Life Cycle Cost Analysis of Wine Processing

Activity Based Costing

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Executive Summary

Life cycle costing analysis (LCCA) is a concept for analysing and comparing the lifetime costs of winery processes and equipment. These costs can include depreciation, waste, resource and other business costs.

An activity based costing (ABC) model provides a tool to quantify life cycle costs of production activities. Understanding the cost of activities using ABC can provide a winery with a range of benefits including:

- Identify winery activities that contribute the greatest to operational costs
- Determine the key activities to change to decrease operating costs
- Calculate the costs needed to produce a particular wine SKU
- Allow the winery to determine the best strategies for production, marketing and price to maximise profits.

The principle behind Activity Based Costing (ABC) is that activities drive production costs. ABC acts to scrutinise the cost of the activities, and not traditional accounting line items. Each of winemaking related activity is the primary driver of cost. The production of wine drives the need for activities to be performed. These activities consume resources, which in turn consume costs

This project collated data 11 diverse wineries and created a tailored ABC model for each. Aggregated data from the ABC models are presented with mean costs per kL of wine highest for bottling ($758), barrelling ($473) and maturation ($113).

The benefits observed by using activity based costing included:

1. Performance metric data that provides better understanding of costs
2. Identification of activities that need efficiency improvements
3. Quantification of lost wine value
4. Easy modelling the cost impact of production changes
5. Determine the actual cost of a wine SKU
6. Performance and cost benchmark data for meaningful comparison
7. ABC data highlights which Lean Production related projects to target

In summary, ABC has been demonstrated to be an effective way to calculate production costs enabling improvement of winery efficiency and business profitability.

Introduction

Life Cycle Costing Analysis and Activity Based Costing

Life cycle costing analysis (LCCA) is a concept for analysing and comparing the lifetime costs of winery processes and equipment. These costs can include depreciation, waste, resource and other business costs. An activity based costing (ABC) model provides a tool to quantify life cycle costs of production activities. Understanding the cost of activities can provide a winery with a range of insights, such as which processes are the most efficient or expensive, what is the actual cost of producing wine and which wine products are the most profitable. ABC is therefore a useful tool for enabling wineries to make informed decisions about increasing efficiency, competitiveness, profitability and sustainability in a competitive global market.

The role of an ABC model

Traditional accounting apportions operating and fixed cost budget lines to the wine produced (Figure 1 left). Once these costs have already been accounted for, it reduces the impetus for change or improvement in processes. For example, using traditional accounting, a reduction in labour costs involves decreasing the funds allocated to that line item. This reduction does not create a strategy or action to enable this saving, rather merely hopes to achieve the decreased expenditure.

The principle behind Activity Based Costing (ABC) is to scrutinise the cost of the activities, and not traditional accounting line items. Each of the winemaking related activities (Table 1) are the primary drivers of cost. The production wine drives the need for activities to be performed. These activities consume resources, which in turn consume costs (Figure 1 right). Changing winery activities will therefore change these activity costs and their operating costs. This means in order to better understand and control costs it is necessary to understand these activities, in particular, what resources these activities consume and why.

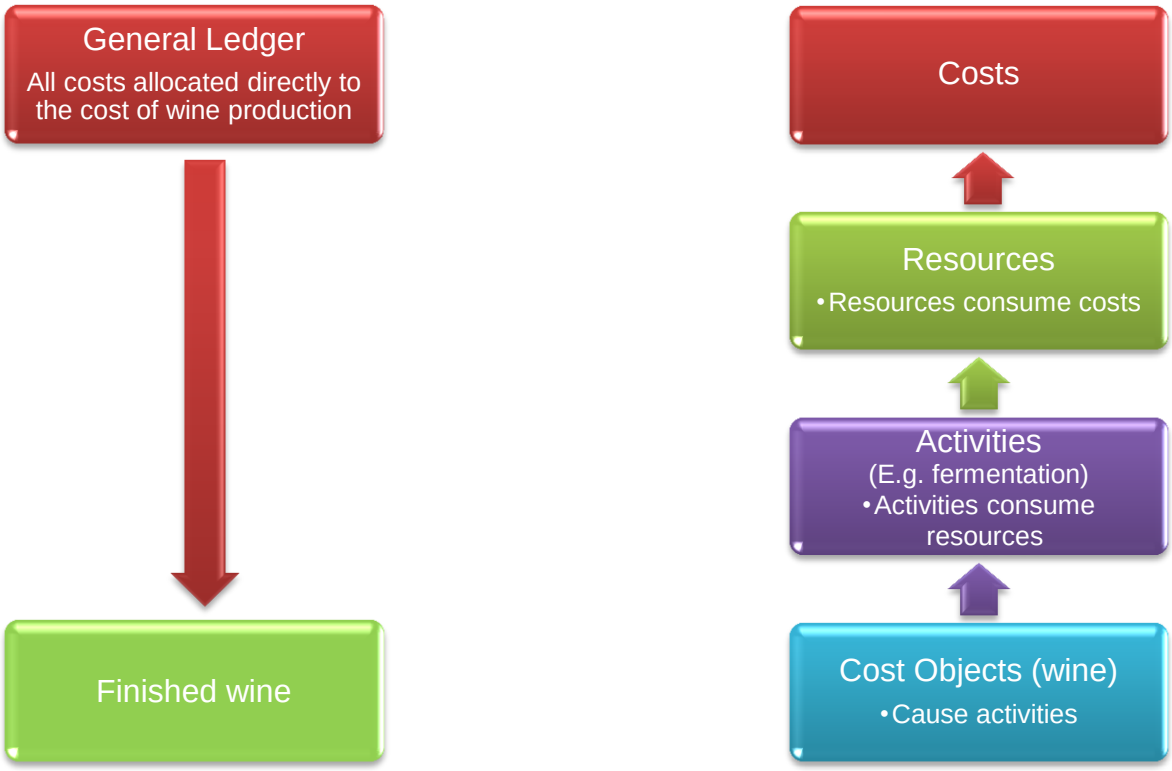

Figure 1: A visual representation of traditional accounting practice (left) contrasted against activity based costing (right).

Table 1 : A list of wine making activities used in Activity Based Costing

Activities	
Alcoholic Fermentation	Filtration
Barreling	Grape Receival
Blending	Maturation
Bottling	Pressing (red)
Clarification	Pressing (white)
Cold Stabilisation	Racking (red)
Destemming and crushing	Racking (white)
Filtering (white)	Warehouse Dispatch

The ABC method traces costs using a ‘cause-and-effect’ approach and all costs are assigned against an activity (Table 1). ABC modeling provides a way to capture information to provide an accurate cost for each winemaking activity and, in turn, the cost of producing a stock keeping unit (SKU) of wine. It then allows the winery to see how changing an activity would modify or eliminate the costs allocated to that activity. If a winery has a list of all

activity cost, this would allow the winery to choose which activities should be targeted for energy efficiency projects to create the greatest efficiency improvements.

An ABC model can be used to:

- Identify winery activities that contribute the greatest to operational costs
- Determine the key activities to change to decrease operating costs
- Calculate the costs needed to produce a particular wine SKU
- Allow the winery to determine the best strategies for production, marketing and price to maximise profits.

Accurately capturing overhead expenses

In traditional accounting, overhead items are externalised from processes and listed as separate line items (Table 2). In contrast, ABC apportions these overheads, along with resources, against the activity that uses these overheads (Figure 2). For example, the depreciation on a bag-press would be allocated against pressing activities using ABC, and not included as a separate line item as per traditional accounting techniques. ABC accurately captures and allocated these costs against each activity and therefore provides a clearer picture of what activities are driving the cost of production.

Table 2: Types of overheads used in traditional accounting

Overhead	Types of costs
Equipment	• Depreciation • Breakdowns
Property	• Rental costs • Mortgage
Administration	• Labour • Marketing
Wine loss	• Lost product • Waste water treatment costs

