DYNAPLAS OPTIMAL INVENTORY SYSTEM DEVELOPMENT

Megan Maguire

Dynaplas Ltd, located in Scarborough, Ontario, is a plastics injection moulding company, which produces automotive components using engineered resins. The Engineering Department designs and builds injection moulds and tools for both internal use and commercial distribution. Dynaplas' automotive products include pulleys, connectors, seals, fuel systems, brake parts, and insert bearings. Recently, as part of a continuous improvement effort, Dynaplas examined trends in its customer orders over the last couple of years. They found that, on some occasions, parts were shipped out late and/or in poor condition, resulting in unnecessary and unforeseen costs. Therefore, the Engineering Department launched a project to develop an optimal inventory level prediction model, Figure 1, to ensure that every Dynaplas product is available in sufficient stock to guarantee customers receive quality parts, on time. To begin, all factors involved in developing the prediction model and user interface had to be identified [1].

Megan Maguire, a 3rd year Management Engineering co-op student from the University of Waterloo, was asked to develop an optimal inventory level prediction model. Her specific tasks include examining the steps required to develop a mathematical model and building a user interface to help implement the application.

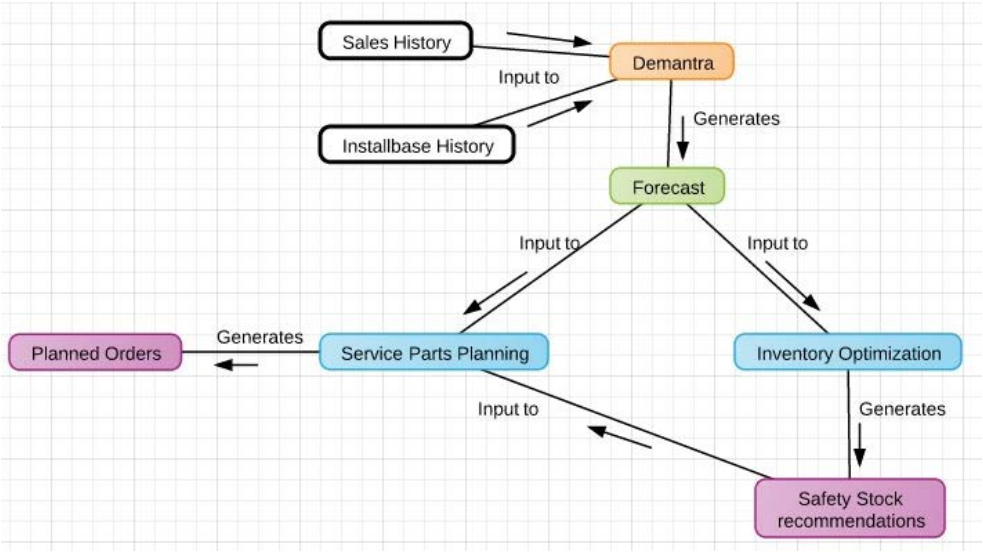

Figure 1: Inventory optimization approach [1]

Dynaplas Ltd

Dynaplas Ltd is a leading high-precision injection moulder of complex, plastic components manufactured using highly-engineered, specialty resins. Dynaplas produces parts that are typically used in high-temperature, under-the-hood automotive applications where precision manufacturing and quality part performance are critical. For example, the company manufactures components for drive train, transmission, fuel, brake, and other subassembly systems using filled engineered resins. Their products used by large automotive manufacturing companies all over the world [3].

Optimal Inventory Level Requirements

Asset managers across all industries have to identify optimum inventory levels to ensure each item in their company's inventory is sufficiently stocked. Dynaplas has identified several occurrences over the last couple of years where parts were shipped out late or in defective condition. Both scenarios result in high unexpected costs that were avoidable if an appropriate inventory level prediction model were implemented. To solve this problem, a customized approach to just-in-time manufacturing and producing sufficient product to meet weeks of demand in a single production run was considered. Although it costs money to have parts sitting in inventory due to a potential lost opportunity to create another product, it does not make sense to use the excess energy and manpower required to constantly change tools and setups. Therefore, an optimized inventory level is required to address these issues.

