UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

MASTER'S THESIS

USING SPREADSHEETS IN PRODUCTION PLANNING IN A PHARMACEUTICAL COMPANY

Ljubljana, April 2018 SAMI HAJ SAID

AUTHORSHIP STATEMENT

The undersigned Sami Haj Said, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), author of this written final work of studies with the title Using Spreadsheets in Production Planning in a Pharmaceutical Company, prepared under supervision of prof. Dr. Jure Erjavec, and co-supervision of prof. Dr. Roberto Henriques.

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INTRODUCTION

Living in the technological era, a successful company nowadays is the company that integrates Information Technology (IT) with its business. Otherwise, it might face a huge risk of not being able to survive in today's market against the huge competition that is highly influenced by IT. However, integrating IT with business is not so simple due to several factors, namely: the available resources, choosing the right solution, top management support, time constraints, and finally achieving the proper user training and adoption. It is obviously not so wise to keep on waiting until all these obstacles are solved when there is a possibility of using some of the available resources such as Microsoft Office tools that might ease several processes of the business until the needed system is implemented and used.

In a supply chain, as a supplier or a manufacturer, production usually follows a production plan that is typically created by the supply planning department. A production plan relies on a demand forecast, whereas a demand forecast usually relies on historical data, but the market demand changes and a forecast does not always match the demand, so whenever there is a change in the forecast, production plans are updated accordingly (Graves, 2011). Therefore, if we are looking to optimize the supply chain, it is necessary to build a strong relationship between the supply chain partners because their collaboration becomes vital in such a scenario. This collaboration means that the partners of the supply chain must share their information with each other (Groznik & Maslaric, 2012). Such information can be about the inventory stock levels of the customer towards the supplier which helps in optimizing the Reorder Level that is defined as "the point at which the company will reorder stock" (Meng, 2006), resulting in creating more successful production plans that matches the market demand. However, these processes can hardly be done and managed manually, theyactually require the help of an IT system that is integrated with the supply chain for achieving the expected results.

Aligning IT with the supply chain and using e-business to manage the relationship between suppliers and customers can lower costs, this is due to the fact that IT can contribute in supporting the collaboration and coordination through an easy way of information sharing between the partners of the supply chain (Auramo, Kauremaa, & Tanskanen, 2005). Moreover, using IT in a supply chain does not necessarily need to be costly or difficult to use; insteadspreadsheets for instance can be used for Inventory Planning that is defined as "figuring out what your inventory should be (not counting what you have)" (Estep, 2012). Even though using spreadsheet tools such as Microsoft Office tools does not require purchasing an IT system, it is still considered a type of integrating IT with a business process that can significantly improve the supply chain.

Additionally, due to the fact that business process modelling enables the company to understand its processes clearly, I will focus on applying the following bodies of knowledge: first, the learnings I got from business process management (and modelling to some extent), this is because a model provides a full comprehensive understanding of a process, where the whole organization can be analyzed and viewed through business process modelling (Štemberger, Vukšić, & Kovačič, 2009). I will later apply the learning's from both supplier-buyer relationship (cooperation/partnership), and inventory management to analyze the efficiency and the effectiveness of a spreadsheet in improving the planning process of a real pharmaceutical company.

As a holder of a bachelors' degree in industrial engineering, I have had the chance to get an internship to work as a demand planner in the supply chain department of a huge multinational pharmaceutical company in Lisbon–Portugal, the internship lasted for a duration of six full months, starting in October 2015 and ending in March 2016. During the internship, I discovered that it was not only important for my professional and academic career, but also was the main inspiration for my master's thesis topic, in which I have chosen the master's thesis topic to be based on a work I have done during the internship. Therefore, the thesis below represents my masters' thesis that is more specifically a double masters' degree: one in Business Informatics and one in Information Systems Management.

The selected company which is located in Lisbon – Portugal (hereinafter: Company X) is a major branch of a big multinational pharmaceuticals group that is rapidly growing day by day. The group itself is globally presented with 29 manufacturing plants in 11 countries worldwide and serving over 50 countries. In Europe: the company has manufacturing facilities in Portugal, Italy, and German. In the Middle East and North Africa (MENA) are: the company is ranked as the fifth largest pharmaceutical company in the area and has manufacturing facilities in Jordan, Saudi Arabia, Egypt, Sudan, Algeria, Tunisia, and Morocco. In the United States: the company is nowadays ranked as the sixth largest generics producer in the US market and the third largest supplier for generic injectable medicines for the US having three manufacturing facilities there.

The Company X produces medicines (mainly injectable) to many countries worldwide, whereas 70% of the overall production is exported to the United States of America making it the largest and the most important market. However, entering the US market goes through a sub part of the big group but with a different name (company Y), meaning that company X produces the medicines, label, and pack them under the name of company Y, and finally ship them to company Y completely ready to enter the US market.

The communication between company X and company Y is done on a weekly basis via a report sent from company Y to company X and a phone call between the two partners

following the report, the purpose of the report and the call is to discuss the inventory status of all the 68 products that company X supplies to company Y so that company X creates a new/update a current production plan as per the inventory status of these products.

However, not only that company X admits that the way it plans its production is not optimal and wastes a lot of time, but the company is also rapidly growing, planning to expand by creating a new production line and is currently in the process of getting the approval of 48 new products to launch in addition to the current 68 it already supplies, which will result in a total of 116 products to be shipped only to the US by the end of the year 2016 (regardless of their other markets worldwide). This means that following the same method of production planning would be extremely difficult and would cause inaccurate and confusing production plans.

Although company X's supply planning department admits that they need to get a system that creates production plans automatically, purchasing the system never happened and there were no promises of having this step to happen anytime soon due to several constrains. However, as the company is expanding there would be a huge risk of having problems in the production planning after the launch of the new products.

Therefore, based on a study about an alternative solution to the problem that is a 3-tab-user-friendly and very easy to be used spreadsheet that shows the inventory level status of company Y for all the products in terms of weeks of stock until the end of the year whether there is a shipment expected to be received or not, which was implemented by myself during my work at company X using the available resources and without the need to purchase a new IT system.

The thesis below will evaluate the success of implementing an inexpensive/simple IT solution when renovating a rapidly growing production planning process by modeling and analyzing the planning process before and after using the solution to assess its efficiency by comparing both models/analysis results later and by answering the following research questions:

- How to support a growing production planning process?
- How to measure the successfulness of introducing a new method to a current business process using business process modeling tools?

To answer those questions, the thesis is structured into five parts as follows:

1) It starts with the literature review part, in which to build a relationship between the research problem and the literature studies, the three main topics that are covered in the literature review part are:
    - Logistics and Supply Chain Management.
    - IT in Business.

- Business Process Management.

2) The second part is the methodology where the used concepts, methods, and models, are all implemented and sequenced as follows:

   - The alternative solution that was implemented is presented and explained.
   - An AS-IS model is built using Business Process Model and Notation tools and techniques.
   - A To-BE model is also built using the same tools and techniques.

3) Thereafter, an analysis and an explanation to both resulted models are identified and presented in the third part of the article that is called the Results.

4) Moving forward to the fourth part, that is the results and discussion, we will be able to see an analysis and a critical review about those results and a comparison between them.

5) Finally, the last part is the conclusion, where the conclusion of the research is identified, and suggestions and recommendations are also presented.

1 LITERATURE REVIEW

This part of the thesis shows an analysis about the problem that the thesis covers and a comparison between the problem and the literature studies of the relative. The three main topics that the thesis covers are Logistics and Supply Chain Management, IT in Business, and Business Process Management. Therefore, a brief analysis in order to understand those topics is clarified below.

1.1 Logistics and Supply Chain Management

1.1.1 Logistics

Due to the industrial revolution, companies became more aware about the importance of having a successful logistics system to control and monitor the movement of their products and items. However, focusing on the movement of the products through a single organization is not a big issue, the role of logistics becomes more crucial and complex when organizations do not work solely, meaning that when there is an interaction between more than one organization together, because in that case, each organization works as a customer when it buys the materials from other suppliers and later on acts as a supplier when it delivers goods and supplies them to other companies, and that case is the most common nowadays because a single organization work does not actually happen due to many reasons but mainly the industrial revolution and globalization.

Logistics is defined by the New Oxford Dictionary of English as "the detailed coordination of a complex operation involving many people, facilities, or supplies. Origin late 19th century in the sense 'movement and supplying of troops and equipment', from French logistique, from loger lodge" the origins claim that when the concept was introduced it had something related to mathematics and especially in a military concern (Mangan, Lalwani, & Lalwani, 2016).

Today, however, the concept spans beyond mathematics or military fields, another definition identifies logistics as "the process of strategically managing the procurement, movement and storage of materials, parts and finishing inventory (and the related flows of information) through the organization and its marketing channel in such a way that current & future profitability are maximized through the cost-effective fulfillment of orders." (Christopher, 1998).

Nevertheless, the Chartered Institute of Logistics and Transport (CILT) in the United Kingdom (www.ciltuk.org.uk) defines logistics as "Getting the right product to the right place in the right quantity at the right time, in the best condition and at an acceptable cost" (Mangan, Lalwani, & Lalwani, 2016).

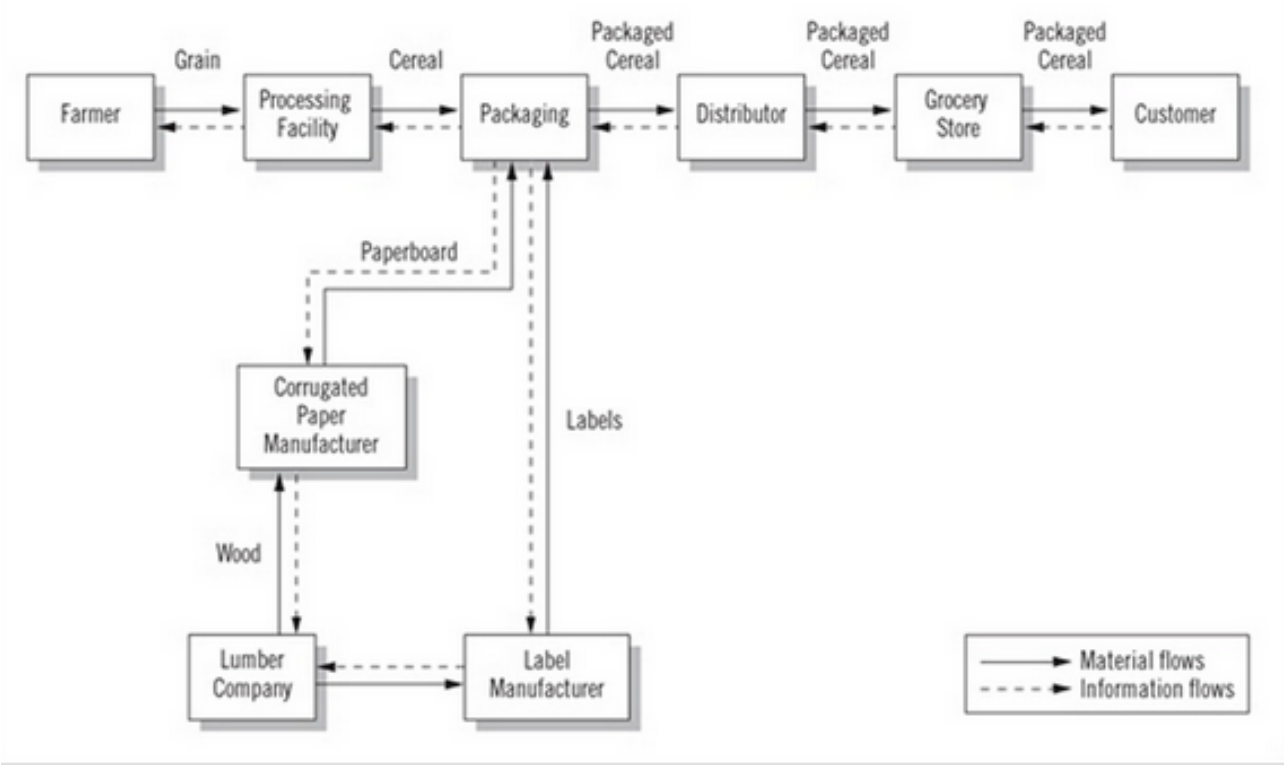
Take for instance a chocolate factory, the factory acts as a customer when it buys the ingredients (cocoa, sugar, milk…etc.) from other suppliers, while the same factory acts as a supplier when it delivers a finished chocolate bar to the retailers. Therefore, after struggling with issues related to the movement of the materials between the partners, companies found out how important it is to manage that whole production and logistics process, new concepts started to appear and new job positions started to show up in the companies, a perfect example about that is the supply planning and the supply chain management which were evolved from logistics and will be discussed further below.

1.1.2 Supply Chain

The supply chain council in 1997 defined the **supply chain** as "a term increasingly used by logistics professionals - encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer. Four basic processes - plan, source, make, deliver - broadly define these efforts, which include managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer" (Lummus, & Vokurka, 1999). We can also summarize the previous definition and define the supply chain as "the series of activities and organizations that materials move through from initial suppliers to final customers" (Waters, 2003)**,** note that it also varies from a product to another, but generally, the more complex the product is, the more complicated its supply chain would be.

Besides the example of the chocolate factory, another good example of a simple supply chain is a cereal production supply chain that is shown in Figure 1 below, the process starts when the farmer plants the grain and when the cereal company purchases that grain from the farmer, which thereafter starts processing it and converts the grain to cereal, note that in the meantime the cereal company also purchases the paperboard and the labels to package the finished cereal, it purchases the paper from the paper manufacturer, who had already purchased the trees from another supplier to manufacture the paper, and it purchases the labels from the label manufacturer, who had already purchased semi-finished label items in order to manufacture the labels from another manufacturer. After the cereal is packed and formed in packs, it goes to the distributor who thereafter sends the packs the grocery shops which sells the packs to the end customer. Notice that even with such a very simple cereal production the number of transactions and information flows is quite considerable (Monczka, Handfield, Giunipero, & Patterson, 2015).

Figure 1. A cereal manufacturer's supply chain



Source: R. M. Monczka, R. B. Handfield, L.C. Giunipero, & J.L. Patterson, *Purchasing and supply chain management*, 2015, Exhibit 1.3.

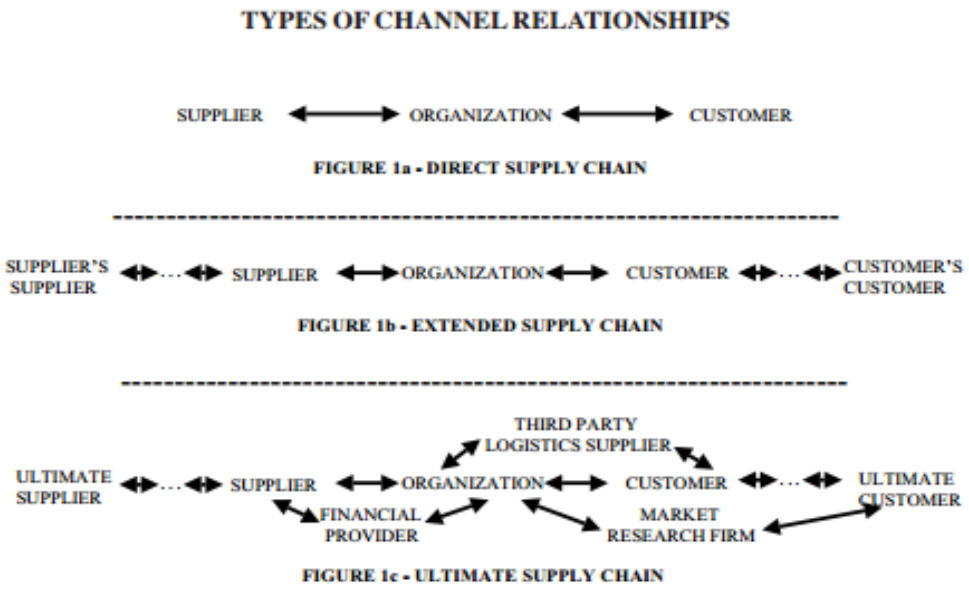
After understanding the concept of the supply chain, we can say that the supply chain complexity is identified into three levels, Figure 2 below shows clearly the three channel relationships levels of the supply chain (Mentzer et al., 2001):

1) Direct supply chain: of which consists of a company, a customer, and a supplier, who are involved in the flow of the information, services, products, or finances in the upstream or/and downstream supply chain.