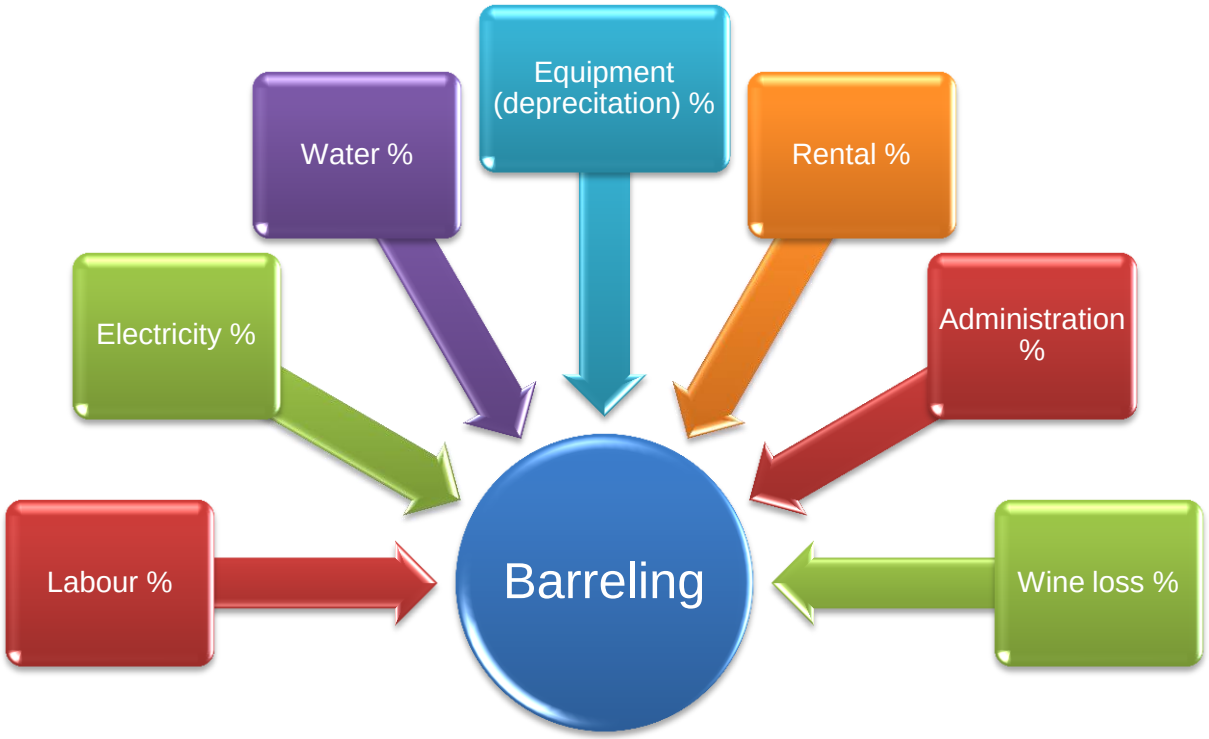

Figure 2: ABC is able to capture overheads and resources associated with an activity, barreling in this example.

Creating an ABC model for the Australian wine industry

Project methodology

The original concepts of activity-based costing were developed for manufacturing industries and these have been adapted to wineries in this project. Australian wineries use a diverse mix of processing methods and business models (Table 3) and this meant the model developed needed to be able to accommodate for these variations.

Table 3: Process and business model variation observed in Australian wineries

Processing and business model variation	
Barreling vs. tank maturation	Finished bulk wine vs. finished bottled wine
Bottling lines vs. external bottling	Integrated vineyard and winery
Contract crushing	Owned vs. leased land
Contract processing in addition to own wine	Pump-overs vs. plunging vs. rotary fermenters
Contract processing only	Receiving finished wine for blending
Different processes for red and white wines	Receiving juice for processing

Process boundary

Winery activities included in the model were limited to sixteen activities (Table 4). To make the model easier to use, winery activities began at grape receival and concluded at finished bottled/bulk wine. This model does not include any costs incurred at external distribution warehouses.

Table 4: Activities used in the Activity Based Costing model

Activities	
Grape Receival	Blending
Destemming and crushing	Barreling
Pressing (white)	Maturation
Racking (white)	Clarification
Filtering (white)	Cold Stabilisation
Alcoholic Fermentation	Filtration
Pressing (red)	Bottling
Racking (red)	Warehouse Dispatch

Indirect winery activities, such as marketing, some aspects of business administration, cellar door, functions and events coordination, were excluded from the model as these do not directly contribute to the production of wine.

Cost boundary

Eight winemaking related costs were included in the model (Table 5). These have been divided into two categories:

a) Traditional costs – items which are common practice to attribute to wine production
b) Hidden costs – often difficult to quantify, hard to attribute and frequently overlooked

Table 5: Cost boundaries used in the Activity Based Costing model

Traditional costs	Hidden costs
Capital equipment costs	Equipment depreciation
Labour	Wine/grape loss
Grapes	Waste water treatment
Resources (electricity, water, gas & waste)	Repairs and maintenance

While labour costs for some administration services (marketing, director fees, and cellar doors) contribute to the overall Cost of Goods (COG), these costs cannot be rationally

attributed to any one winemaking activity. Therefore, these costs were not included in the cost boundary.

A literature study and investigation into ‘readymade’ activity based costing models was undertaken. From this work, it was observed very few ABC models were available for purchase and, of those available, most would need significant customisation to suit the wine industry.

Thus, the development of a model (using Microsoft Excel) was undertaken with the objective to create an easy-to-use, robust framework that could be customised to suit the needs of Australian winery operations.

Using activity based costing in wineries

ABC model results

This section summarises findings from undertaking ABC modelling at each of the 11 participating wineries of varying production[1]. A tailored ABC model was developed for each winery based on their business model and specific operations. Initially, data from winery profit and loss sheets, general ledger statements and depreciation schedules was used to construct the model and distribute costs to 16 winemaking related activities. Where available, further resource information was obtained including labour hours, energy and material audit reports, and other process data.

Data from each wineries ABC model was then collated to create an aggregated ABC model. This aggregated data was used to analyse the cost of winery activities and is presented in this report.

Activity Costs

Using the combined ABC model data provides an overview of proportion each winery activity contributes to costs. Figure 3 displays the average activity cost per kL of wine produced across the 11 wineries.

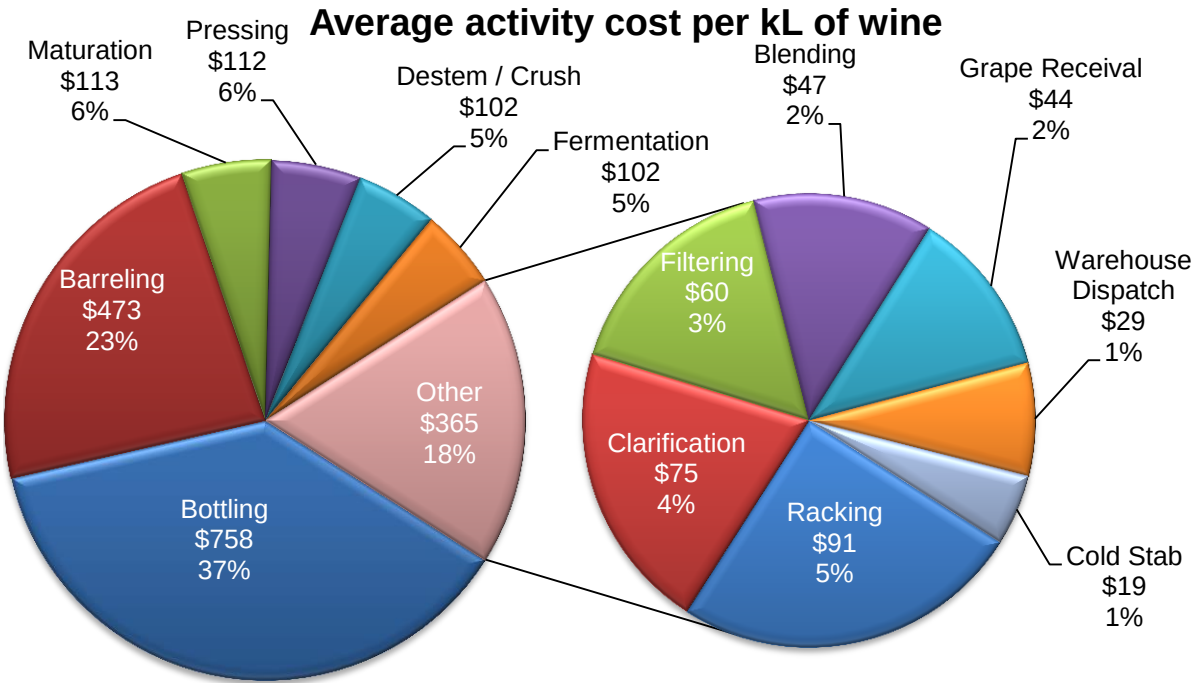

Figure 3: Average activity cost per kL of wine

[1] Small wineries processed less than 1,200 tonnes, medium wineries between 1,200 and 12,000 tonne and large wineries greater than 12,000 tonnes.

The variety of processing methods between wineries resulted in a high variation of activity costs per kL of wine. Basic statistical analysis has been undertaken to provide context for these activity costs (Table 6).

Table 6: Statistical analysis of activity costs per kL of wine from highest to lowest cost

Activity	MEAN	MIN	MAX	MEDIAN	RANGE
Bottling	$758	$66	$1,572	$490	$1,507
Barreling	$473	$65	$1,667	$319	$1,602
Maturation	$113	$14	$215	$112	$202
Destemming and crushing	$102	$3	$309	$82	$305
Alcoholic Fermentation	$102	$3	$331	$66	$328
Pressing (red)	$84	$3	$411	$45	$409
Clarification	$75	$15	$236	$45	$221
Racking (red)	$73	$4	$243	$36	$239
Blending	$47	$0	$149	$38	$149
Grape Receival	$44	$0	$134	$24	$134
Filtering (white)	$30	$2	$114	$24	$111
Filtration	$29	$5	$55	$27	$50
Warehouse Dispatch	$29	$0	$85	$16	$85
Pressing (white)	$29	$1	$89	$26	$88
Cold Stabilisation	$19	$4	$64	$13	$60
Racking (white)	$18	$1	$42	$12	$41

Data from the ABC model indicated a large efficiency variation between wineries. Data from the ABC model has provided a greater understanding of winery costs, and in particular has revealed a large opportunity for wineries to increase production efficiency.

Resource cost per activity per kL of wine

Different wineries have different activity cost per kL of wine. A summary of the associated costs for the six most expensive activities has been summarised in the following section.

