

# Challenges and Effective Management of Supply Chain in Wine Industry and Agribusiness

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**Abstract** Studies have shown that the future of the wine market rests on the effective and efficient changes in technology to the supply chain used by most of the major global players. In today's wine industry, companies are faced with the ever-shifting demand for their products, strict regulation and increasing price competition. Even at that, mature companies in the wine industry are succeeding by scaling up production, streamlining their supply chains, expanding into new geographic areas, implementing more efficient processes, cleverly marketing products, and focusing on ever closer relationships with suppliers, partners and customers.

However, this paper looks at supply chain challenges in the wine industry from a global perspective presented in the inbound, manufacturing and outbound processes as well as offer effective solutions in order for companies to gain a competitive advantage and succeed on a global level.

**Keywords** Inbound and outbound systems, IP (Intellectual Property), AOC (Controlled Designation of Origin), item procurement matrix, Just-in-time system, MPR (Material Requirements Planning System), PICA smart vineyard system, 3PL (Third Party Logistics), INCOTERMS, RFID (Radio Frequency Identification), ABC system.

## 1 Introduction

Studies have shown that the future of the wine market rests on the effective and efficient changes in technology to the supply chain used by most of the major global players. Whilst the internet had opened up the world of wine to the general consumer, it is now being held back by inefficiencies in the supply chain. In today's wine industry, companies are faced with the ever-shifting demand for their products, strict regulation and increasing price competition. Even at that, mature companies in the wine industry are succeeding by scaling up production, streamlining their supply chains, expanding into new geographic areas, implementing more efficient processes, cleverly marketing products, and focusing on ever closer relationships with suppliers, partners and customers. Christian Adamo (June, 2004) argues that as "consumers keep demanding for better products, with lower prices, along with better overall services and customer supports, companies themselves are struggling with shorter product life cycle, increased product variety, and lower profit margins due to fierce global competition." Giving the fact that the market for the wine industry is highly competitive, many of the leading players try to leverage their size and geographical reach to cut procurement costs and deliver more efficiently and at lower costs to their target markets. As the wine industries become consolidated in recent years, both production and distribution capacity becomes increasingly concentrated in the hands of companies with global reach, and there has been consolidation in the retail market as well. The stronger bargaining power of large supermarket chains and buying groups, together with increased competition from private label brands, has put pressure on the wholesale and distribution industry's already thin margins. During the last few years most production based industries and wineries in particular have been under serious pressure to improve upon their top-line growth and bottom-line savings. In this regards, many companies are

turning to systems and technologies that can help optimize the inbound and outbound supply chain activities and improving short-term and long-term demand forecasting.

## 2 Challenges of Wine Supply chain

In line with the inbound system of the wine industry supply chain, there are a number of inputs and a number of suppliers that affect the wine making process. In this section I will be focusing on grapes, cork and glass as the main inputs, and the potential supply chain problems experienced by the suppliers themselves as well as the relationships between the suppliers and the winery.

Within the Wine industry the source or origin of the grapes and the wine are very important. One example of the push for the protection and distinction of brands is the establishment of the distinction of origin and the Country of origin Systems. This is, although developed and administered by the EU was quickly adopted by the wine

producers in the new world. The system allowed marketers to reap increased profits by having their wines designated AOC (Controlled Designation of Origin).

The Designation of Origin gave producers significant benefits such as:

- Designations of the geographic area, production quantities within a quality classification type were defined.
- Attributes were limited in regards to grape varieties, yield and output.
- The IP was protected.

Although on one hand the designation of the Controlled Designation of Origin enabled the wineries to command premium prices, it caused some of the supply issues for growers as will be seen in more detail in the following section.

For the winery within the sourcing area the grapes are the most vital component. In regards to the item procurement matrix, there are four categories of items that a company may analyze as shown in figure 1 below.