2) Extended supply chain: of which includes suppliers of the direct supplier and customers of the direct customer who are involved in the flow of the information, services, products, or finances in the upstream or/and downstream supply chain.

3) Ultimate supply chain: of which includes all the organizations who are involved in the flow of the information, services, products, or finances in the upstream or/and downstream supply chain.

Figure 2. Types of Channel Relationships

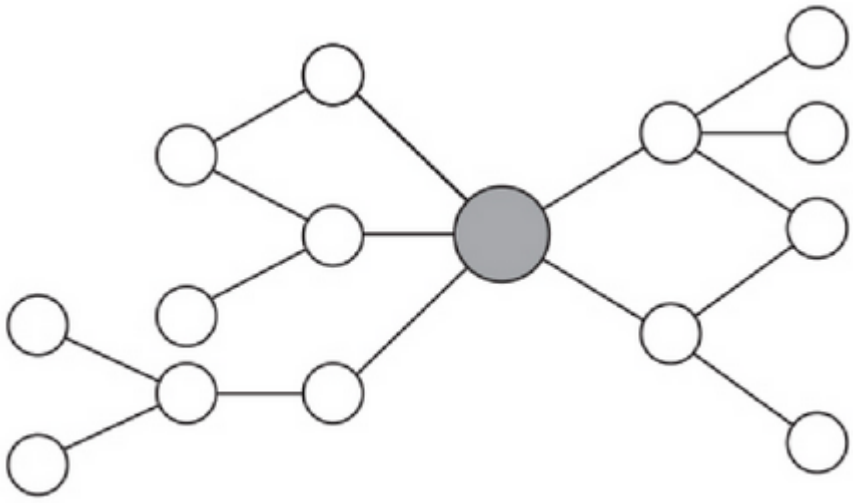


Source: Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G., *Defining supply chain management,* 2001, p.5, Figure 1.

Whilst logistics focus on planning and organizing the movement of the materials and the flow of the information through the business, supply chain comes to connect and links the processes together in the business. Therefore, supply chain is a wider concept than the logistics (Christopher, 1998), and from another perspective, the supply chain is seen a network that

connect the business processes together; **Supply Chain Network** is defined as "a network of connected and interdependent organizations mutually and cooperatively working together to control, manage and improve the flow of materials and information from suppliers to end users" (Christopher, 1999). Figure 3 below clearly shows how the supply chain network looks does, we can see that the firm is centered in the grey circle and all the suppliers and customers in white circles are connected and linked to the firm and between each other.

Figure 3. The supply chain network

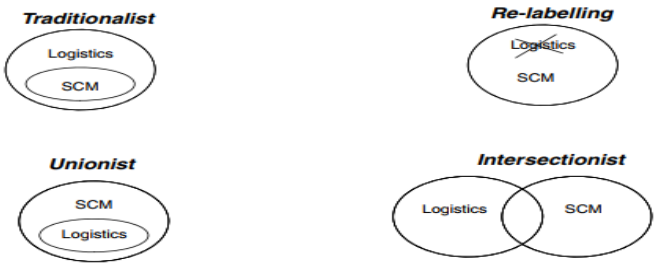


Source: Christopher, M., *Logistics& supply chain management,* 2016, Figure 1.1

1.1.3 Supply Chain Management

As mentioned earlier, the concept supply chain management was evolved from logistics, and the relationship between logistics and supply chain management differs as per to which perspective we are looking from. Figure 4 below shows the four perspectives on logistics versus supply chain management:

Figure 4. Four perspectives on logistics versus supply chain management.



Source: Mangan, J., & Lalwani, C., *Global logistics and supply chain management,* 2016, Figure 1.2

The reason why the concept **supply chain management** was introduced is due to the fact that if the business seeks to optimize the supply chain, it is important to manage the supply chain itself from all aspects, and therefore SCM showed up. Many well-known companies invested in their supply chain and were early supply chain initiatives, some of these companies are: Wal-Mart, Georgia-Pacific Corp., Whirlpool, West Co., Becton Dickinson, Baxter, and Hewlett-Packard, of which opened the door to many other companies to invest in their supply chain management due to the huge success the initiatives have received from this investment (Lummus, & Vokurka, 1999).

Supply chain management (SCM) is defined as *"the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served*." (Hugos, 2011).

The supply chain management became a big issue in the 1990s for three main reasons (Lummus, & Vokurka, 1999):

1) The first reason is that companies at that time became more aware about the importance of finding the right supplier, the one who provides better quality materials at low costs. They have also realized that they can optimize their performance when they manage the whole supply chain, and that whenever a company that deals with another company in the supply chain both companies can benefit if the supply chain is managed well.

2) The second reason is due to the globalization and the increase level of national and international competition where customers have several sources to fulfill their demands; therefore, companies realized that they must satisfy the customer at the lowest costs.

3) The third reason is that companies also realized that maximizing the performance of one department may result in less than optimal performance for the company as all, because the main concept behind the supply chain management is that it views the channel as a single entity instead of a set of independent parts each performing its own tasks, and this is achieved by managing the flow of goods and information from the supplier towards the customer (Ellram & Cooper, 1990).

The supply chain management is a management philosophy that has three main characteristics (Mentzer, DeWitt, Keebler, Min, Nix, Smith, & Zacharia, 2001):

1) A system approach that views the channel as whole, and manages the flow of goods from the supply towards the end customer.

2) A strategic orientation that focuses on cooperation between the participants in the supply chain to synchronize the internal and external operational and strategic capabilities into one unified entity.

3) A focus on the customer by creating more sources of customer value to gain customer satisfaction.

Nevertheless, the supply chain management philosophy must be clearly understood and must be implemented carefully and correctly, this implementation is only achieved by implementing seven necessary activities shown below (Mentzer, 2001):

1) **Integrated behavior:**

   We nowadays live in a world that is full of competition and challenges, therefore, it is necessary that firms expand their integrated behavior to incorporate both suppliers and customers together, and this expansion of the integrated behavior is what is defined as the supply chain management.

2) **Mutually sharing information:**

   Due to the huge growth of the firms and the internationality of the supply chain partners, mutually sharing information among the channel members is vital for implementing the supply chain management philosophy, this information is generally information about the inventory levels, the market strategy, or the forecasts, when this information is clearly shared between the partners in the supply chain it affects in reducing the uncertainty between them and accordingly enhances the performance.

3) **Mutually sharing channel risks and rewards:**

   Not only information should be shared mutually between the partners in the supply chain, but also there should be sharing of channel risks and rewards to have an effective supply chain, this activity affects in yielding a competitive advantage, and is important for the long-term focus and the cooperation between the partners of the supply chain.

4) **Cooperation:**

   Cooperation is necessary to achieve an effective supply chain management philosophy, if we look at any process where the members cooperate and work hand in hand together the result of the work is always better than solely work, and in the supply chain it is not any different, as cooperation contributes in

better planning and control, it reduces the supply chain inventories, reduces costs, and most importantly, it helps in better decision making.

5) **The same goal and the same focus of serving customers:**

Cooperation can hardly be done if the members do not share the same vision and goal, therefore, the members of the supply chain should have the same goal and the same focus of serving customers, because the customer is the buyer and he is the person who all the supply chain is organized for.

6) **Integration of processes:**

Integration of all the processes in the supply chain, starting from sourcing, moving to manufacturing, and ending with distribution, is important because it guarantees that the correct processes are done in harmony within each other and are in the correct sequence.

7) **Partners to build and maintain long-term relationships:**

When the supply chain members become partners and when they build and maintain long-term relationships between them, the supply chain become more efficient and the uncertainties are then reduced.

Supply chain management is a wide concept, it manages all the areas of the supply chain, when the company decides to apply supply chain management to its business it should make sure that following areas are covered (Hugos, 2011):

- **Production area**: what products do the market wants?
- **Inventory area**: how much inventory should be in stock at each stage of the supply chain?
- **Location area**: where should be the facilities of production and inventory is located at?
- **Transportation area**: how should the materials be moved between the supply chain?
- **The flow of information** between the partners in the chain.

1.1.4 Collaboration in supply chain management

Achieving an optimized supply chain management can hardly be done without collaboration between the partners of the supply chain, collaboration means moving from the traditional

adversarial way between companies to a cooperative relationship that provides benefits to the participated partners. The impact of the collaboration in the supply chain is in many aspects, for instance, financially, it improves the customer service by reducing/eliminating stock-out and backorder cases, it decreases the customer wait time by improving the response time, it improves the forecast accuracy making it closer to the real demand, and most importantly it increases the sales revenue. Moreover, collaboration also has an impact on the business processes and the relationship between the partners, for instance, it contributes in building a trust between the people, it expands the knowledge base between the participants, and it improves the communication by creating more quality meetings and less misunderstandings. Nevertheless, collaboration must be planned carefully, because choosing a wrong partner might result in more losses and costs that exceed the benefits, and in some cases, it can cause terrible and undesirable consequences, this is due to the sensitivity and the confidentiality of the information that is being shared between the partners of the supply chain.

It is important to mention that collaboration relationship has different levels, meaning that the relationship between the participants can be one of three mentioned below, but generally, the more trust the partners have between them, the more they share information between each other, the three levels of collaboration relationship are (Shepard, 2012):

1) **Transactional relationship**: where just some data is shared between the participants to improve the visibility of the supply chain, it is the least complex relationship yet adds slight improvement to the supply chain performance.

2) **Partial relationship**: partners collaborate partially, strategic briefings are shared, but major decisions are done separately.

3) **Full relationship**: The relationship can move to the highest level of a collaboration, a full collaboration between the parties, where it involves a full share of all decisions and processes, it is the most complex and sophisticated relationship, however, to achieve this relationship, the partners should have a very high degree of trust between them.

In a supply chain, the more the information is available and accessible, the more accurate the supply chain department processes are going to be, it is said that information is always better than no information, and that is applied to the supply chain for the reasons below (Du, n.d.):

- More information improves forecasts,
- Reduces variability,
- Enables coordination of systems and strategies,
- Improves customer service,

- Enables the company to react more quickly to any market change event.

1.1.5 Forecasting

As mentioned earlier, having more information improves forecasts, the role of forecasting is vital in any supply chain because it is a statement about the future, it is the way to predict future demand and is the base for all strategic and planning decisions, used for both push and pull processes, and is the base of the other supply planning processes in the areas of (Cholette, 2011):

- **Production**: scheduling, inventory management, production planning.
- **Marketing**: sales, promotions, introduction of new products.
- **Finance**: investments, budgetary planning.
- **Personnel**: labor planning, hiring, layoffs.

Forecasting can be done in several methods, mainly one of the three below (Cholette, 2011):

1) **Qualitatively**: of which a forecast is developed based on a primary subjective or an opinion.
2) **Time series**: of which a forecast is developed based on historical data about the demand.
3) **Casually**: of which the forecast is developed using a relationship between the demand and any other factor but time.

Although firms found out that forecasting is a dominant factor in an effective supply chain as it directly affects the inventory and the manufacturing schedules. However, most of the early work on the forecasting area was fruitless due to the lack of being able to determine the actual demand from both parts: the buyers and the sellers. Therefore, technology and techniques were integrated with this field to improve the forecasts, but still, forecast accuracy was measured to be 40 percent accurate in general (Poirier, 1999).

Although forecasting is an essential part of the supply chain, however it is still important to keep in mind the following three notes about forecasting (Kleywegt, 2012):

1) Don’t treat forecast as known information, because they are usually wrong.
2) When forecasting, it is necessary analyze the potential errors of the forecast.

3) The more we increase the forecast horizon the less accurate the forecast is, and vice versa.

Nevertheless, sharing information does not happen manually, in fact, such a process needs an information integrator which is supported by an IT system that supports the supply chain and enhances its processes. Therefore, collaborating and building long-term relationships with suppliers or customers or creating accurate forecasts usually requires an extensive use of IT systems such as Enterprise Resource Planning (ERP) systems, but unfortunately, purchasing such systems is not an easy nor a quick step to take, as it usually takes a lot of time until the system is purchased, implemented, and properly used, it is a critical decision that top management needs to make, the reasons behind this is that those systems are usually very expensive and very complicated, and it happened in many cases that purchasing such a system caused more losses than benefits due to the complexity of the system and the learning curve among the users (Khan, Liang, & Sumaira, 2015).

1.1.6 Supply Chain Management in the Pharmaceutical Industry

Moving forward to talk about the pharmaceutical industry, the supply chain in the pharmaceuticals is similar to any other manufacturing industry, however, due to the sensitivity of the safety of the medicines, and due to the fact that the industry directly affects peoples' health, it is very important to guarantee that the quality and the safety of the drugs in every single step of the supply chain is at its highest level, and that makes the supply chain management more complicated in the pharmaceutical industry than many other industries (Shah, 2004).

A classical supply chain of a drug production is sequenced as below (Shah, 2004):

1) **Granulation**: where the row materials are mixed to form the final drug.
2) **Compression**: where the shape and the form of the pills is created.
3) **Coating**: where the formed pills are coated with a coloring for a better appearance/taste.
4) **Quality control**: where quality tests are done on the coated pills.
5) **Primary packaging**: where the coated pills are packed in a bottle/blister/tube…etc.
6) **Secondary packaging**: where the primary packs are packed usually with a leaflet.

Additionally, although business processes are different between pharmaceutical companies themselves, but the supply chain department in a pharmaceutical company is responsible for the following activities:

- Demand management,

- Inventory management,
- Scheduling and production planning.

The processes mentioned above must be all connected and must complete each other to achieve an optimal supply chain (Shah, 2004).

However, as a successful planning is a success factor in the supply chain management for pharmaceutical companies, many nowadays struggle with the planning process as it is one of the most complex processes that requires a lot of effort by the planners (Tulokas, 2015). The main objective of planning is to maximize profits from production sales during the planning horizon (Agrawal, 2009), this is because a successful plan will prevent costs from excess production that causes undesirable costs, these costs can be direct costs such as waste due to over production, or indirect inventory costs which is costs due to the space where the items are stored at, or costs due to the labor workers who place the items in the space and take care of them, or costs due to the associated risk of damage or theft when items are stored in an inventory (Muller, 2011).

An efficient production plan will prevent an excessive inventory level, and not to forget that the plan should not only cover the finished product inventory, but it should also consider the row materials and the work-in-process items. Generally, the inventory items are classified into three categories (Muller, 2011):

1) **Raw materials**: primary items/ingredients that are needed to prepare a finished product.

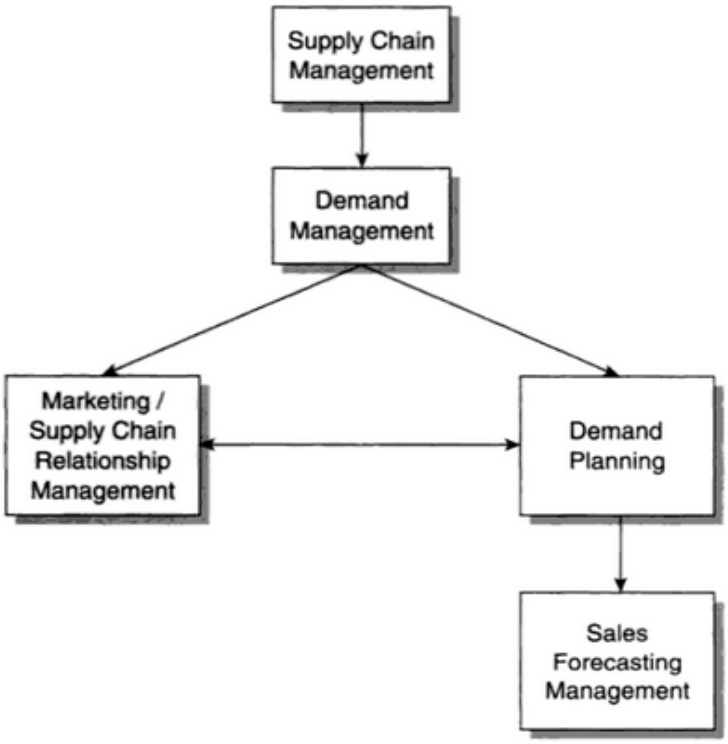
2) **Finished goods**: items that is packed and ready to be sold.