Bottling

The most expensive activity for wineries is bottling and packaging. Packaging cost vary depending on the specific packaging operations,

This variation included:

- On-site glass bottling operations
- Off-site glass bottling operations
- Cask packaging
- Contract wine making
- Bulk wine sales

Figure 4 provides an overview of resource costs for packaging. Most wineries involved in the project have bottling done off-site. This is an external service and cannot be split between resources. This service has been classified as ‘materials’ in the ABC report. For that reason, ‘materials’ represents the largest activity percentage cost associated with bottling.

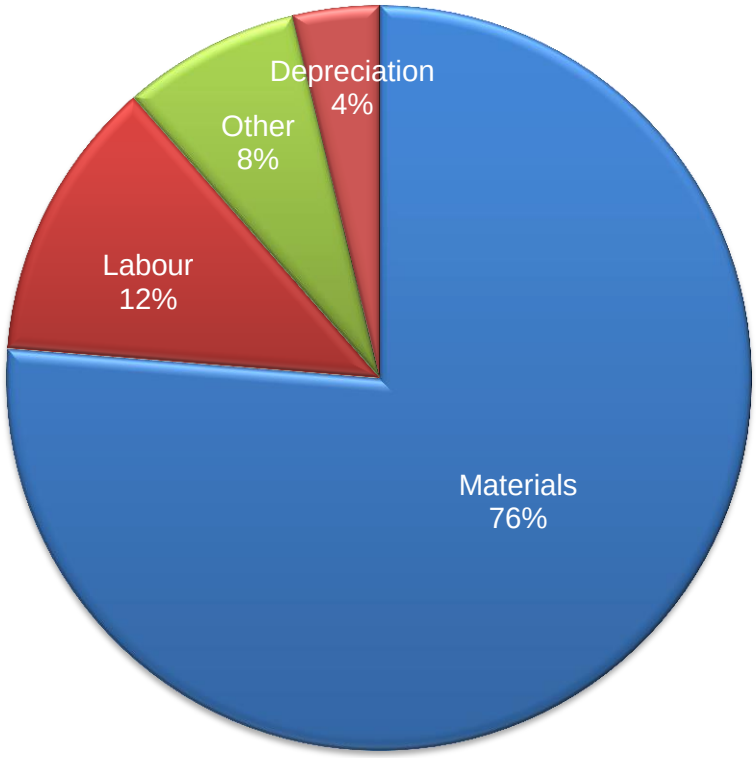

Figure 4: Resource percentage cost of bottling (average of all wineries)

On-site bottling

The highest costs for on-site bottling operations are materials (glass bottles, closures and labels) and capital equipment depreciation costs. Bottling lines that are in constant use and package large volumes of wine provide the greatest return on investment. For this reason, wineries with large bottling operations tend to contract bottle for other wineries to maximise the return on investment and provide an alternative source of income.

Larger bottling operations have a lower ‘cost per kL of wine’ than smaller bottling operations. This is highlighted by the range of bottling costs outlined in Table 6. This is partly explained by high levels of automation and a strong focus on efficiency in larger operations.

On-site bottling operations offer a winery with the flexibility to bottle on demand. However, operating costs (such as depreciation, repairs, wine loss, labour, consumables, etc.) need to be compared with the expense of an external contract.

On-site bottling operations have less tangible costs such as the cost of building process inventory. Process inventory may include purchasing bottles well ahead of bottling needs or developing an on-site stock of bottled finished wine ahead of customer demand (to hedge against sporadic orders).

Off-site bottling

The cost for off-site bottling is the bottling contract. Using a third-party bottling service externalises and consolidates labour, electricity and other resource into a single cost item.

Bottling alternatives

Cask packaging is significantly less expensive than glass bottling due to the lower cost of material used for packaging.

Contract wine making and bulk sales of wine have no packaging cost. The sale price of bulk wine is less compared to bottled wine however, the cost of production is also less.

Barreling

Barreling refers to all costs associated with barrel maturation and was the second highest cost activity. Barreling is characterised by high labour costs (60% of total barreling costs), depreciation (21%) and water (8%) costs (Figure 5).

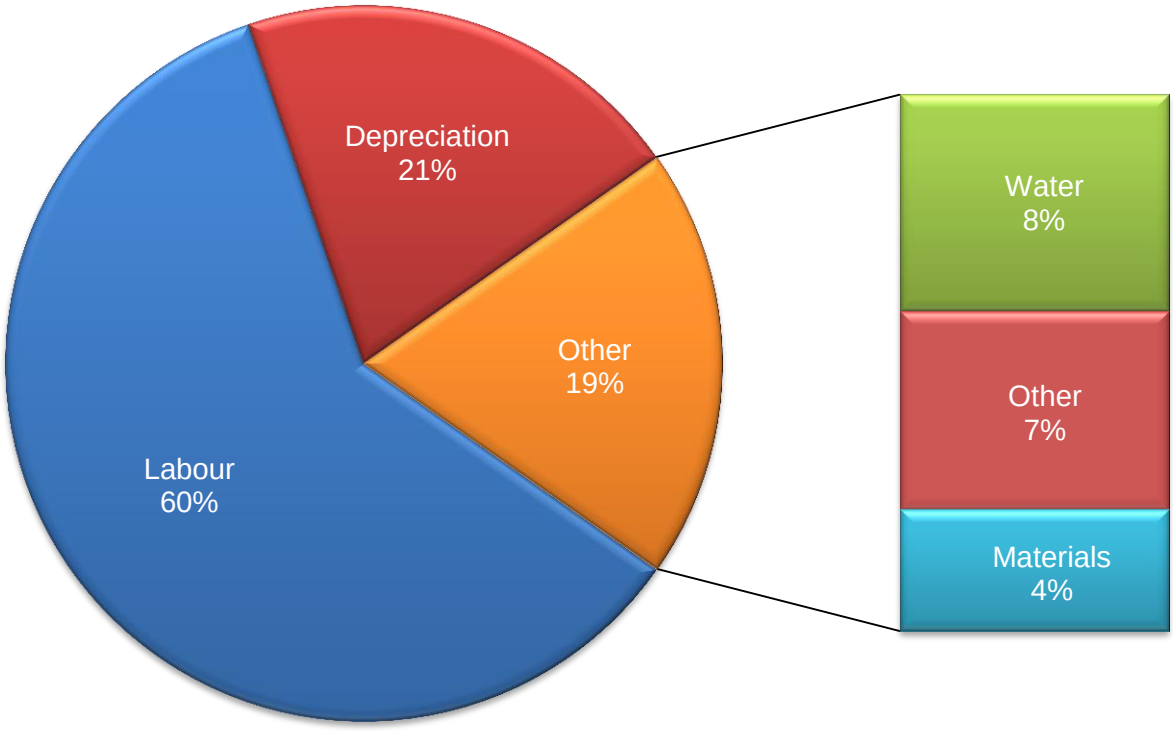

Figure 5: Resource percentage cost of barreling

Labour is the most significant cost and is associated with rack and return activities and laboratory testing.

Barrel cleaning contributes to high water cost and associated wastewater treatment for discharged water. Wineries that utilise automatic barrel washers tend to have lower water cost due to the reuse of water.

Depreciation costs vary depending on the turnover of barrels. The average Australian Tax Office depreciation schedule for wine barrels is four years. However, some wineries in the project replaced barrels after one year's use and some wineries used the barrels for more than ten years.

Tank maturation

Tank maturation process involves transferring and storing wine and associated costs are divided across seven resources (Figure 6).

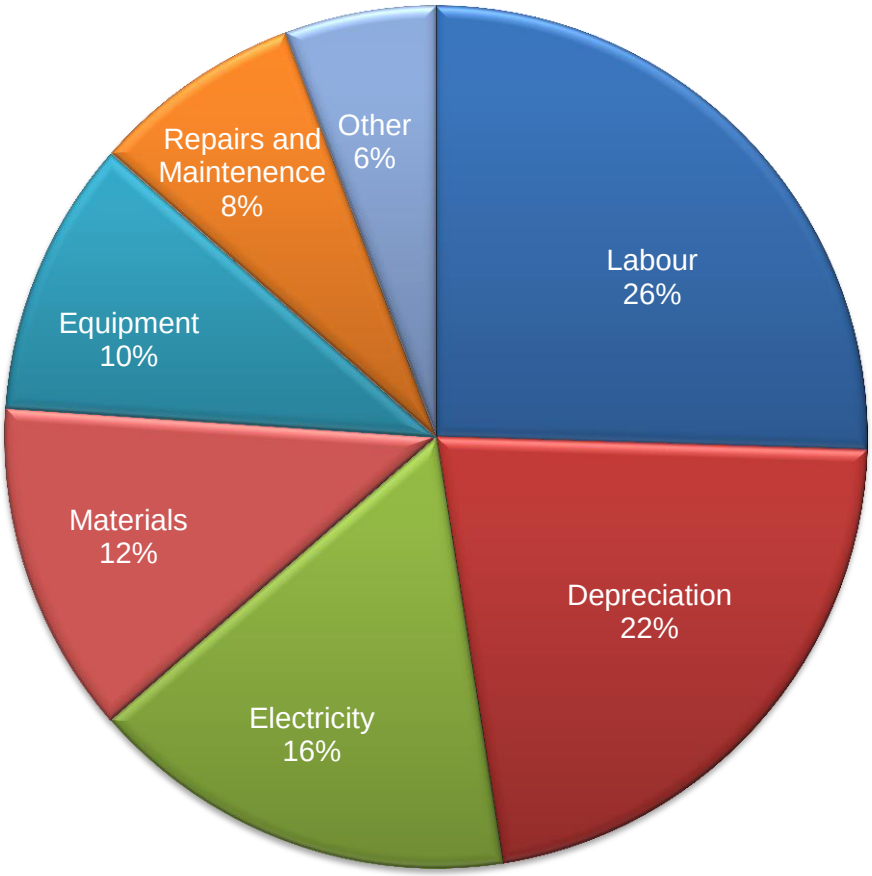

Figure 6: Resource percentage cost of tank maturation

Labour contributes to 26% of costs and is used for sampling, testing, pumping and other manual activities. Depreciation is the second largest cost at 22% and is driven by the large number and purchase cost of tanks. Electricity costs are driven by refrigeration and, in some wineries, tank agitation. Electricity consumption during maturation is lower in wineries that insulate tanks, and lower again in wineries that do not use refrigerated tanks throughout the year.