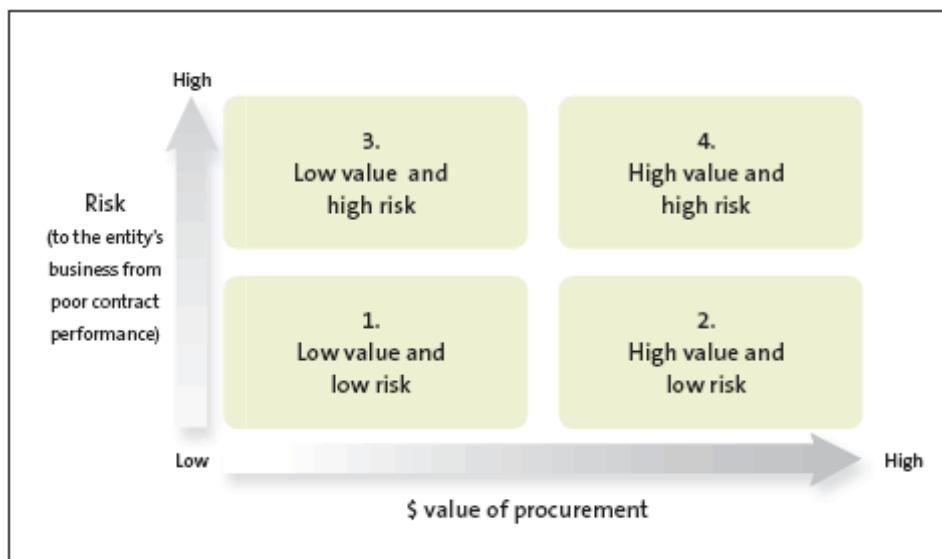


Fig. 1 Item Procurement Importance Matrix

According to this graph the grapes would fall into the critical segment. Although one could argue that the value of the grapes themselves are not great and that they should fall in the distinctive quadrant that is only true if the grapes are looked at as the final product. However in the eyes of a wine producer, grapes have high value, high risk characteristics of a critical, while cork would fall into the distinctive quadrant and glass possibly into the generic quadrant. This is mainly due to the fact that, unlike grapes, if cork and glass are relatively cheap and alternative sources can easily be acquired.

### 2.1 Grapes

The main strength for wineries at the same time becomes a major weakness. Although the mark of Controlled Designation of Origin as mentioned previously commands a premium in price, it causes several issues. By limiting grape varieties, outputs and yields the suppliers have much less flexibility and options in case there are disruptions in supply. A winery, unlike most other industries, cannot easily acquire additional grapes or juice from outside sources or from vineyards outside of its specific geographic

location. This in turn makes the supply of grapes very irregular, and unpredictable.

## 2.2 Over supply and Undersupply

Over supply and Undersupply is another challenge in regards to the replanting of the vines. Due to the time that needs to pass between planting the vines and them starting to produce adequate grapes, causes a constant disconnect between supply and demand. This in turn leads to a boom bust cycle in regards to the grapes that repeats itself circa every 10 years as followed in this historical account. In 1970 in California traditional grape shortage cycles lasted between 6 and 10 years (Joe Ciatti and Cody Jennings, April 9, 2012). In 1970, due to the shortfall, Ciatti et al (April 9, 2012 article) argued that California saw large scale vine plantings driven both by tax incentives and a growing interest in wine shown by the baby boomers. Ciatti et al (April 9, 2012 article) pointed out that the plantings continued into the 80s and the beginning of the 90s. As a direct result of that there was a large oversupply of grapes that lasted till 2010. During that time there was limited replanting since there were several good harvest years. Due to the long time needed for the vines to start bearing the oversupply came at the start of the economic crises. However with the economic recovery the demand for wine increased again, which led to a grape shortage and subsequent mass plantings. Those wild swings between oversupply and supply deficiencies caused issues regarding forecasting and the availability of supply.

The primary solutions to alleviate the wide swings in supplies are that growers should replant their vines with new varieties and higher yields on longer term contracts. Another solution is to turn the grapes into bulk wine, since wine has a better return than grapes currently. In order to move less desirable varieties like Syrah, growers should package them together with varieties that are more in demand such as Cabernet.

## 2.3 Forecasting

In most industries forecasting and inventory management are relatively straightforward. A given company may use a fixed quantity approach, whereby after a given period of time when inventory drops below a certain point, the company would reorder the inventory. However, within the Wine industry forecasting is much more complicated. The first issue is that tastes for wine among consumers may change rapidly. Due to the long lead time needed for the planting of new vines it makes it hard for grape growers

to switch grape varieties. On the grape growers end, since the harvest basically depends on nature, it is hard to predict the yield and sugar quantities within the grapes. A third factor that affects supply is that grapes take a given time to ripen, meaning that unlike other industries the input (in this case grapes) that will be sold for several years, is collected within a matter of weeks once per year.