3) **Work-in-process**: items that are in the stage between row materials and finished goods, but are stuck due to work delays, queues, or wasted time between operations.

Inventories are also considered as an important indicator of the microeconomic and the macroeconomic phenomena, the relation between the demand and the supply in the market can be found out using the ratio of input and output inventories (input/output) (Chikan, 1981; Kornai, 1992), economists believe that in markets where this ratio is high, it is easy to sell but hard to buy, while in markets where the ratio is low, customers have a stronger economic power than sellers (Jaber, 2009). Therefore, to optimize the flow of items in the inventory, companies need to align the forecast with the demand so that they do not have excessive inventory, this act is known as **Demand management**, which is defined as "*the creation across the supply chain and its markets of a coordinated flow of demand*" (Mentzer, & Moon, 2004).

However, to achieve the expected benefits from demand planning in the supply chain, it is necessary to have a high collaborative relationship between all the partners and participants in the supply chain. Moreover, since we are already talking about the relation between demand planning and the supply chain, this will take us to mention the impact and the role of demand planning, demand management, and forecast management on the supply chain that is more clarified in Figure 5, it is clearly obvious that for achieving an accurate sales forecast, demand planners must work alongside with the marketing department to predict the market's need, the result of this corporation and its associated activities is encompassed by the demand management (Mentzer, & Moon, 2004).

Figure 5. Demand management in SCM



Source: Mentzer, J. T., & Moon, M. A., *Sales forecasting management: a demand management approach,* 2004, p.8, Figure 1.3

However, no matter what business the company runs, the days of managing the supply chain from the back office are over. Due to the invention and the evolution of internet and the other technological trends, companies became finally capable to find many supply chain solutions that they have always dreamt about. IT is nowadays the heart of the supply chains; a good supply chain is the one that can move the product to the market faster and cut the cost of moving the products from the source to the customer. However, companies can improve their business processes and operations with the help and the support of all the available wide IT applications (Waghmare, & Mehta, 2014).

In the past, using a computer based IT system was an advantage for a supply chain, but today it became a matter of survival. IT plays a vital role for the system integration, and the degree of success of any supply chain is determined by the supply chain's ability to integrate with the partners and to create an effective and responsive operation. The role of IT in the supply chain is very clear, particularly for demand planning and forecasting, it is not a way of just collecting data, but it is a harmonization system that combines the people, with hardware, software in line with the business process of the supply chain. Moreover, the information will not work alone unless there is a system that utilize it and get the best outcome of this information and data which will then translate this result into an action to benefit the supply chain (Rashad, Gumzej, 2014). Therefore, the section below will be talking about the importance of IT in the business and the role it plays in the business improvement.

1.2 IT in Business

The business exists to produces products or services to gain profits, and IT is used in the business to assist it and enhance its performance. No matter how big or small the business is, technology implementation provides a tangible and intangible benefit that helps in making more money and meet customer's expectations. Not only that deploying technology in the business decreases the number of labor required, but also investing in IT creates more business opportunities and enables the firm to compete and enter new markets. The role of IT is important in business relationships, an example about that is using technology decreases the need of personnel meetings in which the information is exchanged between the partners through technology.

Nowadays, if we look around, we notice that there is an increasing requirement to eliminate the human role in the business processes, instead, there is a preference of replacing the human role with an automated system, the reasons behind this trend are to (Rashad, Gumzej, 2014):

- Eliminate the possibility of having human errors,
- save time,
- do the work on a 24 hour per day if needed, and,
- reduce the costs.

IT does not need to be complicated to achieve the expected results, neither does the IT environment, it is believed that the more complex the environment is, the more additional costs and efforts will be associated. Therefore, organizations must focus on keeping "IT" simple, by saying that, companies must: (Nikoloski, 2014).

- Standardize on both software and hardware,

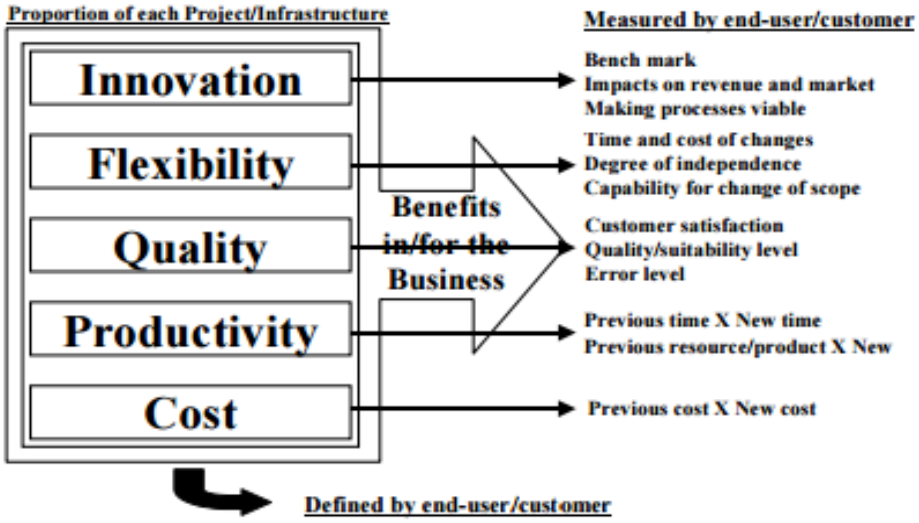
- develop and follow the procedures and the policies,
- document the work infrastructure,
- purchase the products/services from reliable vendors,
- select the IT system wisely, and,
- make sure to limit the business workstation use to business use only.

Once the organization simplify the IT and its environment, there will be:

- Lower costs,
- Improved efficiency,
- Easier administration,
- Easier respond to changes, and,
- Better use of resources such as people, hardware, or software.

It is important to guarantee that IT has contributed positively in the business, and to measure the benefits that IT brings to the business, there are five parameters to measure that: cost, productivity, quality, flexibility, and innovation. Figure 6 below, shows those parameters and examples of how they are measured (Albertin, & de Moura, 2004):

Figure 6. Benefits offered by using Information Technology



Source: Albertin, A., & de Moura, R. *The Benefits of Information Technology in Business Performance,* 2004, p.872, Figure 1.

1.2.1 Spreadsheets and Enterprise Resource Planning

1.2.1.1 Spreadsheets

Computers are the main reason for the evolution of the technological era, and spreadsheets have changed the way that the world deals with and perceives computers (Fischer, & Rathke, 1988). Spreadsheets are not something new, they have been used by accountants and finance related people for hundred years now, in the past, a spreadsheet "*was and is a large sheet of paper with columns and rows that organizes data about transactions for a business person to examine. It spreads or shows all of the costs, income, taxes, and other related data on a single sheet of paper for a manager to examine when making a decision*" (Power, 2004). Nowadays, the old paper spreadsheet is replaced with an electronic one that is supported by software of which the user organizes all the information in columns and rows of which calculations can be made afterwards to help in decision making and to see the big picture of the company.

In 1978, a Harvard Business School student called "Daniel Bricklin", who was named as the father of the electronic spreadsheet, came up with an idea of which to create an interactive visible calculator, he then cooperated with his colleague and both invented a program on personal computers called "VisiCalc" and got a huge success back then. The electronic spreadsheet market started to grow rapidly in the 1980s until Microsoft Excel was introduced, it was intended to be used for 512K Apple Macintosh in the year 1984, it was the first spreadsheet to use a graphical interface of which the user can point and click using a mouse pointing device, Excel was significantly easier to be used by most of the people than the old spreadsheet products (Power, 2004).

Even with many specialist software programs available, Excel is still an amazing option to choose for data analysis for two reasons (Rose, Spinks, & Canhoto, 2014):

1) Cost: as many of us already have access to Microsoft Excel from our own computers, there is no need to invest and buy software.

2) Convenience: For the people, who are new to data analysis, there will be no need to learn new software and getting to grips with the analysis tools and techniques, Excel also easily integrates with other Microsoft Office products in which will ease the process of preparing presentations and reports.

Nowadays, Excel became a powerful analytical business tool with many capabilities, such as: advanced charting, graphing, and algorithmic functions. It is estimated that 50% of the all the business logic in the world is saved within Microsoft Excel spreadsheets (Brauer, 2006). What makes Excel better than other available spreadsheets is that it is not only used for data entry, manipulation, or presentation, but it also offers tools and functions in which helps the user to

prepare his analysis in the way he would like to see the results, even using graphs and charts. An example on the most popular three data analysis tools that Excel offers are listed below (Rose, Spinks, & Canhoto, 2014):

- **Statistical functions:** there are a broad range of +600 statistical functions that are build-in Excel spreadsheet of which do the calculations and the tests that the user wish, an example about that is "AVERAGE" function which calculates the average of two or more cells.
- **Charts:** they are build-in Excel in a form of graphs with different chart types such as bar chart or pie chart.
- **Pivot table**: it is a table that summarizes all the data that the user wishes in ways that are more useful for specific tasks.

Nevertheless, as Excel keeps on increasing its capabilities and adding new features, the latest version of Excel 2016 offers superior features that are helpful to the users. An article called "*Top 10 New Features of Excel 2016*" mentioned the top ten new features in Excel 2016 as listed below (Gurney, 2016):

1. **Tell me what you want to do**: it is a box that can be used to search for help instead of looking up over the internet pages.
2. **Forecasting**: a one-click statistical forecasting feature for data that has time element associated with it.
3. **Search field (Pivot tables)**: now the pivot tables are supported with a search bar that helps when dealing with large set of data.
4. **Date grouping (Pivot tables)**: unlike previous versions, where the pivot tables would register dates manually, now dates are automatically grouped into months, quarters, or years, which is more manageable.
5. **Histograms and Pareto charts**: as Histogram charts shows the frequencies, Pareto charts go one step further by giving the user a trend through the data by sorting the frequencies and adding a cumulative percentage.
6. **Sunburst charts**: shows values by hierarchy, which can be used for instance to analyze sales of a company and break it down by salesperson, customers, and products. The chart will plot the salesperson at the highest level of the hierarchy and the next level would be the customers each sales person has and how much they spent, and the final level would be the products they purchased.

7. **Waterfall charts**: shows the movement from an opening position to a closing position, which can be used to plot the financial data such as cash flow over a specific period of time.
8. **3D data map**: although this feature was added in Excel 2013 already, it was still not fully integrated option as now in Excel 2016. It is perfect to analyze data with a global span, and is the most impressive looking of all the visualizations in Excel.
9. **Power pivot**: a great tool to use if the user is looking to bring data in to Excel, and by data we are talking about hundreds of millions of fields.
10. **Get & Transform**: a tool that helps to import data from various data sources.

However, it is important to mention that although Excel can support the business processes and can enhance the business performance, but it is still a spreadsheet and cannot be a replacement of an ERP system, meaning that there are some risks associated with depending on spreadsheets to manage the business which must be taken into consideration, a white paper published by SBS Group called "*Top Three Risks of Using Spreadsheets to Manage Your Business*" listed the three risks of completely using spreadsheets to manage the business instead of implementing an ERP system as below:

1. Lack of integration limits true business intelligence: especially when we talk about financial issues, as spreadsheets are not a good tool to integrate financial data because they lack the ability to provide true business intelligence as ERP does.
2. Dueling spreadsheets create data face-offs: because having two or more spreadsheets with inconsistent data might cause huge troubles to the business, while with an ERP system the data is bound to a single and unified source.
3. Spreadsheets are a time suck for your company and your staff: although they are easy and fast to set up, when they are used in a repetitive and collaborative enterprise process they waste a lot of time specially when the user edit, modify, or correct them.

1.2.1.2 Enterprise Resource Planning (ERP)

Talking about ERP, it is helpful to explain more about ERP and how it evolved, in the late 1960's the concept **Material Requirements Planning (MRP**) was born through a joint between a manufacturer of tractors and IBM, the concept thereafter became the backbone to both concepts **Manufacturing Resource Planning (MRP II)** and **Enterprise Resource Planning (ERP)**.

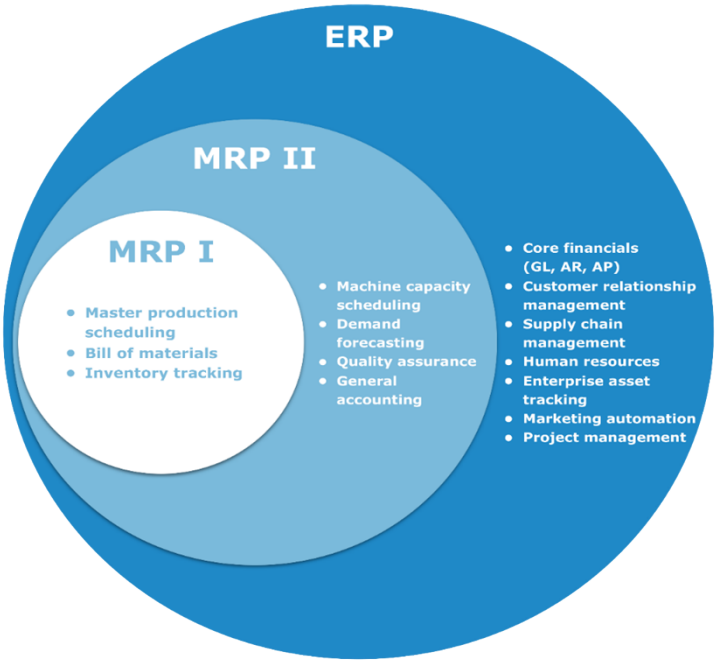
At that time, MRP software was a method for planning and scheduling materials for some complex manufactured products, it was very expensive and required large technical support stuff and special IBM computers. However, in the early 1980s, with all the evolution of the

IBM computers, the focus started to be on evolving Material Requirements Planning to Manufacturing Resource Planning, and this is how MRP II started to take a place, the new software was easier, simpler, faster, and had more capabilities than the earlier MRP systems such as cost reporting features. Nevertheless, the MRP II was evolved in the 1990s in which the concept ERP was introduced, and had a huge success by that time, it is wider than MRP II and is designed for the whole enterprise, ERP systems are still used till today.

It is seen that the future will have ERP systems which will be faster to implement and used that is because the system has reached a level of maturity where both the users and the software vendors understand all the requirements in terms of technicians, financial and human resources for its implementation and usage, and they are all striving to work on implementing ERP systems in a period of six months or less (Jacobs, 2007).

From the previous explanation about the history of ERP, we can conclude that between MRP, MRP II, and ERP there is an evaluation, and that ERP is the widest concept which has in addition to the same functional capabilities of both MRP and MRP II more capabilities, Figure 7 below shows the functional capabilities of MRP, MRP II, and ERP systems and how that an ERP system includes all the capabilities that other systems has.

