7. This column should update each week to show the number delinquent for the current fiscal week.

4.2.8.2 Row 2. Ship Level Promise

1. The **"Ship Level Prom"** row is calculated from the **"Ship Level Sched"** row and the **"DLQ"** column.

PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 34: Production Planning Faceplate, Column 8, Row 2

2. The value in the **"Ship Level Prom"** row for the current fiscal week is equal to the value in the **"Ship Level Sched"** row for the current week plus the value in the **"DLQ"** column for the ship level part.
3. The value in the **"Ship Level Prom"** row for the seven future weeks displayed is equal to the value in the **"Ship Level Sched"** row.
4. The values in this row should be recalculated each week to account for changes in ship level schedules or delinquent parts.

4.2.8.3 Columns 8-17, Rows 4-7: Numbers within the BOM Schedule

1. Go to the most recent **SMIR report**, located in: Z:\RPCoE-Ln\Inventory\Material_input\SMIR_Weekly_Data
2. Locate the values for the order schedule of each BOM part for the current week and the seven following weeks in the **"Sum of Qty"** row.

	A	B	C	D	E	F	G	H	I	J	K
1	BU	TPCE	PRODUCTION + DEVELOPMENT								
2											
3					cf_week						
4	Part_Number	Unit_Cos	ENG	Data	Delinquent	9	10	11	12	13	Grand Total
5	17A190-218P0	1578	CFM COMM	Sum of Qty		13	14			6	33
6				Sum of Ext_Cost		20,514	22,092			9,468	52,074
7	17A190-237P0	2186	CFM COMM	Sum of Qty		6	1	2		4	13
8				Sum of Ext_Cost		13,116	2,186	4,372		8,744	28,418
9		2254	CFM COMM	Sum of Qty	1	1	2		6	2	12
10				Sum of Ext_Cost	2,254	2,254	4,508		13,524	4,508	27,048

Table 35: SMIR Report, Sum of Quantity Row

3. Link these values to the corresponding weeks in the Production Planning tool.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 36: Production Planning Faceplate, Column 8, Row 3

4. This schedule should be updated at the start of each week.

4.2.9 Columns 18-19: Need/Action Box

4.2.9.1 Need

1. This row is calculated using the **Ship Level Promise**, **BOM Schedule**, and **QPE** data.

PRODUCTION PLANNING TOOL																		
							Schedule/Promise											
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 37: Production Planning Faceplate, Need Column

2. The values in this column equal:

Need = (Ship Level Promise*QPE) – (BOM Schedule*QPE)

4.2.9.2 Action FW2

1. This column depends on the value in the **"Need"** column.

PRODUCTION PLANNING TOOL																	
							Schedule/Promise										
Ship Level	BOM	TYPE	QPE	O/H Raw	In WIP	Unit Cost	DLQ	2	3	4	5	6	7	8	9	Total	NEED	ACTION FW2
2110M69G06					Ship Level Sched:		1	3	3	3	3	2	2	3	3	23		
GE90					Ship Level Prom:			4	3	3	3	2	2	3	3	23		
COMB ASSY	17A190-543G02	SMIR	1	0	0	$58,370.00	1	3	2	1	3	3	1	1	0	15	0	ENSURE COMING IN
CYCLE: 2	17A190-789P01	SMIR	1	7	0	$4,295.00	0	0	3	3	5	0	6	3	0	20	-3	PUSH
$131,074.30	17A190-804G01	SMIR	1	1	0	$30,757.00	0	4	0	3	3	4	0	3	6	23	-1	PUSH
	1705M17P06	SMIR	1	0	5	$11,889.00	3	2	3	3	3	2	2	3	3	24	-6	PUSH

Table 38: Production Planning Faceplate, Action Column

2. If the number in the **"Need"** column is:
    a. **"0":** The action column should display **"ENSURE COMING IN"**
    b. **Negative:** The action column should display **"PUSH"**
    c. **Positive:** The action column should display **"PULL"**
3. This information should be displayed for the current fiscal week, and updated at the start of each week.

Chapter 5: Conclusions and Recommendations

In conclusion, the production planning tool has the potential to greatly improve the efficiency of production at GE Aviation in Lynn. By creating a faceplate tool for business leaders and productions specialists where all necessary information can be accessed, all confusion between managements goals for production and the complexity of data and how to get the data needed to meet these goals can be eliminated.