Initially the predictions for the future price of grapes were done using a linear model, whereby it was assumed that prices would increase over time. However this approach didn't take into account the cyclical nature of prices and the effect on prices that the current harvest and previous harvest had. A new model was developed that looked at acreage planted, yield and price. From the article of "Forecasting California Wine Supply Cycles" Steven Cuellar states as follows:

To begin with, it is clear that the price per ton of grapes depends on the current year's harvest. Similarly, the current year's harvest depends on the amount of acreage cultivated (i.e., the supply side of the market). The amount of acreage currently cultivated will in turn depend on the current price and past price of grapes. Again, economic theory tells us that when the price of grapes is high, suppliers will increase the amount of grapes planted. Likewise, high prices in the past, which induced suppliers to increase acres planted, will result in a greater current grape stock.

This in turn enables the new model to follow the cyclical patterns of the supply and demand and more accurately predict the future price of grapes. The new model, unlike the old model of the past which only had approximately a 50% accuracy rate has an accuracy rate of over 90% and allows for both short and long term forecasts.

## 2.4 Production Process

With regards to raw materials the wine grape itself contains almost all of the necessary ingredients to begin the production process, in fact other than grapes just yeasts and a few chemicals are needed. Wine production can vary depending on the type of grape and the amount and type of wine being produced. The process of wine production has remained similar throughout the years, however, new innovations to the manufacturing process have helped to streamline some of these processes and produce a higher yield. In most mid to large sized wineries the manufacturing processes are automated in order to ensure accuracy and efficiency. The wine making process is comprised of four specific steps as shown in figure 2 below.

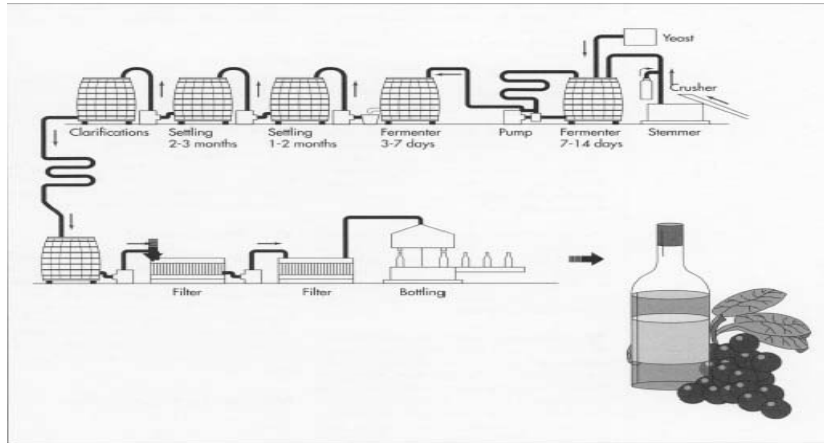


Fig. 2 Wine Production Process

In order to begin the grapes must be harvested and crushed. Once the vineyard harvester has determined that the grapes are ready to be harvested, a mechanical harvester funnels the grapes either into a field hopper or some type of mobile storage container. Depending on the technology of the harvesting system the crushing can be done either at the farm or the winery. Most harvesters will have grape crushers mounted on them, which helps to streamline the process by picking and crushing the grapes at the same time. This is the preferred way, as it prevents oxidization of the grape through tears or splits in the skins.

Once the wine is transported from the farm to the winery it is unloaded into a crusher-stemmer machine, where the grapes are pressed further and the stems are removed. This leaves a liquid “must” which is then pumped into a fermenter in order to settle, clarify and filter. During this process yeast is added into the fermenter in order to turn the sugars from the grape liquid in to alcohol. The time varies from one to two weeks depending on the type of wine and the desired pigment for each type. After the fermentation process is complete the wine is aged in stainless steel tanks or wooden vats. The duration of the aging process is dependent on the quality and the type of the wine that is being produced. White and Rose wines can be aged anywhere from one to four years whereas reds may age from seven to ten years. The majority of mid to large sized wineries age their wine in temperature controlled stainless steel tanks. Smaller wineries will store them underground in wooden barrels in an attempt to keep the wine in a cooler climate without having to pay for the tanks and energy of having the wine at a controlled temperature. In the packaging stage most wineries use automated bottling machines which differ from corks made of oak for moderately priced and expensive wines to screw off caps or plastic stoppers for cheaper wines.