Figure 7. Functional Areas for MRP I, MRP II and ERP Software:

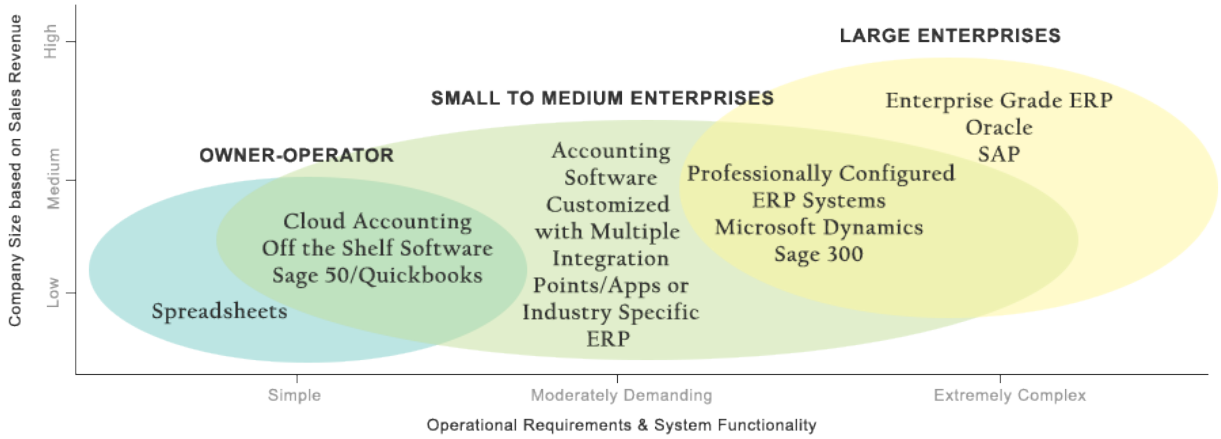


Source: Burnson, F. *The Difference Between MRP vs MRP II.* 2016.

Now that the concept of ERP systems and spreadsheets is identified, it is important for the company to identify its business and understand what to use to manage its business processes.

Usually, the judgment is based on the size of the company and its sales revenues, small companies tend to use spreadsheets while larger ones must use ERP systems. Figure 8 below compares the size of the company in terms of its sales revenue with the operational requirements and the system functionality it must use:

Figure 8. Company size based on Sales Revenue VS. Operational Requirements & System Functionality



Source: ASCEND*, ERP Consulting,* 2015, from http://edmontonbusinessconsulting.com/erp-consulting/.

Figure 8 shows how that the larger the company grows the more complex the system it needs, small companies with low sales revenue need a simple system in terms of operational requirements and system functionality such as spreadsheets, while companies with medium sales revenue need a moderately demanding system such as an accounting software or an ERP system, and finally, large companies with high sales need an extremely complex system such as an Enterprise Grade ERP, Oracle, or SAP. Nevertheless, no matter how large the company is, it still uses spreadsheets for its operations. When the company introduces an ERP system to its business processes, it does not mean that those systems will stop the use of spreadsheets. In fact, many enterprises which have implemented ERP still rely heavily on spreadsheets such as Microsoft Excel to arrive at the truth. Nowadays, there are nearly one billion users of Microsoft Excel worldwide, of which most of them already implemented ERP. To kill the use of spreadsheets in favor of only an ERP solution is impossible because spreadsheet usage in the enterprise will still be used as long as information workers exist (Board Walktech, N.D.).

1.3 Business Process Management

Additionally, as the paper below is going to represent a change of a planning process, it is important to guarantee that the new process is more efficient and effective than the previous

one, and to do so, both methods should be analyzed. This analysis can be done in many ways, the easiest one is using textual descriptions; however, such a method is not precise and will not allow going into deep details of the processes. Therefore, the most convenient method to apply is Business Process Modeling tools which are known for its efficiency in deeply analyzing the business processes (Allweyer, 2016).

Before explaining what business process modeling is, it is necessary to mention three main concepts that will help to understand business process modeling more clearly:

1) Business Process,
2) Business Process Management (BPM),
3) Business Process Management System.

Generally, the reason of having a business process is to achieve a business goal, a **Business Process** is defined as "*set of activities that are performed in coordination in an organizational and technical environment*" (Weske, 2010). Whereas **Business Process Management (BPM)** is "*what includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes.*" (Weske, 2010), meaning that when we talk about business process we are not talking about IT support, but we talk more about the processes and the activities that are essential to complete a business process. However, since information systems plays a big part in the BPM as most of the processes are supported by IT systems, a **Business Process Management System** is defined as "*a generic software system that is driven by explicit process representations to coordinate the enactment of business process*" (Weske, 2010). Moving forward to business process modeling, it is a way of analyzing a business process graphically using symbols and arrows and other graphical notations that will be explained later.

1.3.1 BPM history

Historically speaking, the idea of considering work as a process and try to improve it in any possible way is not something new, many management techniques have showed up in the past and new techniques are still showing up nowadays as well, whether Total Quality Management (TQM), Benchmarking, Six Sigma, Balanced Score Card, Business Process Management (BPM), or any other such techniques, they all promise to improve business processes and therefore enhance the company's performance.

In the 1980's the focus was all on TQM, but 10 years later, when the concept Business Process Reengineering was introduced it faced a huge success at that time, but on the other hand, it faced many considerable failures as well. After that, in the mid 1990's all the eyes were spot on Enterprise Resource Planning (ERP) as it was believed to be the future's big thing since it

promised to be the answer to all the problems that a process face, which was all turned out to be false claims later due to many constrains in implementation. Thereafter, in the early 2000's organizations began to understand the importance of focusing on their customers, that consequently lead to introducing Customer Relationship Management (CRM) systems to improve the relationship between the businesses and the customers. Whilst customer relationship focuses on customers, Six Sigma on the other hand was introduced to focus on internal processes to provide high quality products/services to the customers. Nowadays, it is believed that BPM is going to be the next big thing due to many factors that will be clarified later (Jeston, & Nelis, 2014).

1.3.2 The evolution of BPM

BPM was evolved from Process Management, when process management was introduced it had seven main principles are (Brocke, & Rosemann, 2014):

1) All work is process work.
2) Any process is better than no process.
3) A good process is better than a bad process.
4) One process version is better than many.
5) Even a good process must be performed effectively.
6) Even a good process can be made better.
7) Every good process eventually becomes bad process.

Additionally, it was noted that process management only focus on the processes very deeply regardless mentioning any use of information, and that was a significant factor for evolving from process management to BPM. Therefore, when BPM was introduced, it had three major objectives (Gillot, 2008):

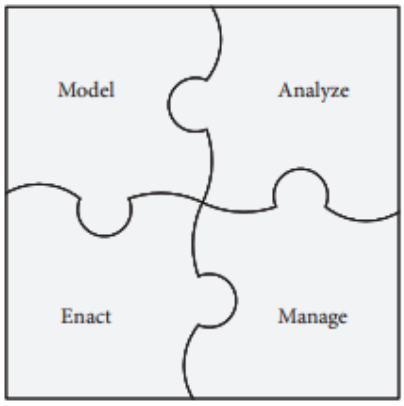
1) **Quality:** BPM aligns the quality of the products/services of what the customers expect with what the company can propose.
2) **Deadline:** since everyone hates delays and delivery waiting, BPM helps in reducing the deadlines.
3) **Costs:** BPM decreases/eliminates unnecessary activities which thereafter reduces costs.

BPM has four main activities that are listed below and shown in Figure 9:

1) Model.
2) Enact.

3) Analyze.
4) Manage.

Figure 9. BPM activities



Source: Van Der Aalst, W. M., *Business process management: a comprehensive survey,* 2013, p.3, Figure 2.

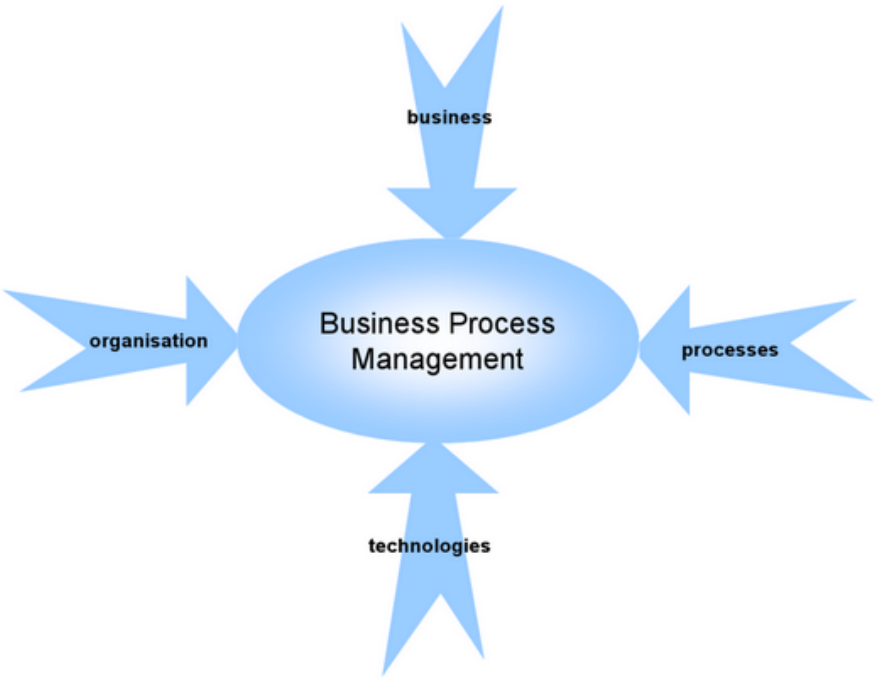
Figure 9 above shows how BPM has four main activities that are connected as in a puzzle, completing each other to form the big picture, that is the BPM in that case. It starts with the first activity that is "to model" where creating a process model that is used to for analyzing or enactment, then "to enact" where the model is used to support and control the concrete cases, next activity is "to analyze" where a business process is analyzed using a process model, and finally "to manage" where managing all other activities such as adjusting the process is done (Van Der Aalst, 2013).

Nevertheless, there is usually a misunderstanding about BPM between organizations, as many of them believe that implementing BPM is easy and is only a modeling of processes, this is not true, because in fact BPM is way wider than process modeling, it is a discipline that relies on five main topics of which process modeling is only one topic of, the five main topics that BPM cover are listed below (Gillot, 2008):

1) Process Modeling.
2) Process Automation.
3) Process Management and monitoring.
4) Process Optimization.

We can also consider BPM as collaboration between the organization, the business, the processes, along with the information systems, all together to improve the business as shown in Figure 10 below:

Figure 10. The four BPM perspectives

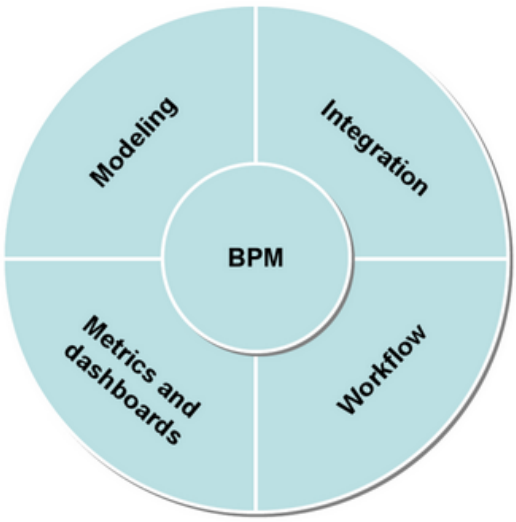


Source: Gillot, J. N., *The Complete Guide to Business Process Management: Business process transformation or a way of aligning the strategic objectives of the company and the information system through the processes,* 2008, p. 38, Figure 5.

However, to implement BPM to an organization, special tools and techniques must be used. Therefore, new management concepts and suits started to show up in order to support BPM to achieve its goal and objectives, and this is what the so-called **Business Process Management Suites** (or BPM suits) is about, a BPM Suits consists of four main elements as shown below and in Figure 11 (Gillot, 2008):

1) Building a module to document, describe, and simulate the business processes.
2) Integrate the module to an information system.
3) Building a workflow module to manage manual or semi-manual activates.
4) Building metrics and dashboards module to follow up on the activities and the processes via reports.

Figure 11. Components of a BPM Suits



Source: Gillot, J. N., *The Complete Guide to Business Process Management: Business process transformation or a way of aligning the strategic objectives of the company and the information system through the processes,* 2008, p. 32, Figure 2

Implementing a successful BPM can bring to the organization many benefits, mainly it (Gillot, 2008):

- Improves the management.
- Improves the quality of the service.
- Reduces costs.
- Decreases the risk associated with purchasing and setting up a new system

However, the success of BPM relies heavily on an accurate and precise modeling of the business processes. Process modeling is where business meets IT by representing the processes and activities visually using flowcharts and models to find out a room for improvement. Therefore, modeling needs to be done properly. Unfortunately, many organizations fall in a mistake of modeling their processes without taking into consideration one or more of the following issues:

- The strategy and governance,
- The involved stakeholders,
- The tools and requirements,
- The practice of modeling,

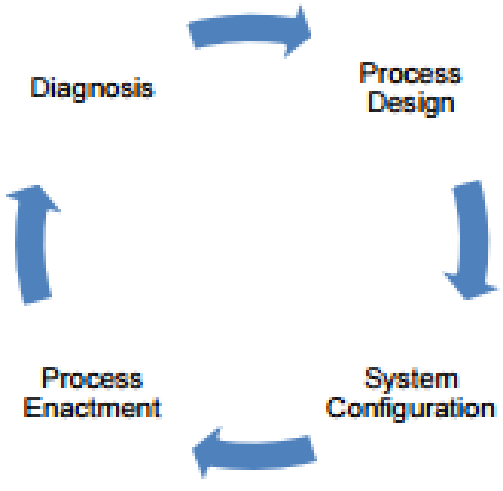
- The way the new models should be designed,
- The maintenance of the models.

All those issues need to be taken into consideration before starting modeling to have a proper model and therefore a successful BPM (Rosemann, 2006).

To effectively understand the features of BPM one should first understand the BPM lifecycle, as per van der Aalst et al, BPM lifecycle, shown in Figure 12 below, consists of (Ko, Lee, & Wah Lee, 2009):

- **Process Design:** In this stage, graphical standards are dominant, and business processes are electronically modeled into BPM systems.
- **System Configuration:** This stage configures the BPM system and its infrastructure.
- **Directory:** This stage is hard to standardize due to the differing IT architecture of different enterprises.
- **Process Enactment:** In this stage, execution standards are dominant, and electronically modeled business processes are deployed in the BPM system.
- **Diagnosis:** Using the appropriate modeling and analysis tools, the analyst can identify the bottleneck and tries to improve it or eliminate it.

Figure 12. van der Aalst et al BPM's Life Cycle



Source: Ko, R. K., Lee, S. S., & Wah Lee, E., *Business process management (BPM) standards: a survey,* 2009, p.5, Figure 2

1.3.3 Business Process Modeling Notation (BPMN)

Since Business Process Modeling is a critical component in a successful BPM, the language **Business Process Modeling Notation (BPMN)** was thereafter introduced, it is defined as "*a standardized graphical notation for visualizing processes within a business*" (Holt, 2009).

Another definition states that "*The BPMN will provide businesses with the capability of defining and understanding their internal and external business procedures through a Business Process Diagram, which will give organizations the ability to communicate these procedures in a standard manner.*" (White, 2005)

BPMN was found and developed by the Object Management Group (OMG) in 2003, and in the year 2006 the language was released as an OMG standard (Recker, 2010). As per OMG, the main idea behind developing such a language was to help businesses in understanding their internal processes and look at them in a deeper way (OMG, 2012) (Flowers, & Edeki, 2013).