Crushing and destemming

Labour is the highest resource cost for crushing and destemming and accounts for 48% of total activity cost (Figure 7). The high labour cost is due to the staff (typically around three staff) required to operate the crushing and destemming machinery.

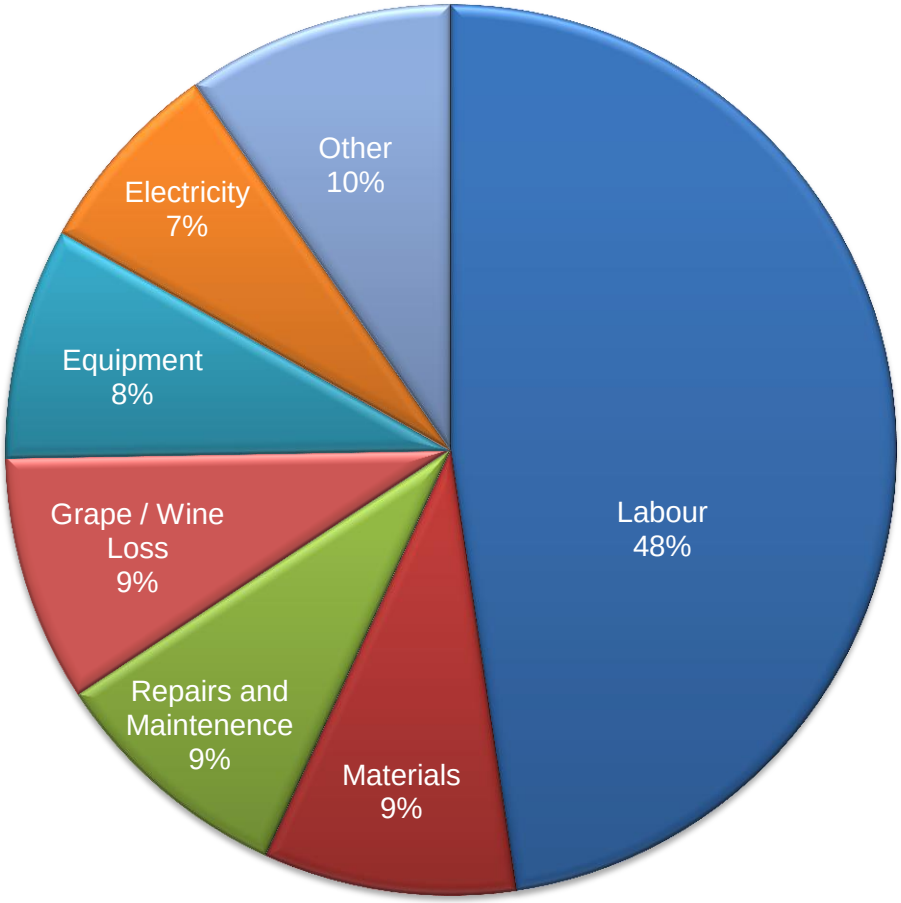

Figure 7: Resource percentage cost of crushing and destemming

All other expenses are evenly distributed between resources. The ‘other’ category consists of all utility and depreciation costs associated with crushing and destemming.

Alcoholic fermentation

Labour, depreciation and materials are the largest resource costs for fermentation. These account for 72% of total activity cost (Figure 8).

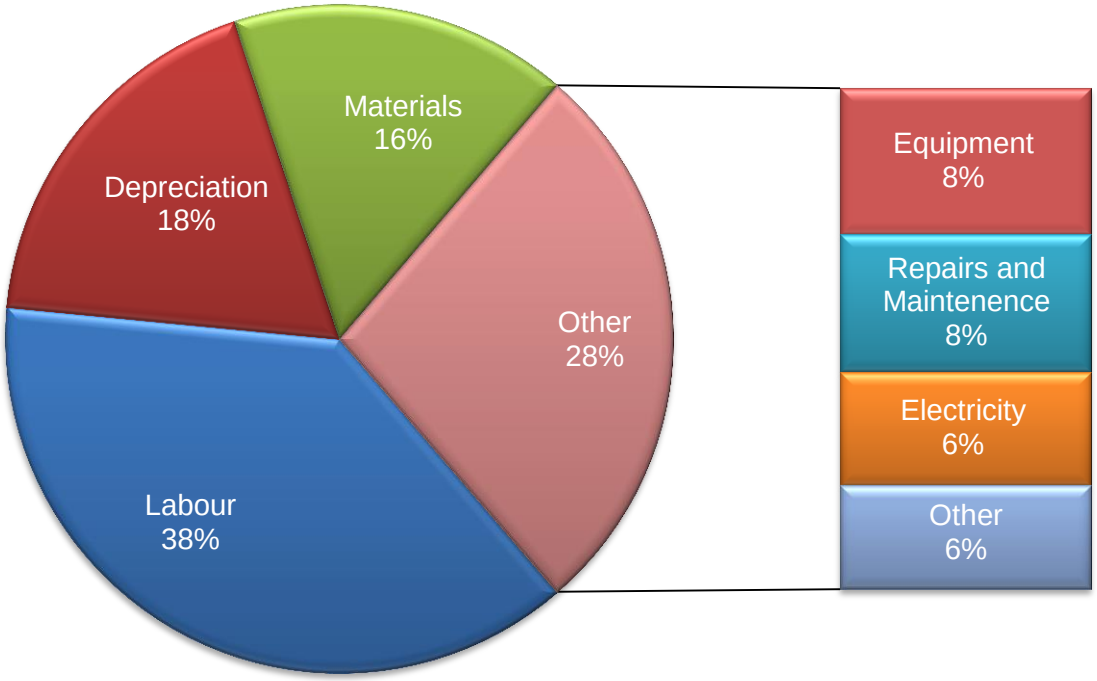

Figure 8: Resource percentage cost of fermentation

Labour for fermentation varies significantly between wineries depending on the type of fermenters used. For example, labour resource used for rotary fermenters was low compared with fermentation in open top tanks which requires significant labour.

Depreciation was the second largest resource expense. Fermentation equipment is expensive to purchase and provide a relatively small rate of return as the equipment is only used for a brief period during vintage.

Materials accounts for 16% of activity cost and are attributed to consumables such as additives (yeast and enzymes) and cleaning agents (caustic and citric acid).

Pressing

Pressing costs varied between wineries due to the diversity of pressing methods, including bag pressing, screw pressing and basket pressing, with consuming different amounts of resources. Labour was the most expensive resource cost (37%) followed by grape/wine loss (21%), depreciation (15%) and electricity (9%) (Figure 9).

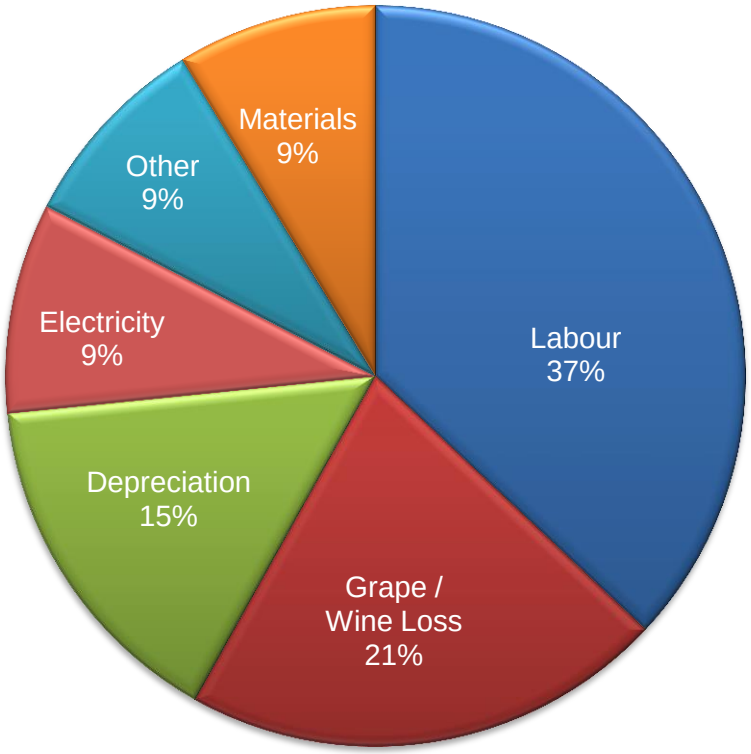

Figure 9: Pressing cost per kL of wine produced

Labour cost varies depending on the pressing method used. For example, basket pressing has a much higher labour requirement than both screw and bag pressing per unit of wine.

