Maximising value through Lean operations

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Background
According to the latest Deloitte annual benchmarking survey (2006), wine inventory levels being held by wineries in Australia are particularly high, with around two billion litres currently being held in stock. This stock has an average turn over rate of less than 1, compared with the double-digit turn-over that is achieved by efficient companies in other manufacturing sectors.

Packaging costs within the Australian wine industry are also known to be particularly high. The level of cost associated with packaging wine is equivalent to approximately 20% of the cost of goods and 50% of the gross margin per case.

Lean Manufacturing
Lean Manufacturing is a business improvement strategy with an emphasis on quality management and a strong focus on customer value. Simple tools and techniques can be used to measure and improve performance across the business. The strategy can be used to reduce supply chain operating costs and promote the reduction of specification failures and product re-work.

Lean Manufacturing can also help to dramatically reduce inventory levels to improve cash-flow, reduce product lead times and can aid the development of operational flexibility to match changing market demands.

Generally speaking, these improvements are low-cost solutions, which provide rapid pay-back and promote the use of innovative thinking and new technologies.

The bottling process
Bottling lines in the wine industry are usually operated at high speeds for maximum throughput, but are expected to cope with constant product and specification changeovers whilst maintaining high efficiency.

Figure 1 below shows the key unit operations found on a typical bottling line and the inputs that need to be managed at each stage. The critical inputs for the bottling process are the wine itself, the closures used to seal the bottles, the labels and the nitrogen or carbon dioxide gas used to purge the bottle of oxygen and control the headspace environment after filling.

The filling, sealing and labelling operations on a bottling line typically experience the most operational difficulties. There are a number of reasons for this and they will be discussed in this article. Key improvement opportunities that may be used to resolve these issues have also been identified.

Bottling line evaluation method
Provisor carried out bottling line evaluations in South Australia and New Zealand, in order to assess typical product and efficiency losses, to identify operational bottlenecks and to determine if there are potential benefits from the adoption of Lean Manufacturing techniques to improve bottling operations.

Observational analysis was carried out at a number of commercial and contract bottling sites and performance metrics were gathered to support the observations. Supportive processes such as winemaking and inventory management were also assessed to evaluate the impact of other business areas on bottling line operations.

Key improvement opportunities
The bottling line evaluations carried out have highlighted significant cost savings that can be realised for both commercial and contract bottling operations. The following key opportunities for improvement have been identified:

- Reduction of the complexity of products and dry goods
- Improved control of product quality
- Optimisation of scheduling and planning processes
- Improved management of dry goods, wine and finished products
- Reduction in the frequency of intermittent line stoppages
- Optimised use of labour
- Improved management of change overs

Reduction of the complexity of products and dry goods
Bottling lines are required to manage a significant degree of complexity with respect to the different combinations of dry goods required for multiple product lines. A reduction in this level of complexity and number of product configurations would lead to fewer and more rapid changeovers and a consequential increase in production capacity.

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**Figure 1.** Typical unit operations and inputs on a bottling line.
Improved control of product quality

Wine product quality is carefully monitored using a number of physical and analytical checks during continuous production. However, intermittent line stoppages can lead to situations where wine suffers extended exposure time to the atmosphere. A better understanding of the effects of line stoppages on the integrity of the wine is required.

Management of bottle headspace is also inconsistent across the industry. Through further evaluation studies such as this, best practice for the use of nitrogen or carbon dioxide gas in headspace control could be identified and the effects of inconsistent headspace gas volumes on wine quality could be assessed.

Optimisation of scheduling and planning processes

Scheduling and planning processes for bottling runs are often inadequate and inflexible for changing market and retail chain demands. Wine is often bottled when no market or distribution channel is available and is therefore stored in warehouses as tied up capital. The development of better links through the retail chain would allow bottling operations to match true demand for wines in the marketplace.

Improved management of dry goods, wine and finished products

Poor management of dry goods supplied to the bottling line can lead to operational errors and ineffective processing. Improved understanding of dry goods specifications and the use of just-in-time material replenishment to the line can help to reduce the number of product defects and improve throughput.

Bottling production runs are typically large, to enable continuous processing of one complete tank volume. The use of a range of tank sizes for supply of wine to the line would allow flexible manufacture and increase the opportunities for processing of ultra-premium wines.

Wineyards typically hold significant levels of stock so that the retail chain can be replenished rapidly. However, this reduces cash-flow within the business and results in poor inventory turnover rates, with figures typically found to be below 1.

In order to improve flexibility within the business, inventory levels should be reduced. Bottling operations should be aligned with this, so that stocks depleted through supply to the retail chain are replenished rapidly. Figure 2 below shows a typical inventory saw-tooth stock pattern seen for both raw materials and finished products.

The reduction of order lead time and reorder quantities and the minimisation of safety stock levels is a focus of Lean inventory management. The rectification of inefficient processes, reduction of operational down-time and changeover times and resolution of supplier delivery issues will help to reduce inventory levels for both dry goods and finished products and help to improve cash-flow through the business.

Reduction in the frequency of intermittent line stoppages

Frequent line stoppages reduce line capacity, increase unit product costs and can lead to dry goods and product wastage. Although some performance metrics are typically collected on the bottling line during processing, they usually lack the detail necessary to help to resolve the problem and therefore corrective actions cannot be instigated.

By collection of accurate line stoppage data and the recording and analysis of the reasons for down-time, the root causes behind the stoppages can be identified. This would then allow the implementation of corrective actions, which can be used to increase line capacities and to drive right-first-time manufacture.

Optimised use of labour

It was observed that more efficient utilisation of labour resources is possible on bottling lines. Through the use of simple standard operating procedures, manuals and work instructions, production efficiency can be increased.

The cross-skilling of bottling line personnel is a strategy which also enables line down-time and changeover times to be reduced and makes training programs easier to manage.

Improved management of change overs

Changeovers between product lines can drastically reduce the capacity of a bottling line. Smoother transitions between product lines and reduced down-time is required to provide operational flexibility and reduce unit cost. Well-drilled changeover routines, similar to those pit-stops seen on the Formula 1 Grand Prix circuit, could help to minimise line down-time, increase capacity and ultimately to reduce inventory stock levels.

Key tools to facilitate this improvement are the use of coded equipment parts linked to the bottle or closure types being used, line-side storage of these parts for rapid access, coordination of rapid wine supplies to the line and the use of standard work instructions for bottling operators.

Conclusions

The evaluations in South Australia and New Zealand have identified the following key bottling line issues that need to be addressed across the wine industry:

- A better understanding of product line complexity and the effects of poor line performance on operational costs is required
- Marketing, planning and logistics need to be more closely linked with bottling operations, so that the operational impact of marketing initiatives can be minimised and bottling runs can be directly linked to true customer demand
- Wasteful activities, inefficient processes and ineffective equipment must be removed or rectified within the business, in order to reduce operational costs
- Bottling line down-time, due to product and equipment defects or re-work, as well as line changeovers, must be minimised in order to maximise throughput and to provide operational flexibility

References