An interesting article by Deepak Singh, the president and CTO of Accu Process Inc. called "*5 Key Benefits of Business Process Modeling*" published on Model Analyst website (www.modelanalyst.com) listed additional indirect five important benefits the organization can gain when it models its processes using business process modeling tools (Singh, 2011):

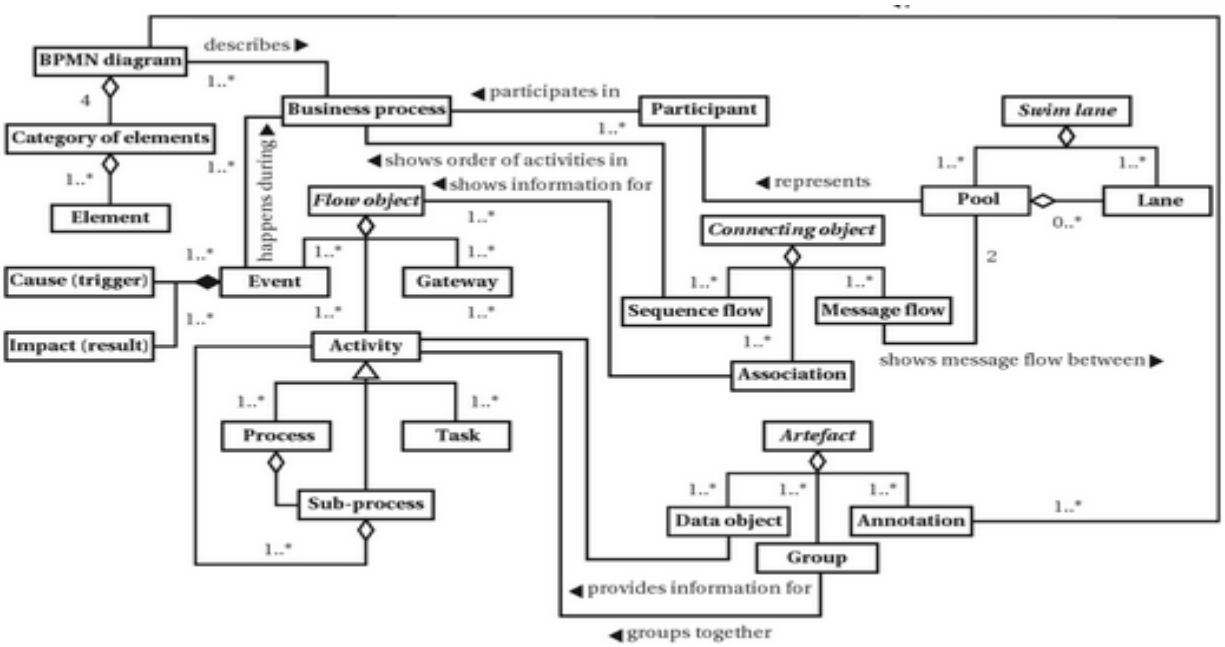
1) It aligns the operations with the business strategy.
2) It improves the process communication.
3) It increases the control and the consistency.
4) It improves the operational efficiencies.
5) It gains the competitive advantage.

As shown from the left side of Figure 13 below, any BPMN consists four main "category of elements", each of them consists at least one "element", and any single process can be described by a one or more BPMN diagram. The four main elements are (Holt, 2009):

1) **Flow objects:** which consists itself of three main elements: Events, Activities, and Gateways.
2) **Connecting objects:** which consists itself of three main elements: Sequence flow, Message flow, and Association
3) **Swim lanes:** which consists itself of two main elements: Pool and Lane

4) **Artifacts:** Data object, Group, and Text annotation.

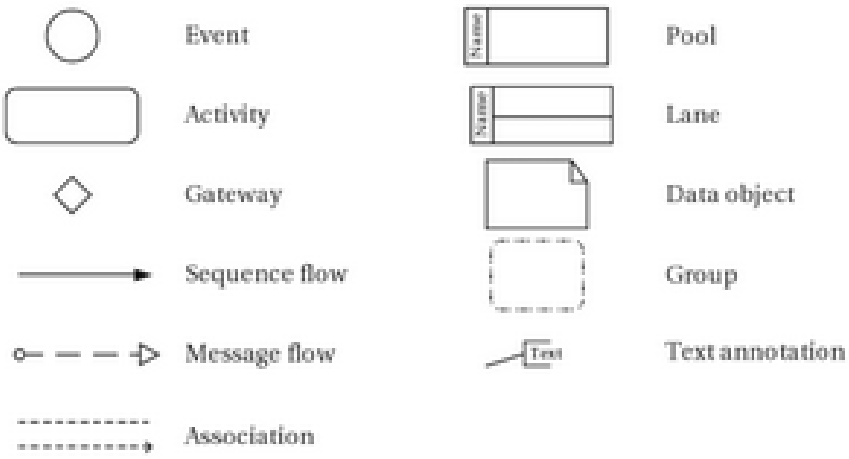
Figure 13. process structure view for the BPMN language



Source: Holt, J., *A pragmatic guide to business process modeling,* 2009, p. 162, Figure 8.1.

An explanation of some of the elements is shown in Figure 14 below shows the structure of a process in the BPMN language * (Holt, 2009):

Figure 14. Graphical representation of core modelling elements in BPMN



Source: Holt, J., A *pragmatic guide to business process modeling,* 2009, p. 163, Figure 8.2

- **Event:** It is anything that happens during the business process, it can happen at any time during the process, it usually has a cause that triggers it to happen, and it has an impact on the process. Events are categorized into three different categories; start events, end events, or intermediate events, a start event is the event the happens at the start of a process, an end event is the event that happens at the end of a process, and an intermediate event is the event that happens at any point between the start and the end of a process.

- **Activity:** it is any kind of work that happens during the business process, such as a tasks and processes.

- **Gateway:** it is what controls the direction of the flows when there are two or more options of decisions, a gateway shows the sequence flow of the process when there are such conditions.

- **Sequence flow:** as its name, it shows the order and the sequence of the activities performed in the business process.

- **Message flow:** it represents the flow of information and messages between two participants.

- **Association:** it shows the information that is associated with a specific activity, as in some cases it is clearer to describe or add a comment to an activity.

- **Pool:** it represents the participant who is responsible for a specific event in the business process.

- **Lane:** some activities are not done by only one "pool" as other participants might be participating in one activity in the business process; this is the so-called Lane.

- **Data object:** it is general information about one or more activities (if necessary).

- **Group:** it groups two or more activities together; usually it is used for documentation or analysis purposes.

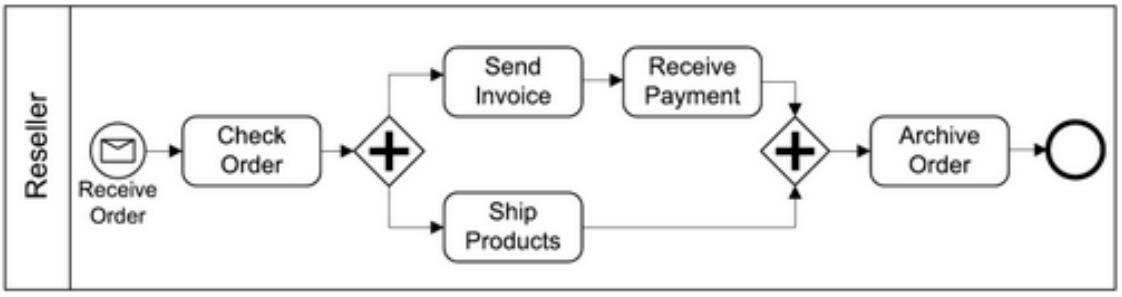
- **Text annotation:** it provides additional information about the BPMN diagram in a less formal way.

Note that the mentioned above symbols are not all the symbols that are used in BPMN language, yet they are the main ones as there are other symbols which are used but less frequently. For example, a model of a general ordering process of a reseller company would be analyzed as follows:

- The process starts when the reseller company receives and order and they check it.
- Thereafter, several activities occur in parallel, as while the invoice is sent and payment is received, the products will be shipped to the customers.
- Then, when all those activities are done, the order will be saved and archived and the order process can be considered complete.

Using BPMN, the model of the ordering process would look as in Figure 15 below (Weske, 2010):

Figure 15. Simple ordering process of reseller



Source: Weske, M., *Business process management: concepts, languages, architectures,* 2010, p.7, Figure 1.1.

Note that as per the explanation of the symbols above, we can clearly see that the Pool in this case is the Reseller, then, the starting event is to receive an order, however, although events are symbol led by a circle, they can still be marked with additional symbols inside the circle to show what type of event is that, in our example the starting event is marked with an envelope which means "message start event" in BPMN, later on, moving from the starting event to the next activity is shown by an arrow that is directed towards the activity which is checking the order, later on we can see a gateway symbol which is a diamond but is marked with a 'plus' sign, this is due to the parallel branch that follows the gateway, as the 'plus' sign indicates that the next activities can be executed concurrently, meaning that the activities do not happen in a specific order and an overlap can still happen between them, and moving until the end of the Figure 2.3.5, the last event to occur is the end of the process which is symbol led by a dark circle. This example is a very simple example to explain how BPMN works, as in big and long processes the model looks much bigger and way more complicated (Weske, 2010).

The importance of BPMN lies behind the fact that this language can represent many different diagrams in many levels of details for any purpose the organization is looking for, so that when processes are modeled, firms and organizations become able to answer the questions that most of them are struggling with, such as (White, 2008):

- What are the real necessary steps?
- Who is responsible to take them?
- To which steps we should outsource/offshore?
- What is the best possible way to have those steps done?
- What capabilities and resources needed?
- What are the expected results? Does it add value?

BPMN can be used to model different business processes, the following are examples of processes which can be modeled using BPMN (von Rosing, White, Cummings, & de Man, 2015):

- High level non-executable process activities,
- detailed executable business process,
- a description of an expected behavior of two or more business participants (a choreography),
- detailed private business process with interaction to one or more external entities,
- two or more executable processes interacting,
- detailed executable business process relationship to a choreography,
- two or more public processes,
- public process relationship to choreography,
- two or more executable business processes interacting through a choreography,
- AS-IS business process, or,
- To-BE business process.

When a business process is represented and modeled in its current state it is then called the AS-IS state, which is the state that is then evolved after applying a change to the business process to a future wanted process called the TO-BE state. However, in practice, looking at only both AS-IS and TO-BE models is not optimal, because it is necessary also to experiment other possible scenarios such as the COULD-BE scenario, and the OUGHT-TO-BE scenario. Table1 below lists all the relevant situations along contextual and temporal axes (Fossland, & Krogstie, 2016):

Table 1. Type of models according to temporal aspects and purpose

Type of model	Past	Present	Future
Ideal model	Ideal model of the past	Reference model	**Ought-to-be model**
Simulated model (what-if)	Possible model of the past	Possible model	Could-be model
Model espoused	As-was model	As-is model	**To-be model**
Model in use	Actual as-was model	**Actual as-is model**	Workaround model
Motivational model	Past burning-platform model	Burning platform model	Burning platform model

Source: Fossland, S., & Krogstie, J. *Enterprise Process Modeling in Practice–Experiences from a Case Study in the Healthcare Sector,* 2016, p. 2, Table 2.

Nevertheless, choosing the appropriate approach of process modeling depends on the strategy the modeler is following, he can start modeling the process architectures, the big picture, and then go to the detailed tasks, this is the so-called "top-down" approach. Another approach is called the "bottom-up", which means starting from the little spaces and details then going to the upper level of the process. Both approaches have their advantages and disadvantages, for instance, the bottom-up approach gives insight details about single processes more than the top-down approach, however, one might be lost and fall in the mistake of starting not deep but deeper than necessary, while top-down approach gives the portfolio of the processes first meaning that it helps in sharing the so called process thinking between the people, but on the other hand finding the big picture requires so much effort due to the fact that in reality processes interacts quite different than in theory (Recker, 2006).

Additionally, as BPMN provides a view of processes supported by flow charts for business processes and their interactions, a second version of BPMN called BPMN 2.0 was launched in 2011 and has more analytical capabilities. The purpose of launching the second version was mainly for three reasons (White, & Bock, 2011):

1) To provide a clearer notation that is understandable by all the analysts or the users who are managing and monitoring the processes.

2) To make process model execution easier, as the notation of the second version is supported by an internal formal execution capability which enables model execution.

3) To make information transfer easier between the models, as the second version is supported by a standard interchange format that enables the transfer of processes and models between modeling tools.

Nevertheless, at some point, the OMG is planning to update the current version of BPMN to version 3.0. Although discussion has been made about this topic, it is still not announced when will that step going to happen. The new version is intended to cover the wide landscapes and complexities that exist in the process-modeling technique as both versions 1.0 and 2.0 did not cover that area (von Rosing, White, Cummings, & de Man, 2015).

2 METHODOLOGY

The base method of the thesis approach is the "Business-Process" Oriented Requirements Engineering Process (BORE), can also be called (PORE) referring to Process Oriented Requirements Engineering Process, the approach basically consists of the following activities (Arao, Goto, & Nagata, 2005):

- Define the problem of the business process.
- Analyze the current as-is process.
- Make assumptions about what the to-be requirement process is.
- Fill the gap between the as-is and the to-be states.

The BORE approach is designed for an organization that is willing to undergo a process innovation (Nosrati, 2017). Therefore; it was the most convenient approach to follow as it will help us to reach the two main goals of the thesis below:

1. To prove that integrating IT with business does not necessarily need to be costly.
2. To provide guidelines for companies when they are deciding how to support a growing production planning process.

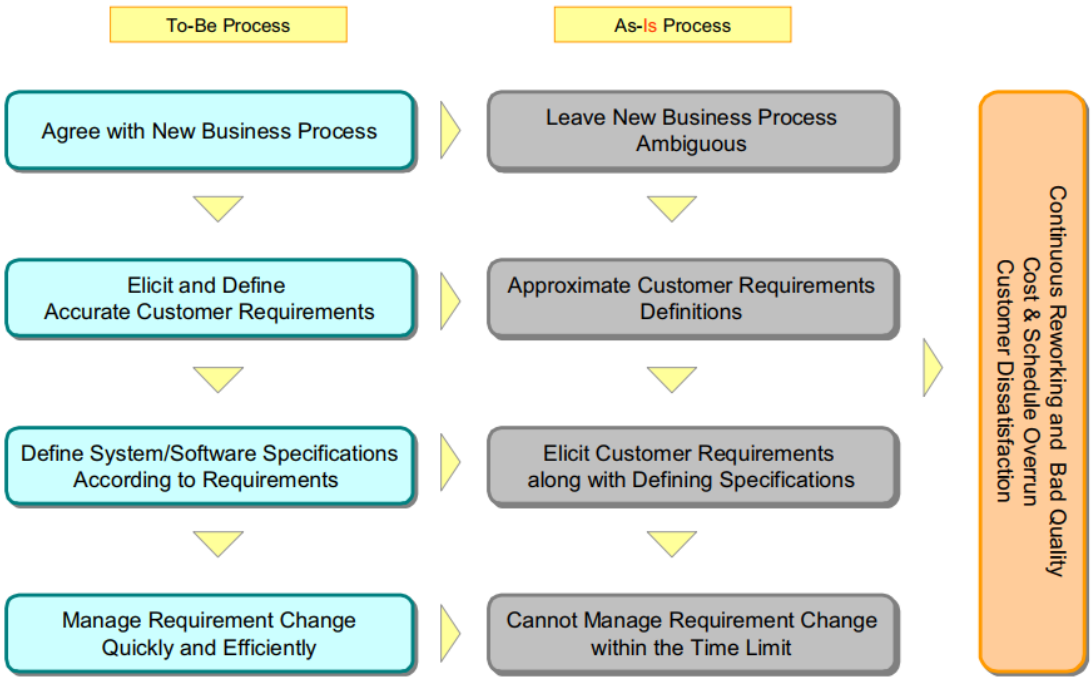
Using business process management tools and techniques, and following the business process redesign concepts, the methodology used below is redesigning the existing planning process by modeling it and transform the resulted model, the original model, -or the so-called AS-IS model- to a redesigned version -or the so called TO-BE model-, this transformation only occurs by reducing or eliminating at least one of the inefficiencies that are found in the AS-IS model (Figl, & Weber, 2011).

Reaching the TO-BE state requires process change from business problem analysis to new system and software design implementation if needed. Generally speaking, the four steps below are the steps required for reaching the TO-BE state are listed below and shown in Figure 16 (Arao, Goto, & Nagata, 2005):

1. The participants such as customers and vendors must agree to the new process to realize project aim and goal.
2. Vendors accurately define the customers' requirements for system and software functions according the agreed new process.
3. Vendors clearly define the specifications of the system/software that satisfy the customers' requirements.