Inventory Optimization Factors

In order to develop a reliable inventory level forecasting model, all factors that affect the decision to hold inventory must be considered. Main factors include customer location, product price, product size, and the weight of the part. Other, less common factors include machine reliability and part complexity.

Customer location

The factor that most affects Dynaplas' inventory decisions is customer location. Dynaplas' policy indicates that if parts are available on the ship date, the customer pays for shipping. However, if parts are not ready on the ship date, Dynaplas pays for expedited transportation to the customer. Dynaplas doesn't mind incurring the low cost of shipping to customers located in close proximity (GTA area) to their facilities; however, shipping to overseas customers can be extremely expensive even for a small quantity of parts. When applied to the inventory control model, this attribute will promote an increased inventory level for products intended for overseas customers and a reduced lot size for products intended for close proximity customers.

Product Size and Weight

Along with customer location, the size and weight of the product influences the cost of shipping. A small quantity of light parts shipped by air to China is less expensive than a large shipment of heavy parts shipped by truck to Mexico. To ensure accurate results, the size/weight ratio of the product must be considered in addition to customer location.

Product price

The unit cost is also significant in determining the optimal lot size. Simply, the more expensive the part, the less Dynaplas will want to hold it in inventory. There are a number of factors that affect product cost, including setup cost. At Dynaplas, the setup of a machine and related tools can range anywhere from two to seven hours, depending on the complexity of the configuration and whether the plastic mould tool was previously warmed up and only requires an insert change. Considering a number of factors, the setup cost was estimated to be $50 per setup hour across all machines and tools. The inventory control system must also include the number of operators needed to run each machine, since this relationship rarely boils down to a simple 1:1 ratio. For example, some machines need minimal attention, requiring 0.25 operators, while others need a more intensive effort to operate properly, requiring 2 operators. To adequately balance labour and scheduling, this factor must be considered to increase inventory for parts that are labour intensive.

Other Factors

There are other factors that affect the model, but are much more difficult to quantify. For example, when inventory sits in a warehouse, there is always a risk that products may undergo design or engineering changes before they are sold and shipped out. Although there is usually enough time to react and clear out inventory before the change occurs, there is still a risk of obsolescence. There is also a maximum amount of time a tool can run before it needs cleaning or maintenance. Most of these times are reliant on the product material used. Both of these items fall outside the scope of the project.

Data Collection and Considerations

Historical demand analysis is always the first step in deciding how much inventory to hold. A demand history for almost every Dynaplas part was available to the project, and could be used to provide a “known” demand in the anticipated model. Each customer submits a forecast for the year, which is entered into the company database system. This makes it possible to compare the customer’s forecast against actual shipments. Since the material resource planning system, called Integrated Quality Management Systems (IQMS), is heavily used and relied upon throughout the facility, the inventory level model interface should eventually be integrated with this system. Data can be extracted from the system using the Crystal Reports reporting tool. Crystal Reports is a business intelligence application used to design and generate reports from a wide range of data sources.

Preliminary examination of product forecast variance from ten customers, providing a representative sampling of Dynaplas product profile in terms of demand volatility, standard cost and customer location, indicated no common trend in their demands. Appendix A graphically depicts the forecast variance for three of these customers, giving a picture of the different types of variability that the lot size model must be able to deal with. The data can be used in the calculation directly or as a factor to determine whether to hold more or less than a straight optimal inventory model value. Dynaplas requires a mathematical model that predicts optimal inventory levels for its products based on various factors that influence part production. The model is expected to eliminate unnecessary shipping costs by ensuring sufficient stock is available to meet each part order, thus preventing shortages. The model should also forecast the optimal lot size for each part, which is the most advantageous number of parts to produce per setup of the machine. Model implementation and testing are also vital to the success of the project.