The amount of MOG and wine loss is also influenced by the type or pressing method used. Typically bag presses express less undesirable phenolic compounds compared with screw presses however, screw presses extract a greater volume of liquid. Most wineries in the project used bag presses.

Depreciation accounts for 15% of overall activity cost and includes the price of pressing equipment and ancillary equipment such as compressed air systems. The electricity was used for motors and generating compressed air.

Comparison of wineries

Range of activity costs

The cost of production per kL of wine varied significantly between wineries in the trial program. The range of costs between wineries for each activity is summarised in Figure 10.

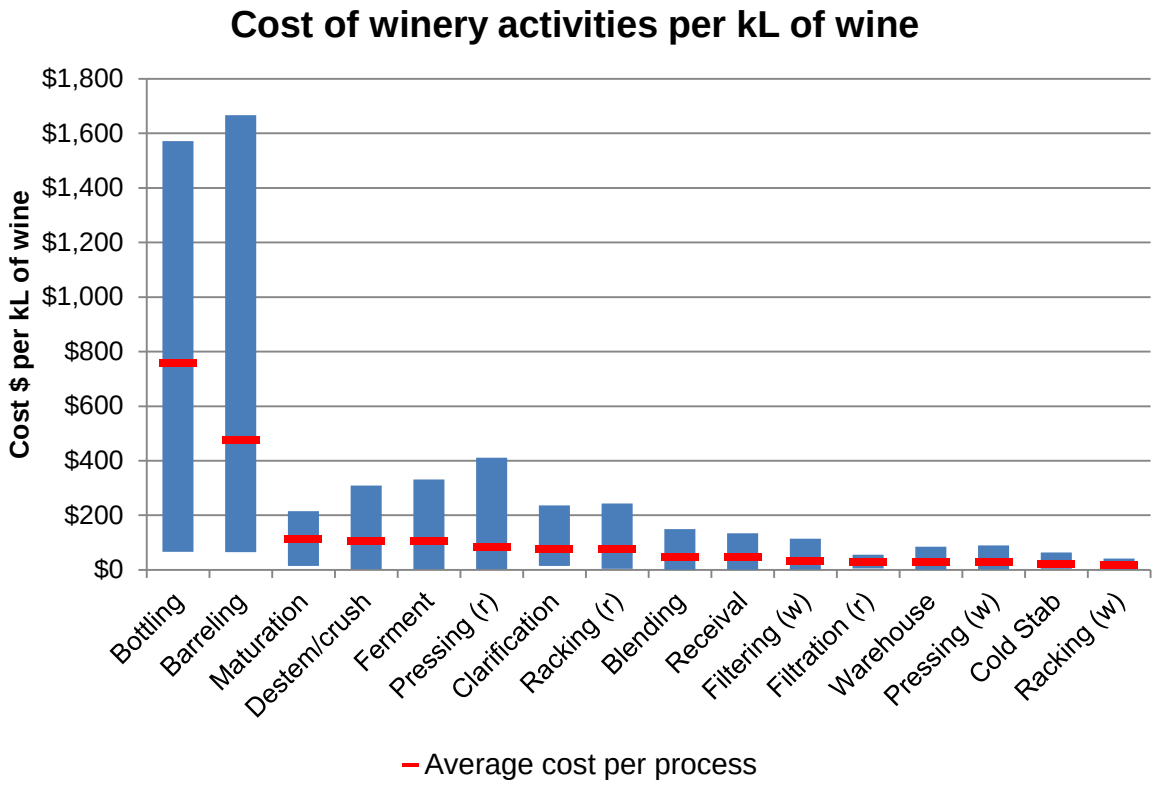

Figure 10: Costs of winery activities per kL of wine produced (minimum and maximums of aggregated data)

Winery size

Data collected during the project revealed a correlation between winery size and winery efficiency, but winery size was not the only factor influencing efficiency. The choice of winery methods (e.g. use of bag press compared with less efficient basket press) most influenced the effectiveness of winery operations.

A comparison of costs of grape receival (i.e. unloading trucks, weighing and tipping), alcoholic fermentation, barrelling and tank maturation ($ per kL of wine) with wine volume processed are provided below (Figure 11, Figure 12, Figure 13, Figure 14).

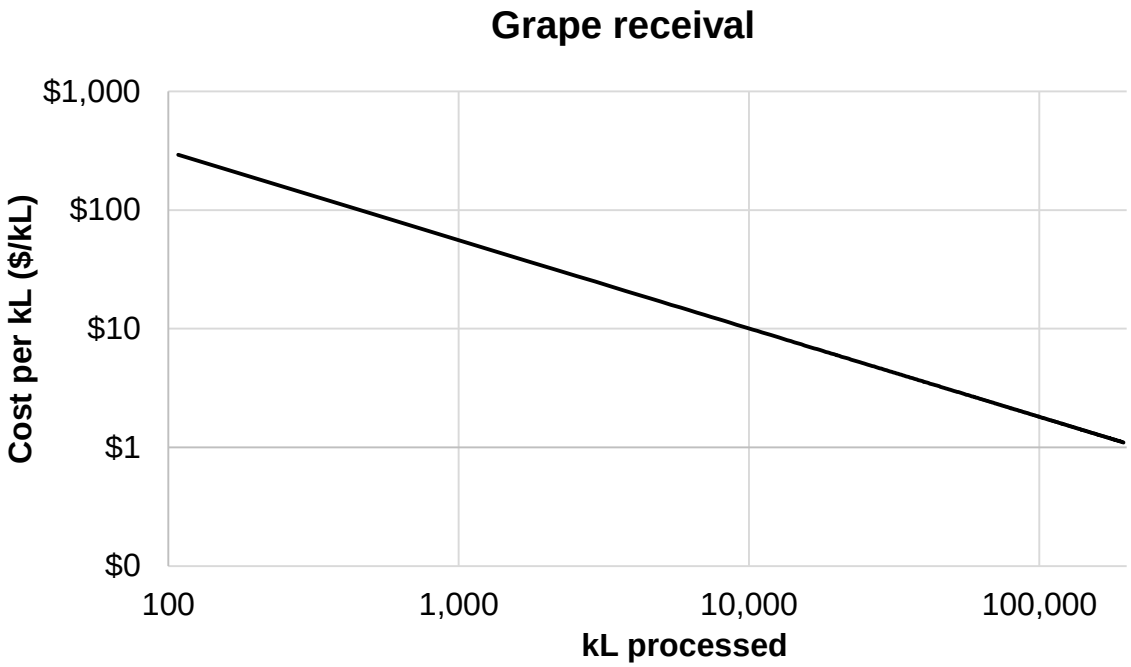

Figure 11: Grape receival costs per kL of wine compared to wine volume processed (kL)

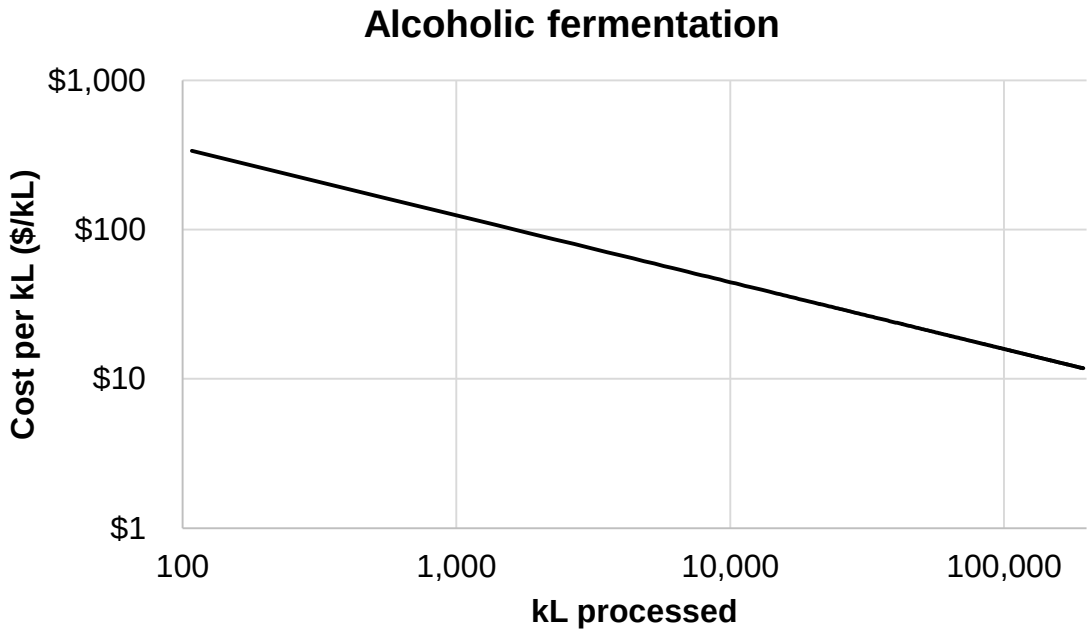

Figure 12: Alcoholic fermentation costs per kL of wine compared to wine volume processed (kL)