4. Vendors manage the requirement changes as quick as possible according to the requirement changes from customers.

Figure 16. As-is and To-be requirement processes



Source: Arao, T., Goto, E., & Nagata, T., *" Business process" oriented requirements engineering process,* 2005, p.2, Figure 1

That said, and after relating the literature review with my case/problem, I will be examining the efficiency of the new solution by following the methodology below:

1) Present the suggested solution of which is the excel sheet.

2) Modeling the AS-IS model, of which is the planning process before using the sheet.

3) Modeling the TO-BE model, of which is the planning process after using the sheet.

4) Comparing both models to check how did the sheet contributed in solving the problem.

3 COPARIOSN OF AS-IS AND TO-BE MODELS

3.1 Suggested Solution

Purchasing an ERP system or an IT system would be the optimal solution for the company, but as said earlier, there are many constrains of which are interrupting the purchase of the

system, but using the help of IT and spreadsheets, more specifically Microsoft Excel, we can still use it to improve a current business process which will result in creating more successful production plans in our case, and fortunately, Excel is a spreadsheet supported by Microsoft which the majority of the people are familiar with and is found on almost every computer.

The current production plans are created fully manually, ideally speaking; the plans must be created by the support of an automatic system that alerts the supply planning department if an item is on a low stock level. The success of the production planning process in the mentioned scenario relies on having an overview image of the inventory status of company Y for the time the report is sent and at any time in the future, so that whenever company Y becomes on a low inventory status of a specific product, a production plan to produce that product must be created accordingly, having all this detailed information can help creating more accurate production plans in the future in less time.

The weekly report that is sent contains many information about the items, one important information can be beneficial for an optimization solution is the data about the current weeks of stock value of the items (that is filled in a column called "current WOS"), for instance, if the current WOS of item 'x' is eight weeks, this means that that after eight weeks from that moment company Y will not have any quantity of item 'x' and they will enter a backorder situation after exactly eight weeks.

Another, beneficial information is the data about the demand of the items, which can be used as an indicator of the quantities that company needs to produce and ship.

Having both information about the current WOS and the weekly demand, company X can accordingly be able to figure out on which week it should start producing the items automatically without the need of having many phone calls and discussions.

Therefore, a 3-tab, user-friendly, automated excel sheet was created to figure out company Y's inventory level in terms of weeks of stock of all the items until the end of the year depending on the markets demand and the inventory status of company Y which will be shown as a weeks of stock value, so that production plans are created as per this information.

The first tab of the excel sheet contains information about the weekly demand for all the products that company X supplies to company Y, in other words, it is the forecast of company Y's sales in units per week and must be the quantity that the company is expecting to receive and have in its inventory so that it will be able to fulfil the market's demand when it is needed. (*note that this information is to be received from the planning team at Y and to be updated manually whenever there is a change*) as shown below in Table 3.1.1, and in Appendix B.

Let us assume that the weekly report of the first week of the year (week one) was sent to company X with a data that says that the forecasted demand of product A is 1000 units per week, and for product B is 3000 unit per week, what company X will do is to simply take this information and paste it on the corresponding areas of the first tab of the sheet, the example is applied on Table 2 below:

The weekly demand of product A is 1,000 units (*in blue*).

The weekly demand of product B is 3,000 units (*in green*).

Table 2: Preview of tab 1 on the excel sheet

Item name	**Average weekly demand (units)**
A	1,000
B	3,000
…	
Z	

The second tab of the sheet has as many rows as the number of the items that company X supplies to company Y which is 68 (*note that it will be increased upon the approval of the new launches*), and has as many columns as the number of weeks in one year which is 52 weeks/year as shown below in Table 3.1.2 and in Appendix C.

On this tab company X fills the quantity it is planning to ship of a certain product on the corresponding week of which Y will receive the shipment at, taking into consideration the shipping method as shipping by sea usually takes four weeks from Portugal to the USA and shipping by air takes one week.

To clarify more, let us assume that company X will ship by sea a batch of 20,000 unit of product A on the first week of the year (week one) and will ship by air a batch of 30,000 unit of product B on the same week (week one), it must fill on the sheet 20,000 on the cell that interacts the row of product A with the column of week five, additionally, it must fill 30,000 on the cell that interacts the row of product B with the column of week two. The example is filled on Table 3 below:

Shipping 20,000 units of product A by sea on week zero (*in blue*).

Shipping 30,000 units of product B by air on week zero (*in green*).

Table 3: Preview of tab 2 on the excel sheet

Item name	Week 1 (units)	Week 2 (units)	Week 3 (units)	Week 4 (units)	Week 5 (units)	Week 6 (units)	… (units)	Week 52 (units)
A	0	0	0	0	20,000	0		
B	0	30,000	0	0	0	0		
…								
Z								

The third and the last tab of the sheet, shown in Table 4 and in Appendix D. below, has the same layout of the second tab, nevertheless, it is the tab where the status of the inventory level is shown in terms of a weeks of stock (WOS) value and is automatically calculated once the data is correctly filled on both tabs 1 and 2. The calculation that was used for this equation is the following formula:

WOS once received = (WOS on the previous week – 1) + (the corresponding quantity on the same week filled on tab 2 / weekly demand of the corresponding item that is filled on tab 1) (1).

As equation (1) shows, the weeks of stock once a shipment is received equals to the current weeks of stock plus the weeks of stock the received shipment will provide, taking into consideration that when time goes on and when the weeks passes by after a shipment is received, the weeks of stock value will decrease by the value of one week for every week passes.

Note that the relationship between the WOS and time is inverse, meaning that if there is no shipment going to be sent, the WOS value will weekly decrease by the value of one, and the second part of the formula would = 0, so the formula would be as in equation (2) below:

WOS once received = (WOS on the previous week – 1) (2).

Let us assume that the current WOS value of both products A and B is 10 weeks of stock on week one, the third tab of the sheet will show the results of our previous example as in Table 4 below:

Table 4: Preview of tab 3 on the excel sheet

Item name	Week 1 (WOS)	Week 2 (WOS)	Week 3 (WOS)	Week 4 (WOS)	Week 5 (WOS)	Week 6 (WOS	… (WOS)	Week 52 (WOS)
A	10	9	8	7	26	25		
B	10	19	18	17	16	15		
…								
Z								

When we updated the value of the data about the weekly demand and the quantities company X is going to ship to company Y, we can notice that the values of the weeks of stock (the third tab of the sheet) were updated automatically, for product A, the value has jumped from seven, the week they are going to receive the 20,000 units, on week four to 26 on week five and has decreased to 25 on week six, the same for product B, the WOS value jumped from 10 on week one to 19 on week two as they are going to receive a quantity of 30,000 units, and the values are decreasing by one when every week passes by.

3.2 AS-IS

The AS-IS model is a diagram that shows the details of the current relationships between the processes, it helps in understanding the organization of the business process. However, creating this diagram needs as many information as possible, this information must be precise and accurate in terms of specifying the exact roles and relationships in the organization. Generally, the AS-IS diagram is validated by the stakeholders to specify the current state of the organization (Nosrati, 2017).

The way company X creates its production plans for the products it ships to company Y is created weekly, depending on the inventory status of company Y at that time and the forecasted market demand received from company Y, the process is explained as follows:

- The supply planning department of company Y sends to company X a report called inventory report by email, usually this report must be sent on Monday, however, it sometimes be sent on a Tuesday if a delay occurred, a preview of the report is shown in Appendix A.

- The supply planning department of company X create a new column besides the list of products called “Comments” as shown in Appendix A, in which they fill that column

with all the information about the current production/packaging status from their side about the corresponding product (if any) and the expected shipping date.

- Thereafter, the supply planning department of company X analyzes the list after having all the information about all the items and they create the production plan accordingly for the following month.

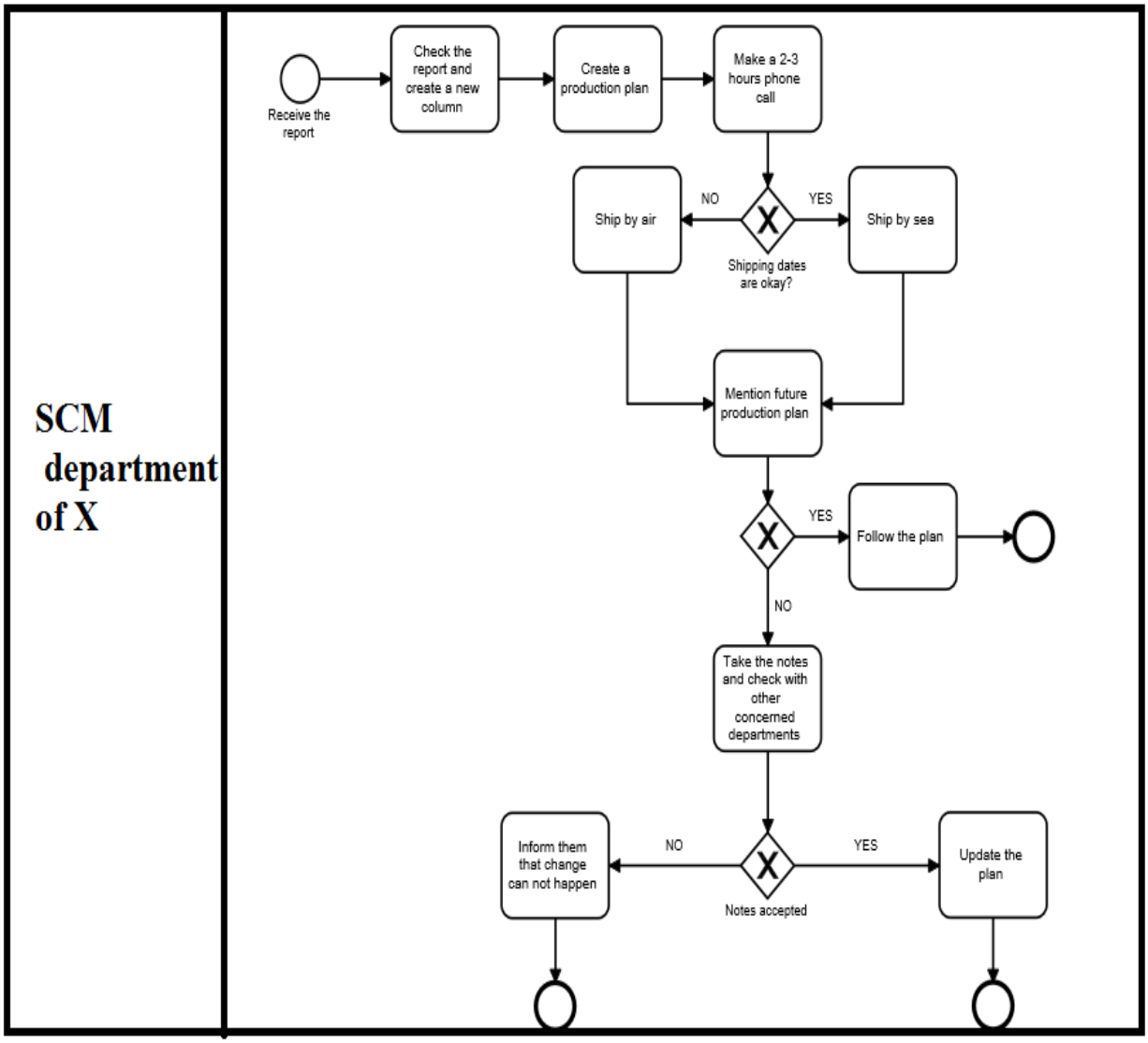
- Later, the supply planning department from both sides makes a conference phone call where all the concerned members join to discuss all the items on the report one by one. This call usually lasts for 2-3 hours and usually occurs on Wednesdays, but if a delay occurs the call is postponed to Thursday.

- The default shipping method from Portugal to the USA is to ship by sea because it is the cheapest method, but if the shipment is needed urgently shipping is done by plane which much more expensive but way faster. The call is divided to two parts, the first part is mentioning the expected shipping dates of all the items (if any) and the dates which company Y would receive the shipment, if they agree then they proceed with sea shipping, while if they disagree, a note is taken by the logistics team to change from sea shipping to plane shipping.

- The second part of the call is regarding the future production plan, if company Y agrees on the plan, the production plan is then approved, if not, company X take a note about changing the plan and deliver it to the concerned departments to check if the change can be done or not, if so, the production plan is updated accordingly, if not, they inform company Y that the change is not likely to happen and promise to ship by air.

Using BPMN modeling tools and techniques, the current planning process before implementing the solution, the AS-IS process, is modeled as in Figure 17 below:

Figure 17. AS-IS production planning process



3.3 TO-BE

After introducing the sheet, the production planning process will be sequenced as follows:

- The supply planning department of company Y sends to company X a report called inventory report by email, usually this report must be sent on Monday, however, it sometimes be sent on a Tuesday if a delay occurred, a preview of the report is shown in Appendix A.

- Company X then checks the report they received and take out the data from the two columns “Current WOS” and “Market Demand”.

- After taking out the data from the two columns, they update the inventory planning sheet they have with the new values of the two columns in their corresponding areas on the sheet (if any).

- Later, to start creating production plans, they go to the 3rd tab of the sheet, where they can see all the weeks of stock value for all the products until the end of the year and they check whether any item has any WOS value that is less than eight in the upcoming four weeks.

- For those items who have a value of less than eight, company X is now alerted that they need to start producing new batches of those items so that company Y receives the shipment before entering in a backorder situation, and in order to figure out how much batches they should produce they use the second tab of the sheet and fill the quantity they are planning to produce on the corresponding week that company Y is expected to receive the quantity, they then go back to the 3rd tab and will find that the WOS value has been updated automatically as per the expected quantity to be received.

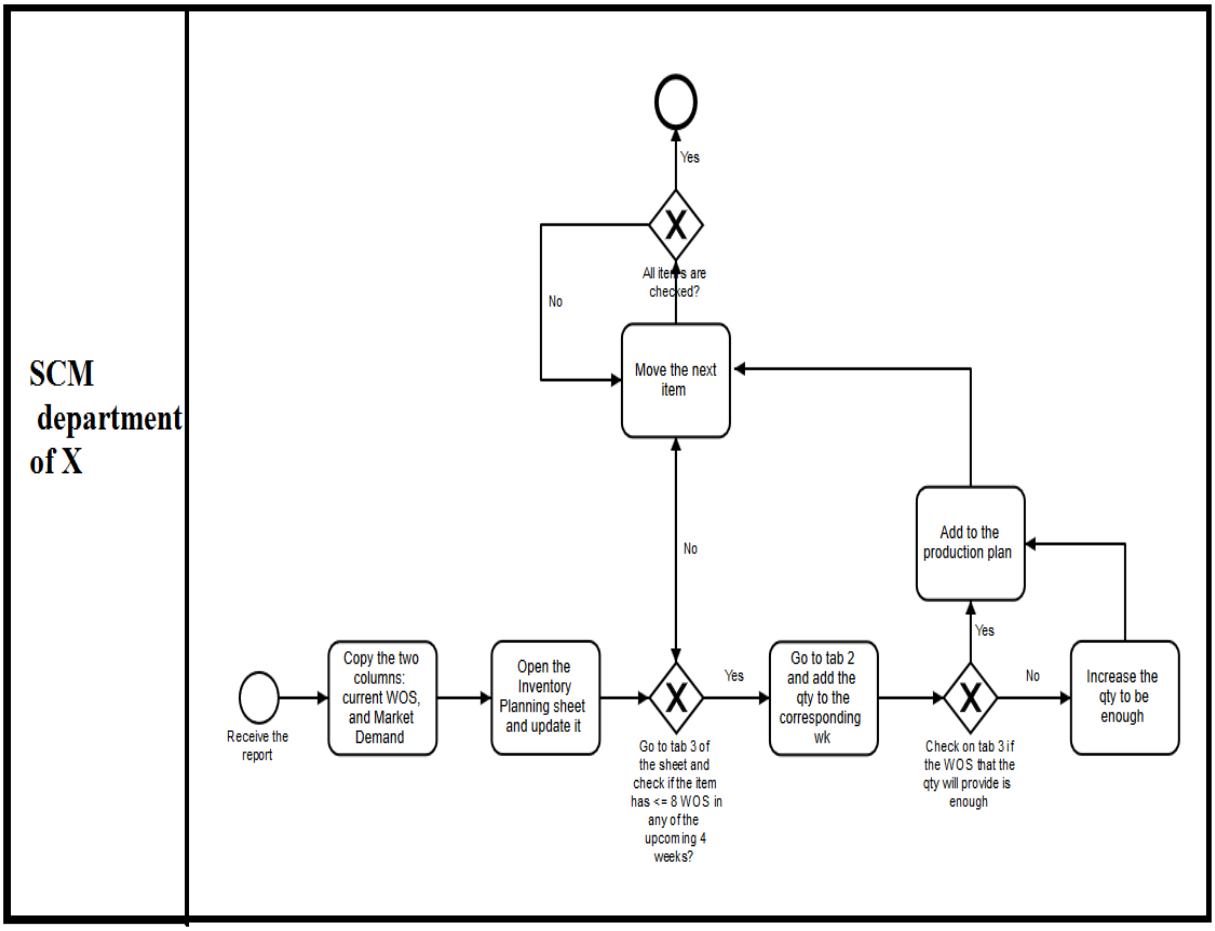
- Nevertheless, in some cases the WOS value might still be low, so in such situations, company X needs to increase the quantity so they increase the filled the data on the 2nd tab of the sheet until the WOS value on the 3rd tab of the sheet becomes sufficient.