In the production process there are numerous complica-

tions and challenges that can be presented. The ones that will be the focus of this paper are chosen as they relate to the supply chain. Wine production has to coincide with the harvesting of the grapes. With this there is a three month window starting in the beginning of August and completing in the end of November. For example, pinot and moscato grapes may be ready for harvest in early August; Merlot, Cabernet Frac, Barbera grapes will not be ready until late September; whereas for Shirz, Nebbiolo and Sangiovese November will be the right harvest period. Furthermore, each type of wine that is being produced is allocated a different amount of time that it needs to be in the fermenter. Coordination between the farmer and winery is challenging due to the timing of each different wine and the vulnerability of the grapes when in transition from the farm to the winery. When the grapes are harvested they need to be crushed and put into the fermenter as soon as possible. If the timing is not effectively coordinated the grapes could arrive while another batch is still in the fermentation process and have to sit. This can have a direct effect on the quality of the grape and leaves it vulnerable to changes in temperature while it is being stored. As a result, a just in time inventory management system is essential for timely information and coordination.

Another challenge is that production runs continuously from the first batch to the last batch for every year. This provides for limited windows to modify equipment and to ensure that you have not changed the production process. Another challenge is finding effective ways to control cost while improving the quality of the product. Quality control during the production process is essential where once a mistake has been made it is not possible to go back and fix it. Therefore it can be difficult for wineries to find effective cost saving methods or strategies in the production process without having an impact on quality. After the initial investment, the largest cost factors in production

are labor and energy.

Since wine production is seasonal there are very few full time, year round employees that work in the production department for wineries. Most seasonal workers are coming from neighboring countries which can pose some challenges. First, every year a new group of seasonal employees must be properly trained in order to be able to fulfill their responsibilities. Because the work is seasonal it is very difficult for wineries to hire back existing employees. Training is a time consuming and costly expense where training can take anywhere from one to two months for an employee to be ready to partake in the production process. Furthermore, language barriers with seasonal employees can pose problems as production is run continuously and is not able to be stopped. If there is an employee that does not fully understand the process or there is miscommunication it can result in costly mistakes.

### 3 Effective Management of Wine Supply Chain

As a result of the complexity and specific needs of having

a Just-in-Time system (JIT), effective communication and visibility is vital to the success of coordinating on time deliveries from the farm to the winery. A solution to implement an efficient JIT system as well as increasing production efficiency can be found in Material Requirements Planning System (MPR). MPR deals specifically with supplying materials and component parts to those whose demand depends on the demand for a specific end product. The MPR system consists of a set of logically related procedures schedule into time-phased net inventory requirements and planned coverage of such requirements for each component items needed to implement this schedule. Therefore, implementing MPR systems wineries can more easily achieve just in time delivery, ensure the availability of materials and plan manufacturing activities. As earlier discussed, the yearly wine production for each company is concentrated to just a few months which mean that smaller errors can jeopardize the entire production and can eventually lead to a company failure. That’s why wineries should study and roll out MPR planning very carefully. The figure below shows how an MPR system can be applied to the wine industry.