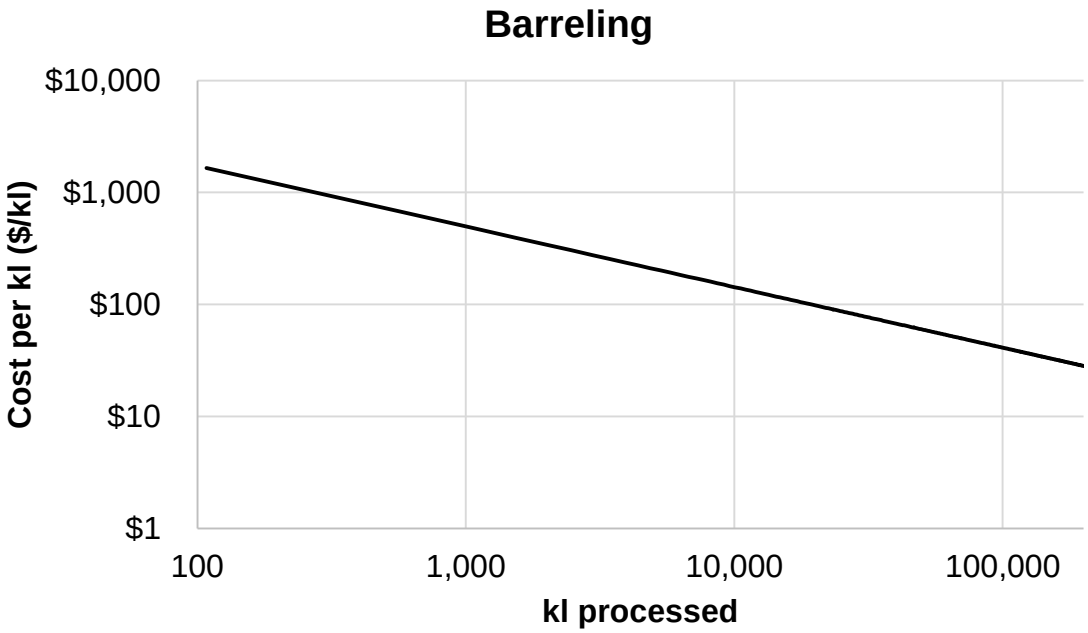

Figure 13: Barreling costs per kL of wine compared to wine volume processed (kL)

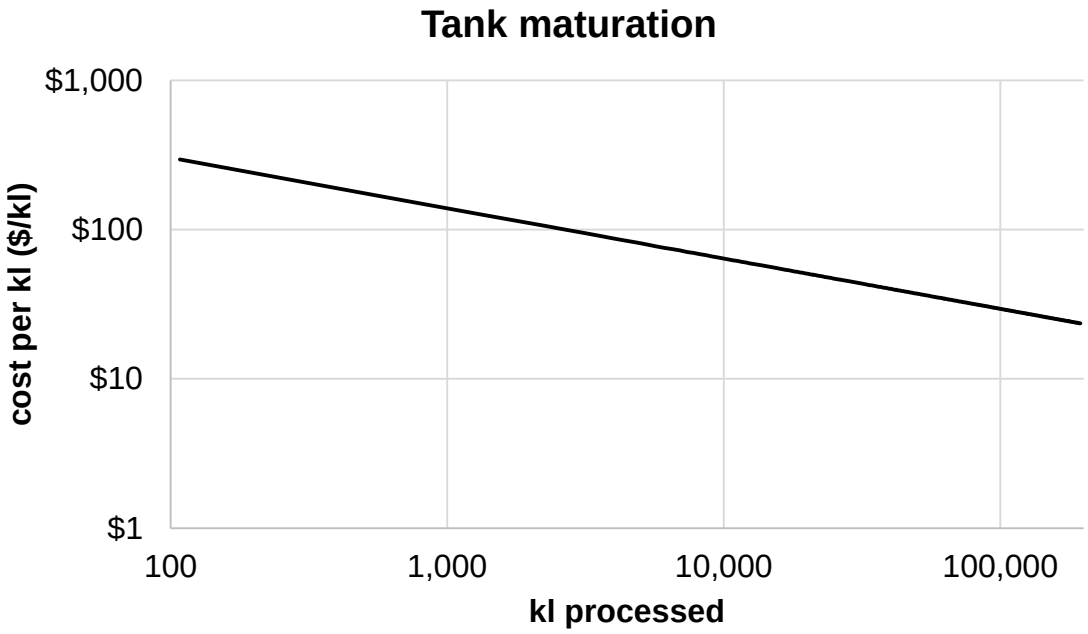

Figure 14: Tank maturation costs per kL of wine compared to wine volume processed (kL)

Benefits of Activity Based Costing

From ABC modelling used in this project, seven key benefits were observed and included

1. Performance metric data that provides better understanding of costs
2. Identification of activities that need efficiency improvements
3. Quantification of lost wine value
4. Easy modelling the cost impact of production changes
5. Determine the actual cost of a wine SKU
6. Performance and cost benchmark data for meaningful comparison
7. ABC data highlights which Lean Production related projects to target

Detailed descriptions are provided below for each outcome

Performance metric data that provides better understanding of costs

A critical first step in creating an ABC model for a winery is to obtain the right information for input. Many wineries do not have data to reflect where resources are used in the winery. Without this, wineries cannot identify which activities are in need of improvement or are unable to measure improvements after changing a process.

Most wineries collect basic performance metric data (Figure 15) based on known costs.

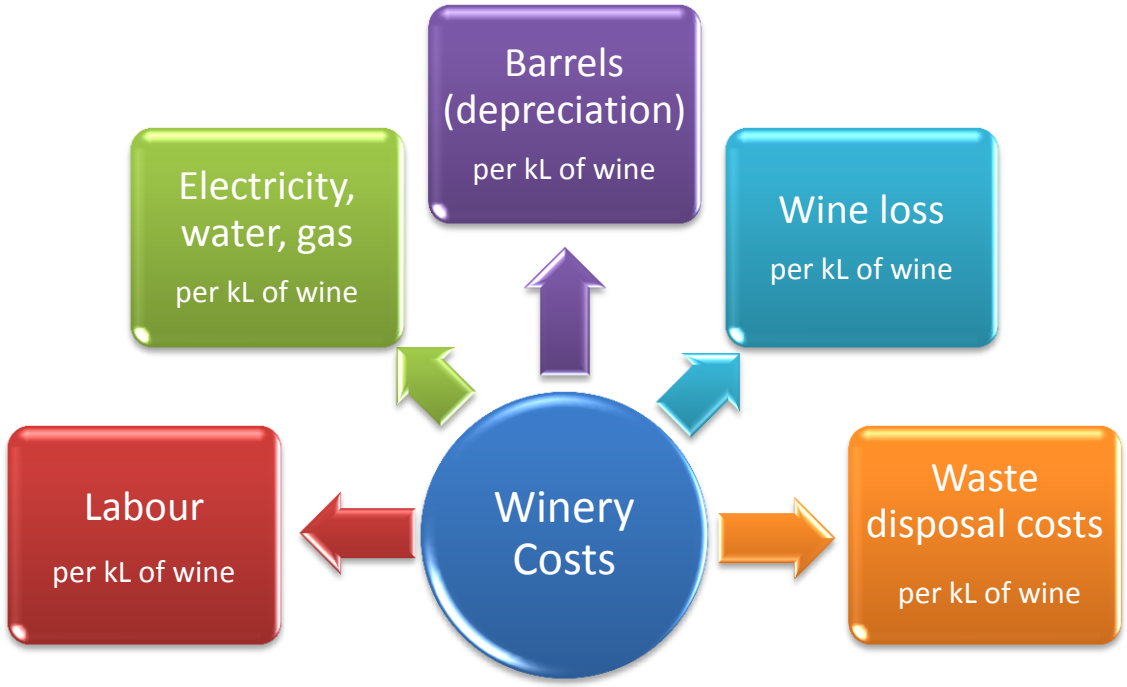

Figure 15: A visual representation of basic metrics performance data related to production (per kL of wine)

These basic metrics are a good starting point, but more tangible performance metrics would allow a winery to better understand where these resources are used. Once the quantity of resources used for an activity is understood, then the winery can identify the cost of an activity. This can provide a framework to identify and target specific activities (i.e. high-cost activities) for improvement. For example, if we consider labour as a resource (that costs money), knowing which activities it is being consumed by assists a winery greatly to understand how it can become more efficient (Figure 16).

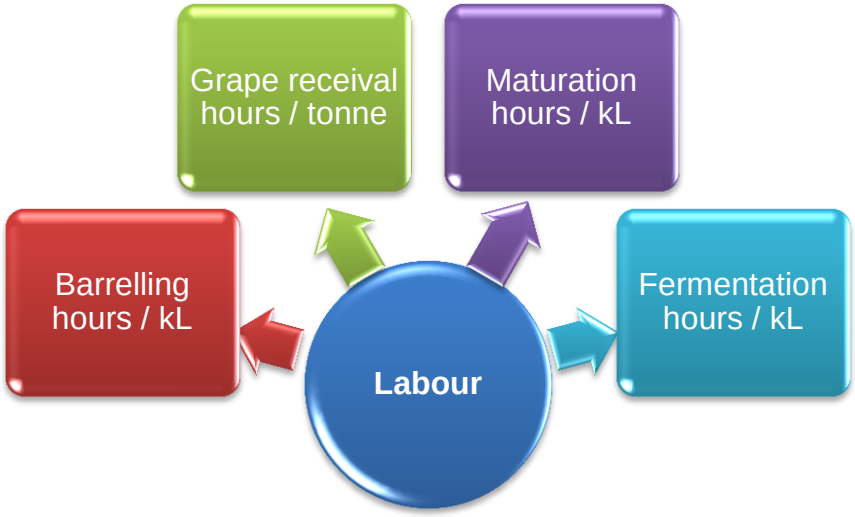

Figure 16: Use of labour resources against several winery activities

Collecting the right data helps to identify which activities consume the most resources. Labour is a high cost for wineries and understanding where this labour is used in the winery provides the first step in collecting the right data.