- This process should be done to all the items that have a WOS value of less than eight in the upcoming four weeks.

- After all the items are checked, production plans are created accordingly as per the filled quantity on the 2nd tab of the sheet.

Using BPMN modeling tools and techniques, the new planning process after implementing the solution, the TO-BE process, is modeled as in Figure 18 below:

Figure 18. TO-BE production planning process



4 RESULTS AND DISCUSSION

After analyzing both planning processes, before implementing the solution and after, we can notice that the first model looks more complicated than the second one, usually when a model is more complicated it means that the process being modeled has many operational activities.

If we look deeply at the first model, the AS-IS model, we can tell that the activity of making a 2-3-hour-phone call is an activity that is in the very early stage of the whole process this activity is critical and all the following activities depend on it, which means it cannot be avoided in any case, this activity is replaced in the second model, the TO-BE model, using the implemented solution instead.

After using BPMN for modeling the AS-IS planning process, the resulted model clearly showed the inefficiencies in the process. The major problem that the model spotted the light on is the long phone call (2-3 hours) between the two sides after company X receives the report and add their comments to the new column they create, as we can see from the model, all the following activities and processes depends on this call, starting from mentioning the shipping method for all the future shipments, and ending with discussing the future production plan.

Although such a long phone call must be avoided in all cases, but as mentioned earlier, the company is rapidly growing, and a 2-3-hour-call is going to be easily doubled upon the approval of the additional 48 items to be produced, therefore, this specific activity must be immediately replaced by another solution and that what happened after implementing the solution as we can see from the TO-BE model.

The main features of the sheet are that it is user-friendly, very easy to be used, and shows the inventory level of all the items in terms of weeks of stock until the end of the year, whether there is a shipment expected to be received or not. The supply chain team of company X can use the sheet as a base for planning the United States demand which can be thereafter used for planning the demand of all the clients, and the logistics team can use it to plan the shipping method (air/sea) of the batches based on the weeks of stack status they see from the sheet.

The supply planning departments in the two companies X and Y were satisfied using the sheet and what is more important is that they accepted the change of the old planning process easily, generally, people usually need some time to adapt a change of a process and accept the fact that the old process is no longer going to be used and that they should start to focus on how to learn and master the new process, this is why people do not accept the change easily, and especially when it comes to a process that they have been using for many years.

Fortunately, in our case, after the sheet was introduced to both companies and used for the production planning process, the two companies admitted that the actual results were fruitful for both, the sheet contributed in creating more accurate on time shipments and less time wasted.

We can list the benefits of using the sheet for company X as follows:

- Creating production plans became easier,
- Long phone calls with company Y are reduced,
- More accurate and precise shipments,
- Shipping method is more clear for the logistics department.

Nevertheless, although the sheet is meant to be used by the supply planning department of company X, but still it had positively impacted company Y at some point, below are the benefits that company Y has gained after company X started using the sheet:

- Setting production priorities, meaning that when company X cannot produce all the needed items at a specific time, the sheet can help company Y to choose its priories per the quantity to be shipped and the next expected quantity received,
- More accurate just in time shipments received,
- Long phone calls with company X are reduced,
- The backorder value from the inventory was significantly reduced, which consequently increased the sales and the profits.

After several weeks of using the sheet, the supply chain department of company X planned to expand the sheet and make it way more beneficial. It was seen that it could be very more helpful if the sheet can show the how much a shipment is profitable, therefore, it was decided to make the sheet more complicated by integrating the market demand with the dollar value of the items through a new tab (call it tab 4) that is calculated using the financial value of the items, so that the user will be able to figure out the production priorities among all the possible plans of all the items according to which way seem to be the most profitable and reflect it then on the production plan.

CONCLUSION

Whether the company is integrating IT with its business or not, we must admit the fact that IT is the next big thing, because nowadays it is not only considered as a support factor for the business but it became a survival factor that plays a vital role for the success of most of the businesses, we cannot neglect the fact that IT is the fastest growing area among all the new trends that most of the successful companies are focusing on.

Nowadays, whatever one's business is, there is a huge chance that IT is integrated with their business regardless of what business it is, not only that when we directly introduce IT to our processes we integrate IT with the business, but also IT can always be connected to our business indirectly through the customers who might be using it, or through the suppliers, the staff, the managers, and so on and so off. If we rationally think about it, if IT is not integrated with our business, our business will not be able to exist (Potts, 2010).

Although most of the companies are aware of the importance of integrating IT with their business, they usually do not step forward to change their old way of working by introducing IT to their business processes, unfortunately that is because generally IT systems seem to be highly expensive and complicated to implement. However, this belief must be changed, the study above clearly proved that no matter what the available resources are, there is always still a room for an improvement, and integrating IT with business does not necessarily has to be expensive.

In the pharmaceutical industry, the business itself is different than any other, pharmaceutical industry is extremely complicated and sensitive, not only because we must always take into consideration that we are dealing with peoples' health, but also the production process is complex, the amount of pills that are produced very huge, and the cost of the ingredients is very expensive, meaning that when the company plans to run a production line of a certain product, it must be sure that there are no mistakes or errors, because any issue can cause a huge loss of money. Therefore, the company must have a well-organized system where to guarantee that the processes are going on the right path.

The supply chain plays a very important role for the success of the business in the pharmaceutical industry, having an accurate and precise production plans will ease a lot of work for the concerned departments and will bring back many fruitful results. Supply chain processes such as production planning, inventory management, or demand planning are not simple nor some easy processes, they must be done very carefully specially in the pharmaceutical industry, because if we think about it in an ethical way, a small mistake by the

production planning for instance can result in not having a medicine available in markets for a patient who needs it.

Nevertheless, it is almost impossible to be able to manage the supply chain of a pharmaceutical organization manually, there must be support of IT to guarantee that the supply chain is well managed and organized. If the resources are limited, or if there are constrains which are preventing the implementation of an ERP system for instance, the company must look for other alternatives.

Spreadsheets such as Microsoft Excel that can be found built-in almost every computer can be amazingly simple or amazingly difficult and sophisticated; spreadsheets can evolve easily with changing business needs. Microsoft Excel is superior software, whether the company is large, medium, or small, it can still get a lot of benefits from Microsoft Excel, not only for summarizing or reporting, but also for building analytical models in which the company can improve decision making and therefore increase its profits. It is highly recommended that everyone learns more about Microsoft Excel and its features; it can be very helpful for any business whatever it is, with many functions and commands that can analyze the data through the spreadsheet and improve the decision-making process. However, it might be difficult to get familiar with all those functions in the beginning, but it only needs patience to get the expected results. And most importantly, Excel is not going anywhere, most of the businesses will continue to use Excel as a primary tool for the support it needs in all processes, ranging from huge IT projects to the company's internal issues. In the working life, nowadays, a knowledge of Excel is vital in most of the office related professions, and strong Excel skills can open the door to anyone for promotions and other better opportunities.

That said, it is important to note that using Excel or other spreadsheets to support the business processes does not mean that they are a replacement to an ERP system, but they can still be used until the purchase of an actual ERP system happens, meaning that if a company cannot purchase an ERP system due to any constrains it must not let those constrains stop them from integrating IT with the business, but in fact they must find alternatives of which can be used until the constrains are solved and the needed system is actually purchased. The study proved how that with a help of Microsoft Excel that is freely available for nearly every computer users we can notice how that a simple spreadsheet has contributed in improving a production planning process of a huge pharmaceutical company, which can then be applied to any other industry or business.

However, another point that the study spot the light on is that change of processes is always essential, especially when the business is growing, by saying that, it is important that the company look at its business processes in the big-picture or through business process

modeling tools by modeling the business processes to find out where are the inefficiencies in their processes, having this information helps to find alternatives which improves the business and enhances the performance and consequently increases the profits.
A change is always necessary, but people do not accept the change easily. Nevertheless, if the inefficiencies in the business processes are clearly pointed and showed through a model for instance, will make it easier to convince the people about the change as there will be a good argument for applying the change thereafter.

The company must also understand that following the same process without paying attention to the new market trends won't let the company survive and will consequently loose against its competitors. At the end of the day, business is about gaining profits, and gaining profits comes from customers who buy the product/service the company offers, while customers look for the best service provider in terms of cost, quality, and time, meaning that the competition between the companies is daily increasing, and the company that does not change and update its processes to follow the market won't be able to survive. A successful company is the one that analyzes its processes and always find the inefficiencies and reduce or eliminate them through any other alternative.

REFERENCES

1. Agrawal, R. (2009). *Planning and scheduling problems in manufacturing systems with high degree of resource degradation*. Georgia: Institute of Technology.

2. Albertin, A., & de Moura, R. (2004). *The Benefits of Information Technology in Business Performance*. USA: Americas Conference on Information Systems (AMCIS).

3. Allweyer, T. (2016). *BPMN 2.0.: Introduction to the Standard for Business Process Modeling (2nd ed.)*. BoD–Books on Demand.

4. Arao, T., Goto, E., & Nagata, T. (2005). *Business Process Oriented Requirements Engineering Process.* (pp. 395-399). France: International Conference. IEEE.

5. ASCEND. (2015). *ERP Consulting*. Retrieved September 22, 2017, from http://edmontonbusinessconsulting.com/erp-consulting/

6. Auramo, J., Kauremaa, J., & Tanskanen, K. (2005). Benefits of IT in Supply Chain Management: An Explorative Study of Progressive Companies. *International Journal of Physical Distribution & Logistics Management*, *35*(2), 82-100.

7. Brauer, B. (2006). *Next Evolution of Data Integration into Microsoft Excel*. Technical report. StrikeIron Inc. Durham University, England.

8. Brocke, J. V., & Rosemann, M. (2014). *Handbook on business process management 1: Introduction, methods, and information systems.*

9. Burnson, F. (2016). The Difference Between MRP vs. MRP II. Retrieved October 10, 2017, from http://www.softwareadvice.com/resources/mrp-vs-mrp-ii/

10. Cholette, S. (2011). *Outline: Demand Forecasting*. Lecture presented in San Francisco: San Francisco State University. USA.

11. Christopher, M. (2016). *Logistics & supply chain management* (5th ed.). Pearson Higher Ed. UK.

12. Du, D. (n.d.). *Supply Chain Management: Forecasting techniques and value of information*. Lecture presented at Lecture 6 in University of New Brunswick, Canada.

13. Ellram, L. M., & Cooper, M. C. (1990). Supply chain management, partnership, and the shipper-third party relationship. *The International Journal of Logistics Management, 1*(2), 1-10.

14. Estep, J. A. (2012). *APICS Executive Briefing: "Demand Forecasting & Inventory Planning for Manufacturers & Distributors*''. Summitview Road, USA: E/Step Software Inc.

15. Figl, K., & Weber, B. (2011). Creative Personality and Business Process Redesign. In *EMISA* (pp. 189-194). *University of Innsbruck, Austria.*

16. Fischer, G., & Rathke, C. (1988). *Knowledge-Based Spreadsheet System,* in Proceedings of AAAI 88 (Seventh National Conference on Artificial Intelligence) (pp. 802-807), Morgan Kaufmann Publishers.

17. Fossland, S., & Krogstie, J. (2016, June). *Enterprise Process Modeling in Practice–Experiences from a Case Study in the Healthcare Sector*. In International Workshop on Business Process Modeling, Development and Support (pp. 365-380). Springer International Publishing.

18. Gillot Jean-Noël. (2008). *The complete guide to Business Process Management,* (3rd Edition), Research Institute, California, United State.

19. Graves, S. C. (2011). *Uncertainty and production planning. In Planning Production and Inventories in the Extended Enterprise* (pp. 83-101). Springer US.

20. Groznik, A., & Maslaric, M. (2012). A process approach to distribution channel re-engineering. *Journal of Enterprise Information Management, 25*(2), 123-135.

21. Groznika, A., & Trkman, P. (2012). *Current issues and challenges of supply chain management*. Economic Research-Ekonomska Istraživanja, 25(4), 1101-1112.

22. Gurney, A. (2016). *Top 10 New Features of Excel 2016*. Retrieved May 23, 2017, from http://learn.filtered.com/blog/top-10-new-features-of-excel-2016.

23. Holt, J. (2009). *A pragmatic guide to business process modeling*. BCS, the Chartered Institute. Swindon: British informatics society limited.

24. Hugos, M. H. (2011). *Essentials of supply chain management* (Vol. 62). John Wiley & Sons. New Jersey: John Wiley & Sons Inc.

25. Jaber, M. Y. (Ed.). (2009). *Inventory management: non-classical views*, Boca Raton: CRC Press.

26. Jacobs, F. R. (2007). Enterprise resource planning (ERP)—A brief history. *Journal of Operations Management, 25*(2), 357-363.

27. Jeston, J., & Nelis, J. (2008). *Business process management (2nd Ed.)*, New York: Routledge.

28. Khan, S. A., Liang, Y., & Sumaira, S. (2015). The effect of buyer-supplier partnership and information integration on supply chain performance: an experience from Chinese manufacturing industry. *International Journal of Supply Chain Management, 4*(2).

29. Kleywegt, A. J. (2012). *Forecasting in supply chains*. Lecture presented at School of Industrial and Systems Engineering Georgia Institute of Technology, Georgia.

30. Ko, R. K., Lee, S. S., & Wah Lee, E. (2009). Business process management (BPM) standards: a survey. *Business Process Management Journal, 15*(5), 744-791.

31. Lummus, R. R., & Vokurka, R. J. (1999). Defining supply chain management: a historical perspective and practical guidelines. *Industrial Management & Data Systems, 99*(1), 11-17.

32. Mangan, J., Lalwani, C., & Lalwani, C. L. (2016). *Global logistics and supply chain management* (3rd Ed.). John Wiley & Sons.

33. Meng, Y. (2006). *The effect of inventory on supply chain*, Diploma work. VÄXJÖ University.

34. Mentzer, J. T. (2001). *Supply chain management*. Thousand Oaks, CA: Sage Publications.

35. Mentzer, J. T., & Moon, M. A. (2004). Sales *forecasting management: a demand management approach*. California: Sage Publications.

36. Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business logistics, 22*(2), 1-25.

37. Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2015). *Purchasing and supply chain management*. Boston: Cengage Learning.

38. Muller, M. (2011). *Essentials of inventory management*. AMACOM Div American Mgmt Assn.

39. Nikoloski, K. (2014). The Role of Information Technology in the Business Sector. *International Journal of Science and Research* (IJSR), 3(12).

40. Nosrati, M. (2017). *Exact Requirements Engineering for Developing Business Process Models*. arXiv preprint arXiv:1705.03883.