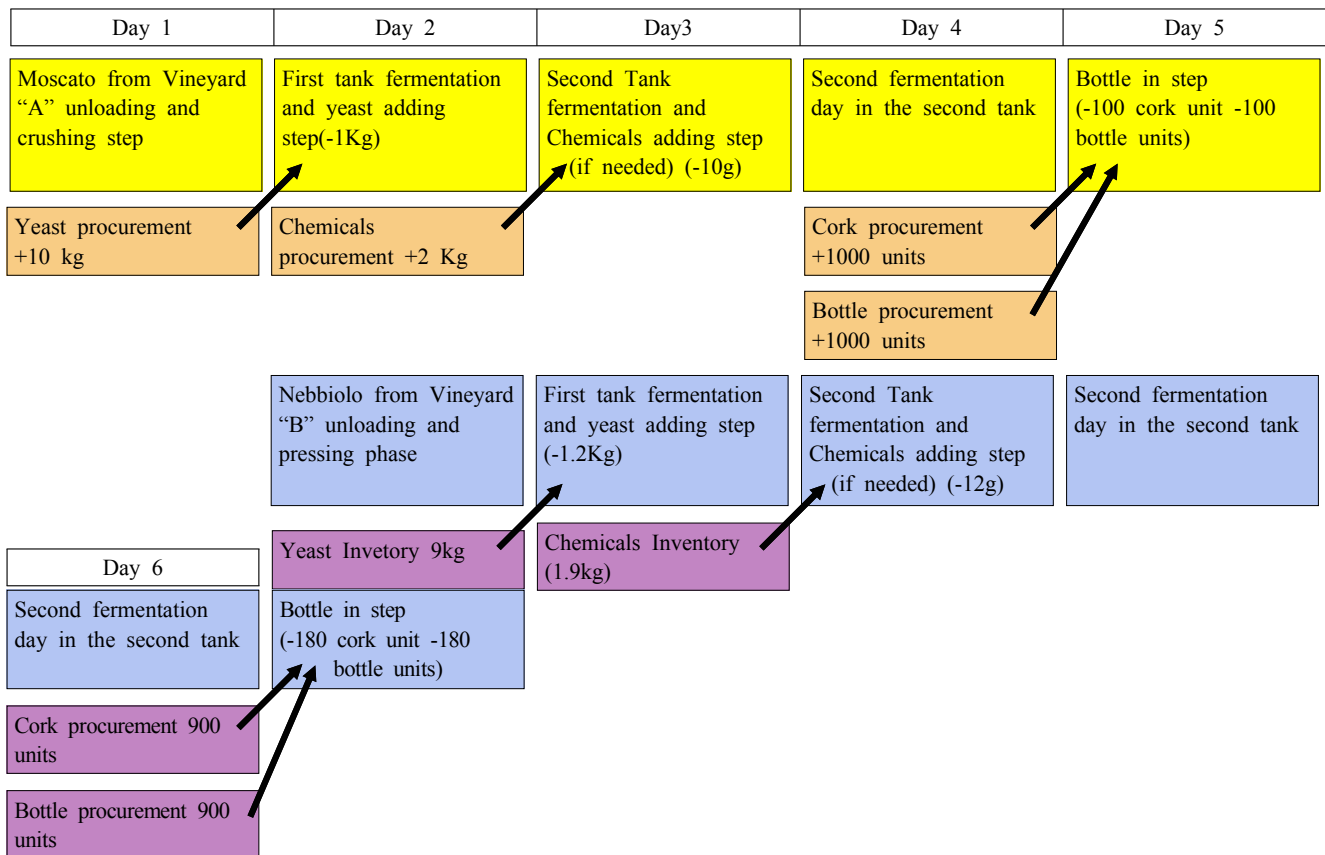


Fig. 3 MPR system, possible example for Wineries

From the diagram above, one can argue that E-collaboration tools can help to improve efficiency in the process. However it is not very realistic for a grape farm to have the available resources and knowledge to invest in these technologies. According to researchers, a possible solution to improve collaboration comes from Italy and is called PICA (Agricultural and Wine-producing Integrated Cartographic Platform) smart vineyard. This is a software/hardware system that allows real time vineyard monitoring (type of grape, quality of soil, grapes volume forecasting etc.). Many other similar products are available on the market but the revolutionary difference is the price. Installation of a PICA system is relatively inexpensive and allows for a new form of collaboration. In fact, due to the low purchase and maintenance price, Winemakers will be able to install this system to all of their suppliers. Farmers can have information tools for their vineyards and winemakers can have more visible, real time information resulting in a win-win situation for both parties.

In order to increase efficiency and ensure quality control during production E-optimization software can help the winery to allocate areas that are the most costly and work to provide solutions to the problems. Furthermore, E-optimization and sensor tools allow for transparency through the production line and are able to pick up on prospective problems in the production process in order to solve them before they start. To benchmark this, Vintegrate, an E-optimization and sensor software program supplies benchmarking and self assessment tools in order to improve production efficiency in the wine making process. The program takes the latest trends in wine production and is able to provide information and application tools to achieve the desired benchmarks for the winery. It also analyzes where costs are most heavily allocated and provides insight on how to resolve them. For example, the cost factors for a winery are mainly comprised of labor and energy. This E-optimization tool has helped wineries find unique ways to reduce their electricity use and CO<sub>2</sub> emissions as well as reduce the amount of labor. The sensory tool monitors each machine and process in order to ensure that every machine is working at full capacity. When problems are detected, it can then notify the management team and offer effective solutions to the problem.