Once inventory levels are established, the maximum space in the warehouse may or may not be sufficient to hold the recommended stock. Therefore a constraint must be placed on the maximum total inventory the warehouse will hold. To standardize the space, it can be assumed that there are 714 pallet spaces available in the warehouse. The warehouse takes up 19.2% of the entire facility space. If the rent per month for the entire plant is $80,000 and the warehouse takes up 19.2% of the facility, the rent for the warehouse is $15,360 per month. This can be further broken down into a rent per pallet space of $21.51 per month.

Problem Statement

Megan Maguire was asked to investigate this issue and recommend a suitable Inventory management system.

References

[1] Megan Maguire, “Manufacturing Success: Discovering the Optimal Inventory Level” 3B Work Term Report, Department of Management Sciences, University of Waterloo, Waterloo, ON Canada, June 21, 2012

[2] http://vcp-planning.blogspot.ca/2012/04/introduction-to-vcp.html

[3] Home. (n.d.). Dynaplas Ltd. Retrieved April 16, 2012, from www.dynaplas.com/

[4] Inventory Management. (n.d.). My Industry. Retrieved March 4, 2012, from www.canadabusiness.ca/eng/page/263

[5] Nahmias, S. (2005). Production and operations analysis (5th ed.). Boston: McGraw-Hill Irwin.

Appendix A: Sample Forecast Data

The graphs below show expected demand for three customers in 2011.