Our faceplate combines data from on floor WIP data, warehousing On/Hand data, SMIR report spreadsheet, Cognos report, sox76_LMO_201009 report, Sept YTD SDC spreadsheet, Top_Parts_for_BOM Bill of Materials, all of which production specialists would need to analyze before making production decisions.

Because it was out of the scope of our project to automate the faceplate, we aided future automation by creating the Step-by-Step Process Map found in Appendix A. This process map details each section, column, and row of the faceplate as well as where and how to access the information used for each section. By creating this automation, the sustainability of the faceplate increases greatly, and in relation the improvement to production at GE Aviation in Lynn will greatly improve and become more efficient.

5.1 Recommendations for Further Improvement of the Faceplate

With the time and information that we had during this project, we developed the best possible faceplate. Though the faceplate as it is would be beneficial to the production specialists at GE, there are a few suggestions that we have to make it and even more useful.

The most basic suggestion we had was to add a business unit section or filter to the faceplate. This would allow those looking at the tool to easily be able to search within their specific business unit and make a quick reference to what area each ship level part belongs.

Another piece of information that we thought could be useful while looking at the faceplate would be to have the vendor code there. This is because different vendors bring in some of the same parts. If there is a problem part coming in and more than 1 vendor supplies that part, it will

easily show with vendor is the problem and allows the production specialist to know who to take action with immediately. Along with pulling in the vendor code, we believe that pulling in the specific vendor information (name, location, etc.) so that the production specialist does not have to go look at yet another spreadsheet to determine whom they need to contact about the problem.

The next suggestion we have for the future of the faceplate is to add the number of nonconforming parts into the WIP. GE has nonconforming parts that are not taken care of that sit around wasting space and money. Many of these parts are often forgotten about. By including the number of nonconforming parts with the WIP on the faceplate, the production specialist will be able to take actions on those parts that are wasting money. Until they take action on those nonconforming parts, the number will remain prevalent on the faceplate hopefully forcing the production specialist to either have those parts reworked or removed from the system.

Our last suggestion for improvements upon the faceplate is to sort the parts of the BOM according to the action needed on them instead of in alphabetical order, then numerical order. For some of the ship level parts, there could be 100 parts in the BOM and only a couple of them might have an action required on them. To prevent the production specialist from having to search over the list to find the ones that require the action, those could be right on top so the hassle of searching could be eliminated. Underneath all the action parts, the list could remain as it is now in alphabetical then numerical order.

Furthermore, having a "search" area where production specialists can search for a specific part number either may be a helpful tool to add to the faceplate.

5.2 Recommendations for Future Improvement of the Business

Though the faceplate has the potential to improve production and reduce inventory turnover rates and lead times, GE has the opportunity to further progress production in its Lynn, MA plant by implementing other tools and initiatives throughout the manufacturing floor.

The first recommendation is to organize within the Operations Management Leadership Development (OMLP) Program's Technical-Lean sector a *Continuous Improvement Manager* rotation. The employee in this rotation can be in charge of creating new ideas and initiatives for further Lean improvements within the plants in Lynn. An example of the type of project this manager would be in charge of is creating tools to improve ergonomics within the plant.

Machines and parts within the plant can be cumbersome and can cause injury. Working with the plant employees and machine operators to improve the ergonomic state of the plate will create a safer and more enjoyable work environment. The Continuous Improvement Manager can also be in control of 5S initiatives (Sorting, Setting in order, Systematic cleaning, Standardize, and Sustain) within the plants. Because many of the machines create massive amounts of heavy metal chip residue, it is imperative to create a system for the safe removal of these chips throughout production because they can become a safety issue.

When creating our faceplate, we learned that some of the WIP in the plants is nonconforming (NC), but there is no system where all nonconforming information is held that is easy for production specialists to find. We therefore propose the use of a *Red Tag System* where if a part is nonconforming within production for a standardized, allotted time, it is added into a computerized 'red tag' system that will hold details of when the part became nonconforming, how far along in production it is, any machine operator notes on the part on how to fix it, and where it can be located. The most important part of the red tag system would be physically putting all nonconforming items into a given space in the plant so they are not adding clutter to the process area where they became nonconforming.

Also while completing our production planning faceplate we noticed many parts in the BOM are bought from different vendors, and in many cases the same part is bought from multiple vendors. While this creates a fall back if one vendor does not come through, it also adds a lot of confusion and can cause the over-ordering of a part. For example if a production specialist realizes they are running low on a part, they will reorder from a given vendor. However what they may not realize it that a shipment of that part is scheduled from a different vendor also. We therefore propose a re-evaluation of vendors to try and reduce numbers where possible. This may create more positive relationships with GE vendors, which ensures business with those vendors to run more smoothly.