When dealing with outsourced or immigrant labor there are some effective approaches in order to breakdown communication barriers and increase efficiency in the training process. The first is hiring a trainer that speaks the native language of the employees being trained. For example, most wineries in the US hire Latin Americans for seasonal work, as wineries in Italy will hire Eastern European or

North African immigrants respectively. A larger issue is the time and money of having to continuously train employees year after year. The ability to rehire previous seasonal employees or hire workers that have past experience in wine manufacturing would enable the company to save time and money on training. In order to execute this, a company could establish recruiting pools domestically as well as in the foreign country where the majority of their seasonal employees are coming from. If a winery wishes to establish recruiting pools in another country a 3PL provider would be the best option where they are specialized and will have access to more information than if the company tries to navigate it alone. Domestically, a winery could either hire a 3PL or establish recruiting pools through collaboration with other wineries in their area. With this, the wineries can share their knowledge and expertise in order to find employees that have previously been trained in the manufacturing process.

#### **4 Distribution and Global Market**

Wine distribution focuses on three different modes of transportation. Historically, truck and rail were the main modes of transportation where distribution was largely domestic. Due to the global demand of wine throughout the years, ocean transport has become an increasingly popular and necessary mode of transportation for global distribution. This has also brought on a rising demand for intermodal services. The service availability for transporters in the supply chain becomes a critical part of demand fulfillment. Global distribution has increased the complexity in outbound processes with a larger amount of products to store and a greater need to effectively manage inventory in order to increase efficiency and lower overhead costs. E-commerce is another dimension to distribution where the purchasing from online stores of the individual wineries or from online marketplaces has become a popular and convenient way to connect wineries with the end buyers.

There are numerous challenges when transporting wine. The first challenge is that wine is temperature sensitive. It is imperative for it to be kept in a temperature controlled climate. With this, different types of wine require different storage temperatures making it difficult to transport different wines in the same container. As a result of not being able to consolidate different types of wine, this can lead to having to utilize multiple containers that are not fully stocked. Quality control with regard to storage temperature also brings in questions of who is liable if the temperature

in the containers are not effectively regulated and how can negligence of a party be proven. Historically, when issues arise with wine being corked due to temperature fluctuations in the shipping process, there is very rarely any record of variations in temperatures once the wine has left the producers cellar. This brings in the need for increased knowledge and specialization when handling INCOTERMS as well as the need for tracking technology. Tracking technology has been primarily through barcode systems which pose their own challenges and limitations in the distribution process. Barcode labels can be easily damaged or misread as well as have restricted data length. They are also time consuming and difficult to maintain as they require special printers and label stock. In addition, when barcode data is updated old labels have to be torn off and new labels with barcodes have to be installed with costs time, money as well as the further potential for human error. Finally, all data that is captured by the scanners has to be manually synchronized and correlated.

As wine is distributed in glass bottles another challenge to shipping is how to effectively pack it. At the end of the bottling process wine is either loaded into crates or boxes to be palletized and then either stored or loaded into a container to be shipped. With this, one has to look at the safest way to pack it, organize it on a pallet and then organize the pallets in the containers. With intermodal transportation the shifting of the containers differs from truck to ship. On a truck, the pallets are more vulnerable to shifting from back to front where on a ship they are more vulnerable to shifting from side to side. Furthermore, once bottles are broken they can also affect the packaging of the other bottles. Because wine is done seasonally and in batches it is not replaceable which makes quality control in shipping the top priority for transportation companies.

Warehousing and inventory management have posed challenges for wineries and distributors alike. Due to the many different types of wines and their individual temperature constraints it makes it difficult and costly to store. With these constraints warehousing managers must look to find the most effective and efficient ways to organize the warehouse in order to fully utilize all of the available space but still make it easy to navigate when the wine needs to be loaded. Furthermore, taking accurate inventory has posed problems for warehousing managers in the past due to the complexity in the multiple types of wines which can also differ by the year. The development of E-commerce in recent years has also brought upon questions of efficiency in shipping and warehousing depending if the company is selling directly from their website or from a different online marketplace. Depending on the regions of

the buyers it brings into question of whether the company should fulfill orders in house or establish distribution centers closer to the location of the buyers.