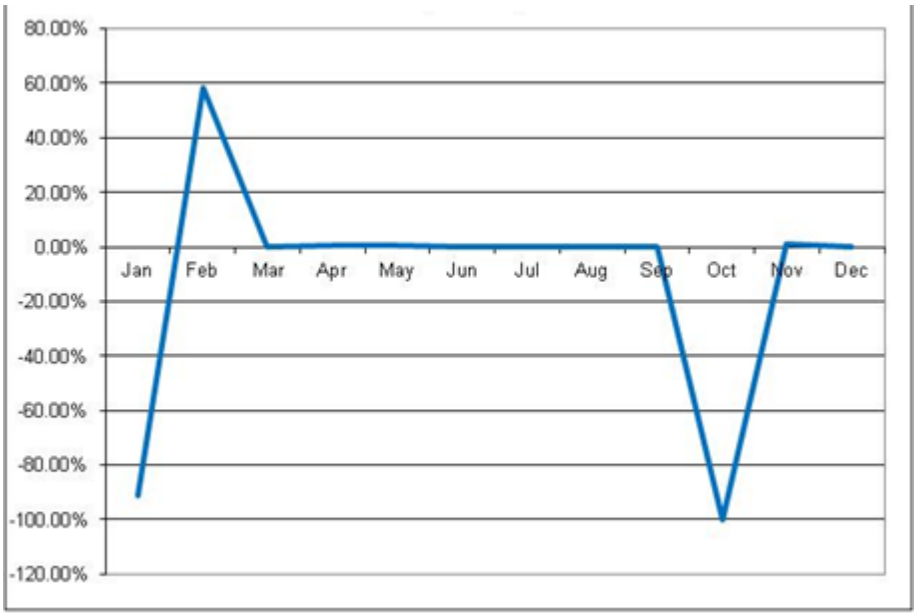

Figure A-1: Forecasting variance customer A

Figure A-2: Forecasting variance customer B

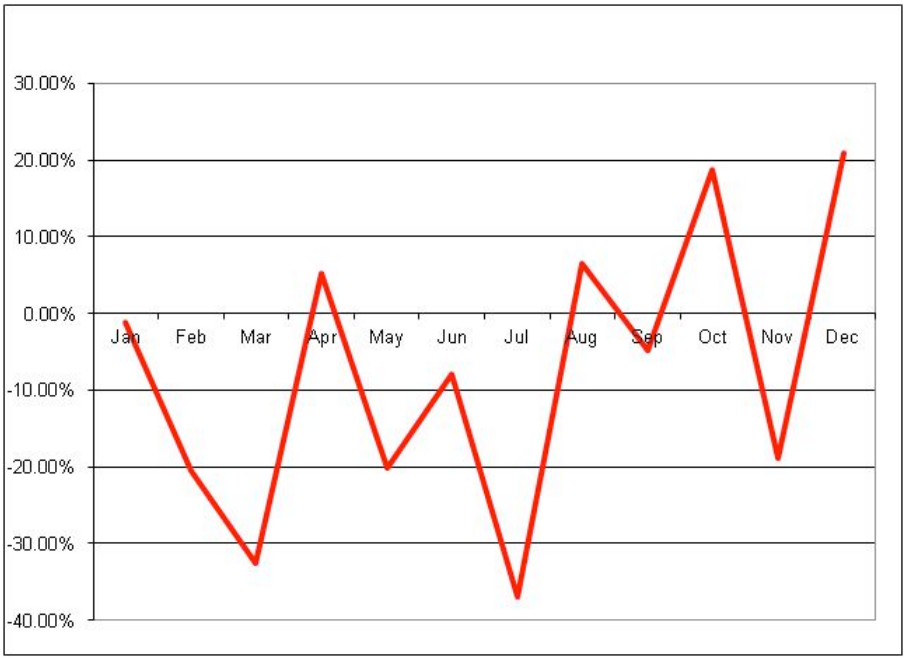

Figure A-3: Forecasting variance customer C

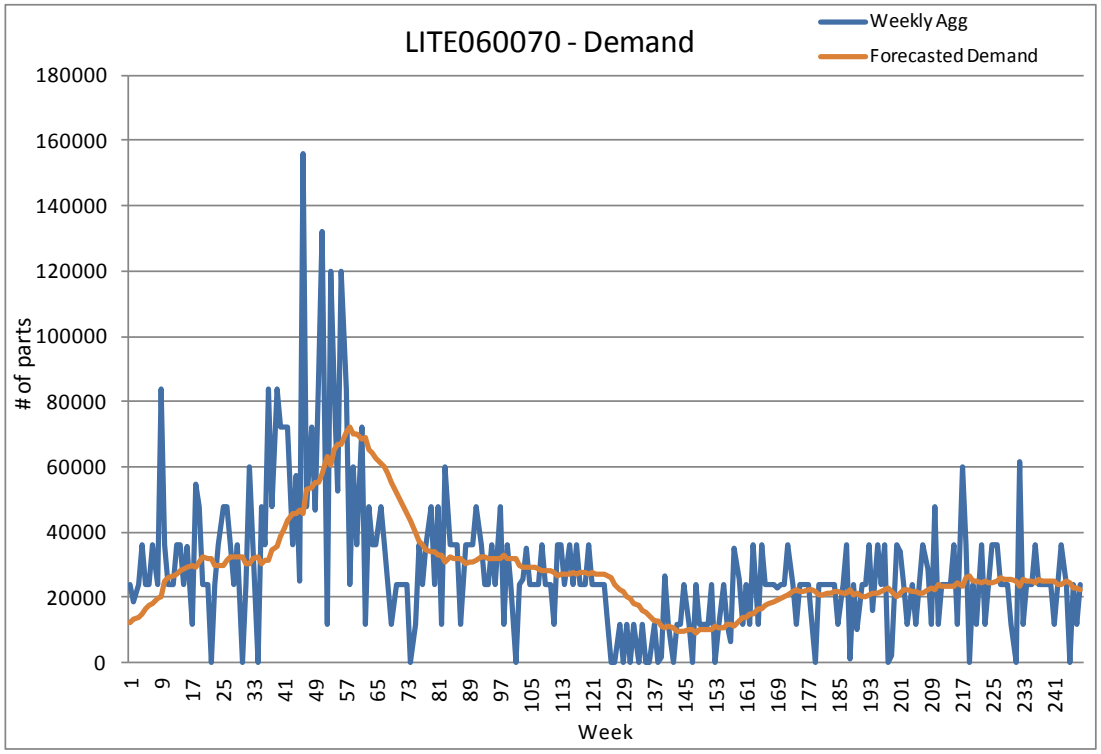

Figure A-4: Actual and forecasted demand

Module 2

Module 3

Other Modules

Examples of other modules cannot be displayed because they contain solutions to the Case Study and thus cannot be made public at this time.

Please contact us if you have any questions writing these modules