Appendix A: Works Cited

Al-Salamah, Dr. Muhammad. "ABC Inventory Control." 14 February 2011. King Fahd University of Petroleum and Minerals- Faculty Pages. February 2011 <http://faculty.kfupm.edu.sa/SE/salamah/ABC_inventory_control/ABC_inventory_control.htm>.

Andrew Goldman for Gaebler Ventures. "Pareto Analysis: ABC Inventory." 2001-2011. gaebler.com- Resources for Entrepreneurs. January 2011.

AutoInc. Magazine. Can You Profit From Improved Inventory Control? 3 March 1996.

Barron's Educational Series Inc. "Abc Method." 2000. Dictionary of Business Terms. February 2011 <http://www.answers.com/topic/abc-method>.

Burton, E. James and Steven M Bragg. Sales and Operations for Your Small Business. Hoboken, NJ: John Wiley and Sons, 2000.

BusinessDictionary. "Material Requirements Planning (MRP-MRP-I)." 2011. BusinessDictionary.com. January 2011 <http://www.businessdictionary.com/definition/material-requirements-planning-MRP-MRP-I.html>.

Current Directions Inc. "Vendor Managed Inventory." 2011. Current Directions Inc. January 2011 <http://www.currentdirections.com/success/mfg-corrigated-materials--vendor-managed-inventory.html>.

Draganfly Innovations Inc. "How RC Jet Engines Work." 2008. Draganfly Innovations. February 2010 <http://www.rctoys.com/pr/2008/07/16/how-rc-jet-engines-work/>.

Encyclopedia, Reference For Business. Inventory Management - levels, system, model, type, business, system, What is inventory?, Why keep inventory?, Controlling inventory, Balancing inventory and costs, Other lot-sizing techniques. 2011. January 2011 <http://www.referenceforbusiness.com/management/Int-Loc/Inventory-Management.html>.

Finntrack. "Learning Operations and Productivity- Capacity Planning." 2010. EDU-Finntrack. February 2011 <http://courseware.finntrack.eu/learners/ops_principles.htm>.

General Electric. "2009 Annual Report." 2009. GE: Imagination at Work. December 2010 <http://www.ge.com/ar2009/pdf/ge_ar_2009.pdf>.

—. "Engines 101." 2011. GE Aviation. January 2011 <http://www.geae.com/education/engines101/>.

—. "GE Aviaiton Factsheet." 2011. GE Aviation. January 2011 <http://www.geae.com/aboutgeae/factsheet.html>.

—. "GE Organization Chart." 2011. GE: Imagination at Work. January 2011 <www.ge.com>.

Hamlett, Kenneth. Methods for Inventory Control. 2011. January 2011 <http://smallbusiness.chron.com/methods-inventory-control-2234.html>.

Harmon, Jane. "What is LIFO and FIFO?" 11 February 2011. wiseGEEK. February 2011 <http://easybib.com/cite/form>.

Hedrick, Floyd D. "Inventory Management." Management and Planning Series (2010): 1-5.

husdal.com. "Less supply chain disruptions with vendor managed inventory?" 20 February 2009. Supply Chain Risk Research and Literature Review. January 2011 <http://www.husdal.com/2009/02/20/less-supply-chain-disruptions-with-vendor-managed-inventory/>.

Institute for Working Futures. "Basic inventory decisions and EOQ." 2011. The Institute for Working Futures. January 2011 <http://www.marcbowles.com/courses/adv_dip/module4/module4/m4three1.htm>.

Investopedia. Investopedia- Inventory Turnover Definition. 2011. January 2011.

Keasler, Constance. "Definition of ERP Systems." 2011. eHow.com. February 2011 <http://www.ehow.com/about_5159452_definition-erp-systems.html>.

University of Portsmouth. "cnfolio.com." 2010. Inventory and network models. January 2011 <http://cnfolio.com/ELMnotes05>.

Vendor Managed Inventory. "Definition of Vendor Managed Inventory." 2011. Vendor Managed Inventory.com. February 2011 <http://www.vendormanagedinventory.com/index.php>.

World News Network. "Turbofan Engine." 2011. World News. January 2011 <http://wn.com/turbofan>.

Pantazopoulos, John (2010). Optimized Welcome To GE Lynn JP ABRIDGED PowerPoint