The recent developments of RFID (Radio Frequency Identification) tracking systems have allowed for increased visibility during the handling, transportation and distribution processes. It has been slow to catch on in the wine industry due to the relatively high cost. However, some wineries have begun to see the substantial benefits with regards to visibility, quality control and inventory management. A specific type of RFID tag called IPICO provides solutions to quality control concerns of producers as well as facilitates in quick and accurate inventory readings. Traditional RFID tags have some engineering and physics issues that can result in unreliable tag readings on containers that are filled with liquids. The liquid can absorb the RF signal which prevents the tag from being read. IPICO tags are the only RFID tags that have been proven to accurately tag readings from containers filled with liquids. There are different types of IPICO tags depending on whether they are being placed in a container, barrel or on the bottle. The IPICO tags placed in containers track the location as well as monitor the temperatures during shipping three times a day. When there is a quality control issue it can help producers and distributors determine where the issue arose, making liability and insurance claims easier to determine and manage. Another advantage to these tags is that they are significantly more durable than barcodes where they are sealed onto the bottle instead of printed onto the label. By providing real time data the tag allows producers and manufacturers transparency through the transportation process in order to identify where there are inefficiencies and take the necessary steps to find effective solutions for them. For warehousing and storage, RFID chips can allow for efficiencies in inventory management. Because there is a chip placed on each bottle, inventory is taken with the click of a button, where a tracking system can relay and synchronize data from multiple warehouses and present them in a clear and organized format. To increase efficiency in warehousing space and organization there are multiple options to take into account. First, for global distribution it will be the most efficient to organize the wine using the ABC system. If any company decides to distribute their wine globally, in order to maximize profits we suggest a "market segmentation" process. Following the concept of ABC segmentation, wineries should divide their market into different groups ranking those using appropriate criteria or metrics. As in the ABC segmentation process, there is no fixed criterion, instead every company should pick up the criteria that will

most accurately align with the companies wants and needs. Nevertheless, the following section will provide an example to have better practical understanding of this concept.

**Table 1** Gross Revenue

Marker	Unit 2011	Price 2011 in \$	Unit 2012	Price 2012 in \$	Logistic cost	Logistic cost w/3PL	Gross Revenue
China	100	\$ 4.50	140	\$ 4.50	\$ 150.00	\$ 29.00	\$ 630.00
France	320	\$ 2.00	290	\$ 2.00	\$ 50.00	\$ 8.00	\$ 580.00
Germany	300	\$ 2.00	280	\$ 1.90	\$ 50.00	\$ 8.00	\$ 532.00
USA	210	\$ 3.20	180	\$ 2.90	\$ 120.00	\$ 18.00	\$ 522.00
UK	200	\$ 2.50	190	\$ 2.30	\$ 80.00	\$ 12.00	\$ 437.00
Korea	60	\$ 4.00	90	\$ 4.00	\$ 170.00	\$ 27.00	\$ 360.00
Canada	90	\$ 3.30	90	\$ 3.30	\$ 135.00	\$ 22.00	\$ 297.00
Brazil	30	\$ 3.00	70	\$ 3.50	\$ 140.00	\$ 24.00	\$ 245.00
Chile	20	\$ 3.00	50	\$ 3.30	\$ 120.00	\$ 27.00	\$ 165.00

In this case a Gross Revenue can be used. Nevertheless, Gross Revenue doesn't give any information about profitability or cost to serve. As a result, this kind of criteria can be used by wineries which don't distribute but just sell wine to importers and exporters, hence no extra logistic costs are involved.

**Table 2** Gross Revenue-Logistic cost

Marker	Unit 2011	Price 2011 in \$	Unit 2012	Price 2012 in \$	Logistic cost	Logistic cost w/3PL	Revenue-Logistic cost
France	320	\$ 2.00	290	\$ 2.00	\$ 50.00	\$ 8.00	\$ 530.00
Germany	300	\$ 2.00	280	\$ 1.90	\$ 50.00	\$ 8.00	\$ 482.00
China	100	\$ 4.50	140	\$ 4.50	\$ 150.00	\$ 29.00	\$ 480.00
USA	210	\$ 3.20	180	\$ 2.90	\$ 120.00	\$ 18.00	\$ 402.00
UK	200	\$ 2.50	190	\$ 2.30	\$ 80.00	\$ 12.00	\$ 357.00
Korea	60	\$ 4.00	90	\$ 4.00	\$ 170.00	\$ 27.00	\$ 190.00
Canada	90	\$ 3.30	90	\$ 3.30	\$ 135.00	\$ 22.00	\$ 162.00
Brazil	30	\$ 3.00	70	\$ 3.50	\$ 140.00	\$ 24.00	\$ 105.00
Chile	20	\$ 3.00	50	\$ 3.30	\$ 120.00	\$ 27.00	\$ 45.00

Wineries can also develop their own distribution system. In this case logistics must be added in the market evaluation. The new criteria may be Gross Revenue-Logistic cost. Companies that decide to entrust a 3PL to do the distributions instead of using logistic cost will use the 3PL hiring costs.