A list of resources to be collected and some key questions to help collect the right data are suggested below:

Depreciation cost of equipment

- What is the depreciation of capital equipment and where is it used?
- What are the depreciation costs of barrels per kL of wine?

Materials

- What is the cost of additives and where are they being used?
- How much do bottles/labels cost? How many are used?

Electricity, water, gas

- How is refrigeration energy used in the winery?
- What activities use the most water?

Grape and wine loss

- What are the losses in grape receival? (E.g. parcels of grapes with excessive matter other than grapes)
- Where does wine loss occur in the production chain?

Collecting this data and creating an ABC model will help a winery understand their efficiency performance and identify the largest opportunities on-site for improvement.

Identification of activities that need efficiency improvements

ABC monetises wine production activities allowing a winery to target expensive activities for improvement.

Activity costs take into account all resources (including depreciation, wine loss, labour, electricity, water, etc.) allowing a winery to understand where money is spent (or lost). This information can provide a business case for changing processes or investing in new technology to decrease operating costs.

The Australian wine industry uses a variety of process methods to make wine and these use different resource levels. For example, the total cost per kL of wine pressed is significantly different when comparing basket press with bag-press and screw-press. Also, the way a press is used varies the cost of production per kL. For example, a winery with a bag press with automated pressing cycles uses less labour than one that is continually monitored. Likewise, a winery that can schedule and separate red and white batches on different days can minimise cleaning and increases labour efficiency compared with a winery that presses reds and whites on the same day.

Understanding activity costs can help wineries target efficiency projects towards inefficient activities.

Volume and price of lost wine quantified

ABC modelling highlighted a lack of consistent and reliable methods for pricing wine loss and MOG in overall production costs. Few wineries involved in this project had considered the actual cost of wine loss or identified it as an operating expense.

Costs associated with matter other than grapes (MOG) are often ignored, however the additional transport costs, potential crusher/destemmer block issues, labour for disposal costs and interruption to workflow can be significant

Lost wine is defined as lost product that had the potential to be a saleable product. Most losses occur in poor wine extraction from lees, but various other processes contribute to lost wine also.

Matter other than grapes (MOG)

MOG levels vary depending on how grapes were harvested (Figure 17). MOG levels in machine picked grapes are usually low and have a small impact on operating costs. In contrast, MOG levels from handpicked grapes are much higher and can have a bigger impact on processing costs.

MOG is included in the purchase of grapes meaning a winery pays for material not used in creating wine. While MOG is a relatively small percentage of grape receival by weight (even with handpicked grapes), the cost of disposing of MOG exceeds the purchase cost of MOG

Figure 17: Bunch rachises from handpicked grapes significantly contribute to matter other than grapes (MOG)

The labour required to remove MOG, the disposal cost and any interruptions to process flow are paid for by the winery. In machine harvested grapes, larger pieces of MOG (e.g.: cordon wood) can enter the load of grapes. While most crushers and destemmers are relatively robust, large pieces of wood can cause breakdowns or slow processing. Production downtime significantly adds to labour costs and decreases processing capacity.

It is important that wineries recognise the processing and disposal costs that MOG can impart upon a winery.

Wine loss

Many wineries have identified that wine loss needs to be avoided, but still accept wine loss in various stages of production. Without pricing wine loss and recognising there is an opportunity to save wine, there is little impetus for change.

For example, a winery may want to purchase a cross-flow filtration unit to increase labour efficiency however labour savings alone may not provide a robust enough business case. However, recovering quality wine from lees (Figure 18) to increase production volume (and the quantity of saleable wine from what was previously a waste) provides a much stronger business case. Purchasing new equipment in this example can only be justified if the quantity of lost wine is priced.

In many wineries participating in this project, the cost of process wine loss was high.

Figure 18: Wine loss in lees should be priced to understand its importance in contributing to activity costs

Wine lost during the wine making process also adds to cost and complexity of wastewater treatment plant (WTP) operations. Decreasing the quantity of 'lost' wine will reduce running costs of a wastewater treatment plant. The ABC model factors wine losses throughout the process allowing wineries real price data on lost wine to build a justification to change their processes.

Cost impact of production changes easily modelled

ABC allows a winery to analyse a scenario to anticipate the change in operating costs by changing processes. For example, a winery may wish to understand the benefits and change in operating costs by replacing their current diatomaceous earth filtration system with a cross flow filter. If the winery has created an ABC model, they will already know the current operating cost (per kL of wine) of their filtration system. The next step for the winery would be to input the operating parameters of the new cross-flow filtration system into the ABC model and compare the operating costs before and after the change to their process. In this example, the ABC model would reveal a decrease in wine loss costs, a reduction in the purchase and disposal costs of filtration medium, an increase in labour efficiency and an increase in depreciations costs.

Determine the actual production cost of a bottle of wine

Many wineries produce several 'types' of wine, referred to as stock keeping units (SKU). Each SKU has a particular production cost and a major issue for many wineries is not knowing the true production cost of each SKU.

In traditional accounting, wineries record and factor in costs of many items used in the winemaking process (e.g.: grapes, bottles, oak barrels, etc). However, the method does not account for all of the activities undertaken and their costs to produce a bottle of wine.

Knowing the production cost of a bottle of wine is critical it allows the winery to:

1. Accurately price wine for the market
2. Calculate the actual profit for each wine

Many wineries in the project did not have enough data to calculate the cost of production down to an individual SKU.

Performance and cost benchmark data drives improvement

An outcome of the ABC modelling is that it allows wineries to compare their performance before and after efficiency projects have been completed. An example of efficiency benchmarking (resource use per kL of wine) is detailed below (Table 7).

Table 7: An example of benchmarking using ABC defined activities (based on kL of wine)

Activity	Resource			
	Labour	Materials	Wine loss	Water
Bottling	ΔHours per kL	$Δ per kL	ΔLitres per kL	ΔLitres per kL
Barreling	ΔHours per kL	$Δ per kL	ΔLitres per kL	ΔLitres per kL
Maturation	ΔHours per kL	$Δ per kL	ΔLitres per kL	ΔLitres per kL
Pressing	ΔHours per kL	$Δ per kL	ΔLitres per kL	ΔLitres per kL

From data collected in the project, a comparison of labour hours per kL of wine produced versus size of winery was made (Figure 19).

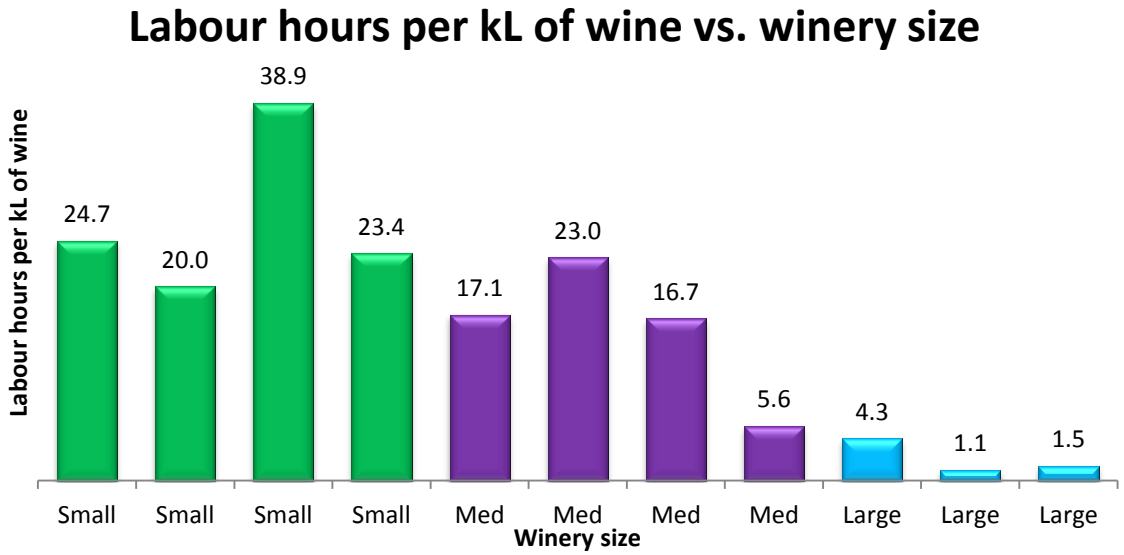

Figure 19: Comparison of labour hours per kL of wine produced vs. size of winery

Wineries in the project indicated an interest to benchmarking their operations against other wineries of similar sizes. Where the efficiency performance of a winery was less than the industry average, the winery undertook projects to identify and reduce the use of the resource.

Use ABC to gain extra benefits from Lean Production

ABC identifies the most expensive activities in wine production to improve efficiency. Lean production is also focused improving efficiency through identification and elimination of hidden, non-essential activities and production steps. When used together, information from ABC can inform the winery which is the best lean production tools to be used to enhance efficiency of winemaking activities.