41. Poirier, C. C. (1999). *Advanced supply chain management: How to build a sustained competitive advantage*. San Francisco: Berrett-Koehler Publishers.

42. Potts, C. (2010). *Integrate IT with the business? It already is. But are you?* Retrieved September 27, 2017, from http://www.cio.com/

43. Power, D. J. (2004). *A brief history of spreadsheets*. DSSResources. com.

44. Rashad, W., & Gumzej, R. (2014). The Information Technology in Supply Chain Integration: Case Study of Reda Chemicals with Elemica. *International Journal of Supply Chain Management, 3*(1).

45. Recker, J. C. (2006). *Process modeling in the 21st century*. *BPTrends*, 1-6.

46. Rose, S., Spinks, N., & Canhoto, A. I. (2014). *Management research: Applying the principles*. New York: Routledge.

47. Rosemann, M. (2006). Potential pitfalls of process modeling: part A. *Business Process Management Journal, 12*(2), 249-254.

48. SBS Group, (2015). *Top 3 Risks of Using Spreadsheets to Manage Your Business*. Retrieved May 29, 2017, from http://www.erpsoftwareblog.com/2015/09/top-3-risks-using-spreadsheets-manage-business/

49. Shah, N. (2004). *Pharmaceutical supply chains: key issues and strategies for optimization*. Computers & chemical engineering, 28(6), 929-941.

50. Shepard, D. (2012). *Collaborative Demand and Supply Planning between Partners.* Supply Chain Acuity.

51. Singh, D. (2011). *5 Key Benefits of Business Process Modeling*. Retrieved July 01, 2016, from http://www.modernanalyst.com/Resources/Articles/tabid/115/ID/1728/5-Key-Benefits-of-Business-Process-Modeling.aspx .

52. Štemberger, M., Vukšić, V., & Kovačič, A. (2009). Business process modelling as a critical success factor in implementing an ERP system. *South East European Journal of Economics and Business, 4*(2), 89-96.

53. Tulokas, S. (2015). *Developing Demand Planning in a Global Engineering Company.*

54. Van Der Aalst, W. M. (2013). *Business process management: a comprehensive survey*. ISRN Software Engineering.

55. Von Rosing, M., White, S., Cummins, F., & de Man, H. (2015). *Business process model and notation—BPMN*. The Complete Business Process Handbook, 429-453.

56. Waghmare, M. P., & Mehta, M. B. (2014). Information Technology and Supply Chain Management Practices in Global Business Organizations–A Study. *IBMRD's Journal of Management & Research, 3*(2), 107-112.

57. Waters, D. (2003). *Logistics; an introduction to supply chain management.* Palgrave Macmillan.

58. Weske, M. (2010). *Business process management: concepts, languages, architectures*. Springer Publishing Company, Incorporated.

59. White, S. A. (2005). *BPMN fundamentals*. In OMF BEIDTF Meeting, Atlanta (Vol. 12).

60. White, S. A. (2008). *BPMN modeling and reference guide: understanding and using BPMN*. Future Strategies Inc.

61. White, S. A., & Bock, C. (2011). *BPMN 2.0 Handbook Second Edition: Methods, Concepts, Case Studies and Standards in Business Process Management Notation*. Future Strategies Inc.

62. Why ERP Can't Stop Spreadsheets [White paper]. (n.d.). Retrieved May 26, 2017, from https://www.boardwalktech.com/resources/WP-Spreadsheets-Rule-ERP-BWT-BAE.pdf.

63. Zaiontz, C. (2015). *Built-in Statistical Functions*. Retrieved June 15, 2017, from http://www.real-statistics.com/excel-capabilities/built-in-statistical-functions/

APPENDIXES

TABLE OF APPENDIXES

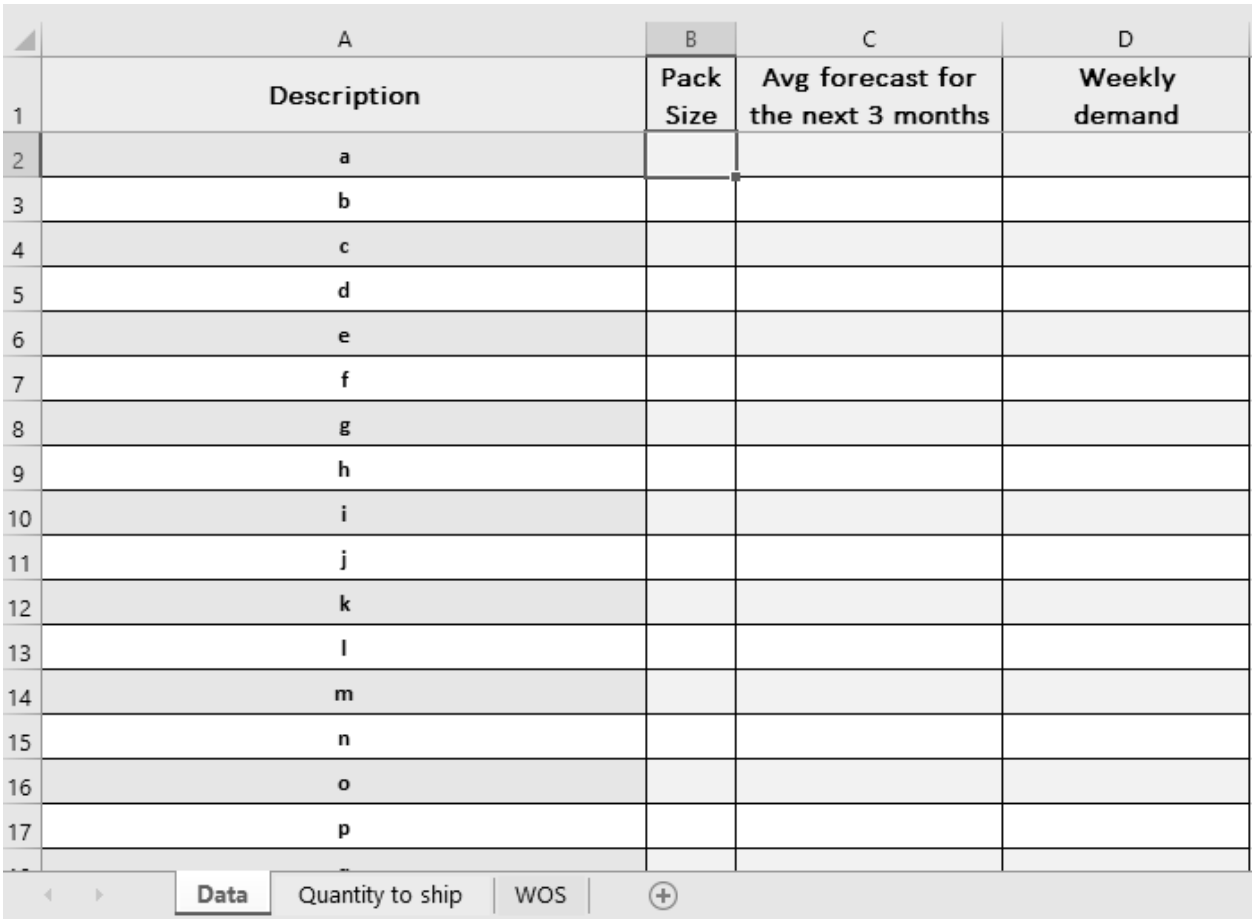
APPENDIX A: Preview of the inventory report

Figure 1. Preview of the inventory report

Item Number	Description	Forecasted Demand	Inventory	Open Orders	Dollars	WOS	Quantity Expected	Expected Date	Comments
1	A								
2	B								
3	C								
4	D								
5	E								
6	F								
7	G								
8	H								
9	I								
10	J								
11	K								
12	L								
13	M								
14	N								
15	O								
16	P								
17	Q								
18	R								
19	S								
20	T								

APPENDIX B: Preview of the first tab of the inventory planning sheet, called "Data"

Figure 2. Preview of the first tab of the inventory planning sheet, called "Data"

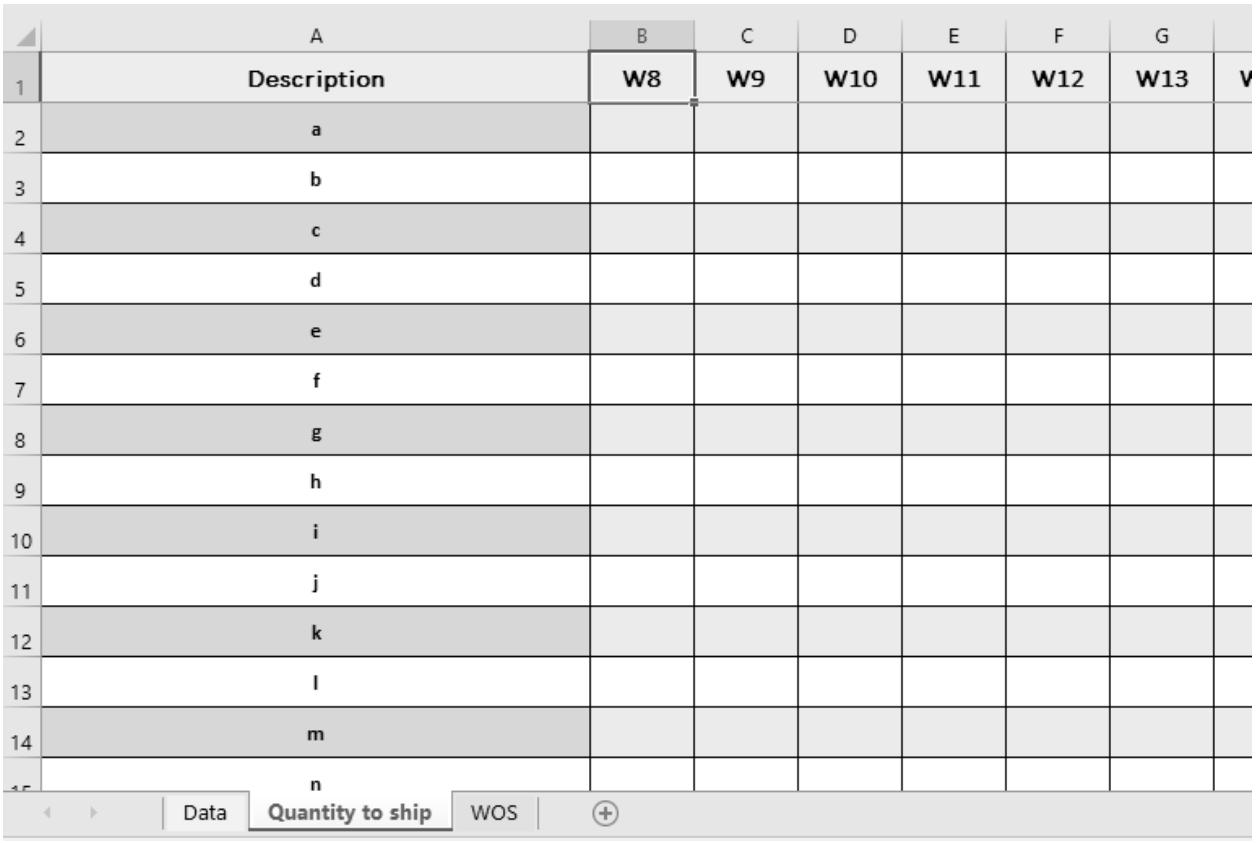


	A	B	C	D
1	Description	Pack Size	Avg forecast for the next 3 months	Weekly demand
2	a			
3	b			
4	c			
5	d			
6	e			
7	f			
8	g			
9	h			
10	i			
11	j			
12	k			
13	l			
14	m			
15	n			
16	o			
17	p			

Data | Quantity to ship | WOS

APPENDIX C: Preview of the second tab of the inventory planning sheet, called "Quantity to ship"

Figure 3. Preview of the second tab of the inventory planning sheet, called "Quantity to ship"

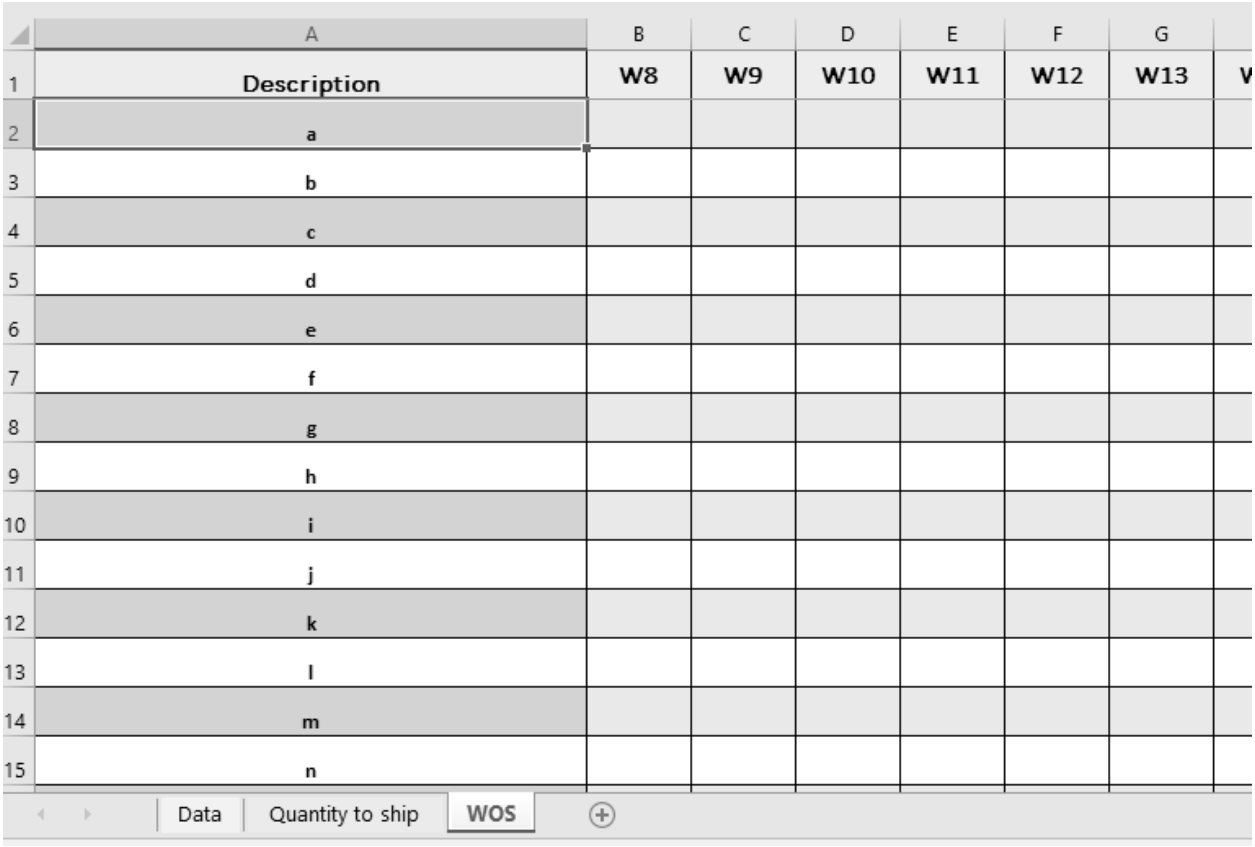


	A	B	C	D	E	F	G
1	Description	W8	W9	W10	W11	W12	W13
2	a						
3	b						
4	c						
5	d						
6	e						
7	f						
8	g						
9	h						
10	i						
11	j						
12	k						
13	l						
14	m						
15	n						

Data | Quantity to ship | WOS

APPENDIX D: Preview of the third tab of the inventory planning sheet, called "WOS"

Figure 4. Preview of the third tab of the inventory planning sheet, called "WOS"



	A	B	C	D	E	F	G	
1	Description	W8	W9	W10	W11	W12	W13	W
2	a							
3	b							
4	c							
5	d							
6	e							
7	f							
8	g							
9	h							
10	i							
11	j							
12	k							
13	l							
14	m							
15	n							

Data | Quantity to ship | WOS