**Table 3** Dynamic Growth

Marker	Unit 2011	Price 2011 in \$	Unit 2012	Price 2012 in \$	Logistic cost	Logistic cost w/3PL	Revenue-Logistic cost 3PL
China	100	\$ 4.50	140	\$ 4.50	\$ 150.00	\$ 80.00	\$ 550.00
France	320	\$ 2.00	290	\$ 2.00	\$ 50.00	\$ 40.00	\$ 540.00
Germany	300	\$ 2.00	280	\$ 1.90	\$ 50.00	\$ 40.00	\$ 492.00
USA	210	\$ 3.20	180	\$ 2.90	\$ 120.00	\$ 80.00	\$ 442.00
UK	200	\$ 2.50	190	\$ 2.30	\$ 80.00	\$ 50.00	\$ 387.00
Korea	60	\$ 4.00	90	\$ 4.00	\$ 170.00	\$ 90.00	\$ 270.00
Canada	90	\$ 3.30	90	\$ 3.30	\$ 135.00	\$ 100.00	\$ 197.00
Brazil	30	\$ 3.00	70	\$ 3.50	\$ 140.00	\$ 100.00	\$ 145.00
Chile	20	\$ 3.00	50	\$ 3.30	\$ 120.00	\$ 100.00	\$ 65.00

We call the last possible criteria Dynamic Growth, which is the difference between the revenue for the current and previous year. This can show another market dimension being revenue growth for each single market. Doing this kind of segmentation through metrics wineries may be able to better allocate their resources in each market. Better resource allocation and planning will lead the company to achieve profit maximization year by year.



With this system a pallet runner satellite system will help to utilize the maximum space available and increase efficiency in the handling of the pallets. The runner system has the ability to run up and down lanes to retrieve pallets and bring them to the front. This increases efficiency by making the storage system denser by eliminating the need for multiple lanes in the warehouse. While the forklift driver is delivering the pallet to the trucks, the pallet runner is moving the pallet to the front which cuts down on the amount of time the forklift driver has to spend moving and picking up the pallet.

In order to mitigate the cost of having to use different containers for wines that need to be stored at different temperatures, wine producers and distributors should look at horizontal integration or collaboration with producers or distributors in order to combine like shipments. This will allow for companies to increase efficiency by sharing information and aligning alike wine shipments in order to utilize all of the available space in the container. This results in equal cost savings for each company where they can pay for the amount of space that they are utilizing in the pallet.

There are numerous third party logistic providers that offer services to wine producers and distribution companies. 3PL companies can help to provide solutions and increase efficiency in many aspects of the supply chain. The challenge is finding the right 3PL provider that offers the value added services that can align with the wants and needs of the company. For example, for quality control measures that deal with temperature regulations, 3PL companies can provide the information and systems technologies with RFID technology to effectively manage and measure and control the products from the producer to the end buyer. However, RFID chips are not able to prevent the challenges of shipping fragile products. In order to improve this quality control measure it is essential to find a 3PL provider that can offer services of finding the most effective ways to organize pallets in a container as well as implement stuffing and destuffing systems in order to ensure that bottles are not broken through transport.

## 5 Conclusion

Historically, the wine industry and the processes from the farm to the consumer have presented numerous challenges. As the wine industry is romanticized as being a simple and traditional process, the logistics and supply chain throughout the wine industry is a complex process that

needs to be continuously monitored and innovated in order to keep up with a growing demand and gain a competitive advantage. In recent years, the global demand for wine has turned efficiencies in logistics and supply chain into a vital part and necessity for wineries to be successful. The main focus of wine has always been on taste and quality. While this is true, the onset of globalization has put emphasis on the need for companies to continuously change and adapt their processes through the supply chain in order to stay competitive in the market and to ensure that their wines are reaching the end consumer in a timely fashion and in the same condition from beginning to end. In order to do that company should invest more time and resources in improving their logistic chain system through new technology as well as through better integration and cooperation between all the actors involved: wine producers, farmers and 3PLs.

However, given the enormous complexities of planning and scheduling in agricultural supply chain, many new solving methods such as evolutionary algorithms, fuzzy systems, genetic algorithms, have been introduced into software applications to help manage and optimize this complexity at the level of grape production and processing. Therefore, future research on the impact of technology in the wine supply chain is of paramount.

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