ABC and lean production 'fast changeover' – an example

A large winery identified the bottling line as a high-cost activity due to the high depreciation cost and labour cost per unit of wine packaged. ABC identified the need to maximise processing volume to increase the rate of return and decrease resource use to increase efficiency.

Bottling line 'changeovers' decreased efficiency and increase costs due to a high level of downtime decreasing efficiency and increasing costs. The winery began projects to decrease changeover time and maximise equipment operating time. A lean production technique, called 'fast Changeover', provided a practical means to reduce downtime, increases throughput and decreases cost per unit of wine. Further details can be found in '*The Lean Guide – a primer on lean production for the Australian wine industry*' available at www.research.agwa.net.au/wp-content/uploads/2014/10/AGWA-Lean-Guide_FINAL1.pdf

ABC and value stream mapping - an example

ABC and lean production tools can be used together to identify the resource costs of an activity. The lean production tool, value stream mapping, is used to examine and quantify resources employed in a given activity. This is similar to ABC.

Value stream mapping can be used to examine and identify changes to steps in the activity to increase efficiency and decrease resource use. Projects are then created to implement the changes identified by the value stream map.

ABC or value stream mapping can be used to measure the new activity cost. Figure 20 describes this relationship.

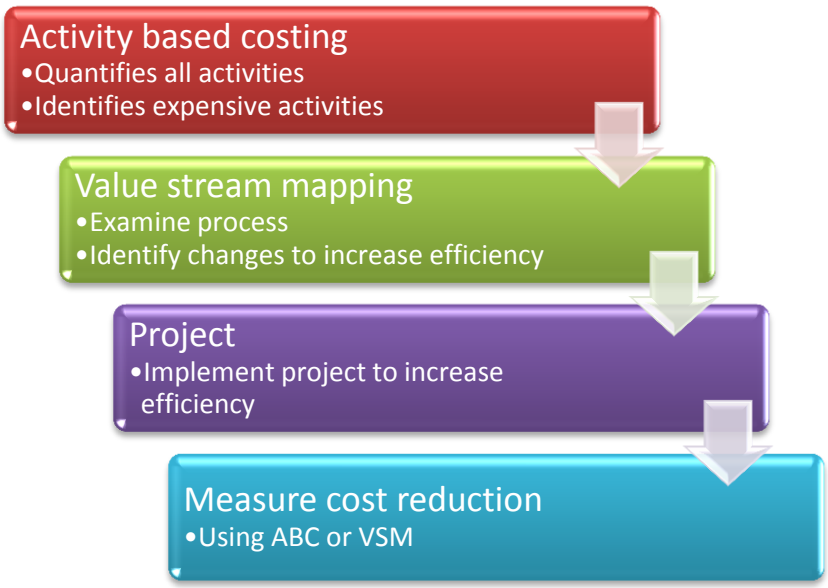

Figure 20: Flow chart showing relationship between information collected using ABC and value stream mapping

Targeted activity efficiency improvements

Modelling insights

The following section provides an overview of some key insights from ABC modelling.

These include:

1. Bottling
2. Barreling
3. Maturation
4. Pressing
5. Fermentation
6. Filtration
7. Warehouse

Detailed descriptions are provided below for each insight.

1. Bottling

Bottling is the single largest activity cost for wineries at $758 (average) per kL of wine.

Wineries either bottle on-site or off-site. Bottling lines are high-cost capital items and can require high levels of labour.

Bottling lines processing large volumes of wine tends to have lower bottling costs per kL of wine. This efficiency is due to a higher rate of return on the purchase of capital equipment (i.e. depreciation cost per kL of wine). The return on investment also increases when bottling lines are in constant use.

High volume lines tend to use labour and other resources more efficiently due to a strong focus on efficiency.

Smaller bottling lines that are idle for periods of time tend to be the least efficient. Wineries with small bottling lines tend to have limited resources for improving bottling line efficiency. For this reason, the cost per kL of wine packaged tends to be higher. Small bottling lines are less automated and use more manual labour increasing the cost of labour per kL of wine packaged.

In some cases, wineries that undertake packaging operations on-site may need to bottle for several months before the quantity of wine required to fill an order has been achieved. Large bottling lines may only need weeks or days to package enough wine to fulfil an order. For small wineries, packaged finished wine increases inventory (this is a similar situation to wineries that bottle offsite and store the finished wine back on-site ready for orders). Inventory ties up cash flow by converting available cash into a financially illiquid product. In some instances, wineries have several years' worth of finished packaged stock on hand significantly decreasing the wineries cash flow.

It is important that finished packaged wine be stored on-site for the least amount of time (and sent to market) to maximise winery efficiency and cash flow. When analysing a bottling process using ABC, a winery must determine if the cost of depreciation, labour use, and cash flow is more economical than sending wine to off-site bottling facilities. Once the total costs of bottling on-site have been determined, the winery can compare these costs against bottling off-site.

2. Barreling

Barreling is an extremely expensive activity primarily due to high labour costs and high depreciation costs (barrel purchase cost).

On average, Australian wineries use barrels for approximately four years, although there is wide variation. Some wineries may use barrels for up to ten years before replacing and others will use barrels for one year before replacement. The longer the barrels can be used, the lower the depreciation costs per kL of wine.

Labour required barrelling is very high requiring almost year round activities. Simple changes to maturation including rack and returning three times per year instead of four times per year would decrease labour use. Ensuring the barrels are accessible and well laid-out will also reduce the labour used in barreling.

Many barreling alternatives are available including micro-oxygenation and the use of wooden staves/chips. Alternatives are far cheaper than traditional barreling and, in most cases, can mimic the flavour and quality of barreled wine. Many wineries are concerned that using these alternative technologies would decrease the value customers are willing to pay for the wine. Understanding market demand allows wineries to determine if barreling alternative methods are acceptable at a price the customer is willing to pay.

3. Maturation

Maturation tanks use high levels of electricity for refrigeration. Some wineries use little refrigeration energy for chilling and cold stabilisation however, some wineries in the project are still over-chilling tanks for long periods of time causing high electricity costs. Cold stabilisation is only needed for a few weeks, not several months and can be shortened further by seeded cold stabilisation.

There are several ways to reduce refrigeration costs. The sub-zero temperatures of cold stabilised wine can be recovered and used in the next tank requiring cold stabilisation. A heat exchanger can be used to recover the cold temperatures of the previously cold stabilised wine to chill the next batch of wine. This returns the cold stabilised wine up to temperature ready for bottling and chills the next batch of wine for cold stabilisation.

4. Pressing

There are many methods used for pressing in the wine industry including basket, bag and screw pressing.

From the data gained in this project, wineries that undertook batch pressing methods (such as basket pressing) tended to use the most labour and have the lowest recovery of wine. Bag presses tend to be more efficient due to automation and higher processing volume.

Continuous pressing systems such as screw pressing can process large volumes of must rapidly however, these can extract phenolic compounds not desired in finished wine.

Alternative technologies such as belt pressing (used in the cider industry) may provide a solution for providing a high rate continuous pressing system while allowing fractionating of the pressed wine. Fractionating can separate low and high phenolic fractions while drying/dewatering must for easy disposal. High phenolic wine may be used for alcohol recovery by third party processors.

5. Fermentation

Fermentation efficiency varies between wineries depending on vintage and winery processes.

In the 2014-2015 vintage, many wineries in the project needed to rework incomplete ferments due to high Baume levels. Rework increased the fermentation activity cost, increasing the average number of days to complete fermentation and decreasing the capacity of the winery.

Methods such as early activation of yeast (i.e. inoculating juice several days in advance of receival to increase yeast activity and yeast number) decrease latency observed during the beginning of fermentation. This method decreases the average fermentation time allowing for a faster turnover of fermentation tanks increasing winery capacity.

Some wineries in the project are beginning to add malolactic cultures during initial fermentation stages. This practice decreases the time required for malolactic fermentation further decreasing maturation times.

6. Filtration

There is a large difference in wine filtration costs when comparing cross-flow filtration and diatomaceous earth plate filtration. While there are significant decreases in labour costs from moving from diatomaceous earth plate to cross-flow filtration, the primary saving is the recovery of wine that would normally be lost during wine production. Table 8 provides an example of a five-year comparison between filtration processes (using ABC to quantify the real cost of activities).

Table 8: Comparison of two filtration methods over a five-year term

Resource	Costs	
	Diatomaceous earth filtration	Cross-flow filtration
Material	$350,000	$50,000
Waste disposal	$50,000	n/a
Electricity	$20,000	$25,000
Labour	$275,000	$80,000
Wine-loss	$20,000,000	$800,000
Capital	n/a	$500,000
Total	$22,695,000	$1,455,000
Cost Saving		$21,240,000 (over five years)

7. Warehouse

The primary efficiency issue for warehousing is the decrease in cash flow due to the conversion of cash into illiquid stock. The costs of resources involved in warehousing are minimal compared with the risk to cash flow.

A critical issue for wineries is to focus on moving wine to customers and minimising stored inventory. For this reason, it is important that wineries understand customer needs, in particular, the price customers are willing to pay. It is important to know the cost of wine production and to understand a sustainable wine price. In the project, most wineries produced wine in the range of $20 - $40 per bottle. Competition in this price range is high and the demand much lower than the demand for sub -$20 bottles of wine. Market placement and matching production to demand is necessary for moving wine and decreasing cash flow issues related to high inventory levels.

In summary, ABC has been demonstrated to be an effective way to calculate production costs enabling improvement of winery efficiency and business profitability.