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**Research Report: ZLC-2015-4**

**Measure & Monitor: Improving Identification to Increase Keg Rotations**

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# MEASURE & MONITOR: Improving Identification to Increase Keg Rotations

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**Summary:** The purpose of this thesis is to gain an in-depth understanding of the feasibility and capacity of existing tracking technology to improve visibility of keg flows, as well as potential impacts of technology implementation, including any opportunities for increased keg rotations and improved financial and operational impacts.



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## KEY INSIGHTS

1. RFID is the most viable technology for tracking and identification purposes as defined by Company needs and must support greater efforts to understand keg time in market
2. RFID implementation necessitates both operational and financial considerations to improve short-term KPIs with long term value creation
3. Introducing a pilot program to begin measuring real-time data is crucial to assessing the actual cost and benefit of RFID implementation via an appropriate sample size reflective of the larger keg float

## Introduction

Delivering millions of kegs around the world on time and in quality condition requires extensive logistics expertise. Keg management becomes increasingly critical as operations expand with growing global demand for beer. A consistent problem for many brewers across the industry has been inadequate keg inventory management systems to obtain reliable tracking and identification of keg floats in the market. As a result, the brewer may need to

purchase more kegs than necessary in order to have sufficient on-hand inventory to replace lost or misallocated kegs as well as support new market demand.

To determine if any viable solutions exist to improve the current situation, a combination of both practical approaches and more theoretical methodologies were applied to provide a comprehensive study of the landscape:

- Empirical research and personnel surveys to determine status quo processes and preferences for areas of improvement with respect to identification and tracking technology
- Site visit to a Company brewery and interviews with on-site management to obtain first-hand observations and information
- Research and evaluation of existing technology alternatives, including advantages and disadvantages of various barcode and RFID solutions
- Benchmarking of technology solutions utilized by industry counterparts and analysis of industry trends that enhance usage experience
- Simulation of process improvements based on recommended tracking technology
- Analysis and extrapolation of historical financial and operational data obtained from

the Company to determine any existing trends and forecasting patterns

- Development of a business case framework to quantify and justify project costs and opportunities gained by a potential technology implementation

## Best Technology Decision

In order to decide which technology is the most appropriate to track and identify the kegs through the supply chain, the limitations and strengths of each alternative need to be studied. After an overview of the different technologies used in the industry for the purpose of the thesis, the viability study is limited to two major alternatives: RFID and barcode.

While RFID provides quick bulk reading and storage capacity, its radio communications technology faces substantial operational challenges in metal and liquid environments. On the other hand, barcodes provide a very well established technology that are cost effective but have inner limitations in bulk reading and durability. The following table highlights the major differences between the two technologies:

	RFID	Barcode
Cost	Expensive equipment and implementation costs	Standardized implementation and cheap variable costs
Readability	Long range. Bulk reading	Need line of sight. One reading at once
Durability	Depends on the tag's protection	Stains and other conditions severely affect durability
Accuracy	Only depends on conditions	Depends on conditions, process and state of tag
Data capacity	High-user preference	Low-limited to standard

Although it was clear that RFID was the best alternative due to its capacity to satisfy the bulk reading needs in Company operations, the metal and liquid constraints needed to be addressed. Several improvements have been made in this regard and after three on-site demonstrations from RFID suppliers with an accuracy ratio of more than 99.5%, RFID was chosen for implementation.

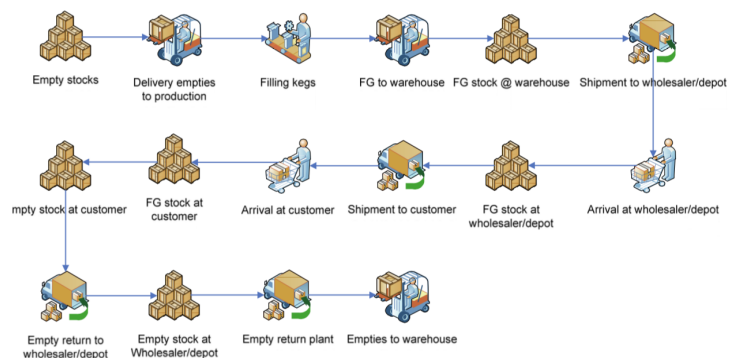
In consultation with the Company sponsor and MIT Zlog advisors, the authors sought to understand how the Company would consider the options (and the costs and benefits of these) available to them prior to deciding to install RFID. Supported by a literature review on RFID and per the Company's guidance, this study proposes that it would be beneficial to establish a robust business case framework around which future RFID purchases could be made. This would indicate that the Company must obtain from

suppliers correct and current cost and benefit data for the business case. This study also assessed the influence of RFID on supply chain management with respect to kegs in circulation and sought to define the cost drivers and benefits that will aid the design and configuration of future installation options. This study also sought to provide the Company with a means to carry out benefit and key performance indicator tracking.

## Simulation

In order to visualize the implications of implementing RFID in the supply chain, a simulation of the entire process is designed with Rockwell's software ARENA Simulation.

The first step consists of an in-depth study of the present distribution chain of the kegs in order to better understand each stage in which the keg passes through during its time in market and its associated time and cost drivers. The current keg process flow as provided by the Company is below.



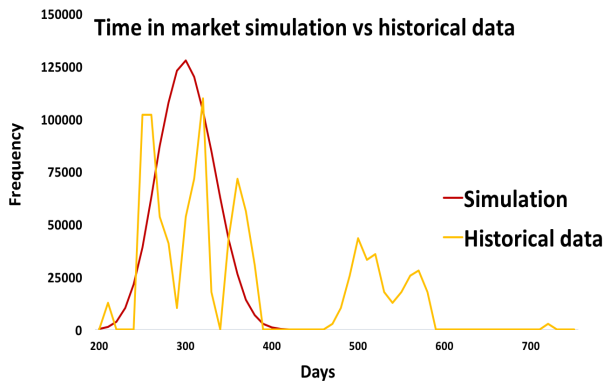
Once the current keg's supply chain is defined, three simulation scenarios are designed to study RFID implications:

1. Due to all the variables and processes that take place in the supply chain, it is not feasible to run the supply chain simulation scenario as is but rather analyzed in stages. First, the stages in the time in market are simulated to know if a keg's time in market follows a particular distribution.
2. Once the time in market behavior is assigned a distribution, a scenario with full implementation in which all kegs are tagged is designed to study the benefits provided by RFID in terms of visibility in the brewery's domain while only installing a reader at the brewery stage of the supply chain.
3. Finally, a third scenario is designed to study the implications of tagging only a percentage of the whole keg float.

## Results Analysis

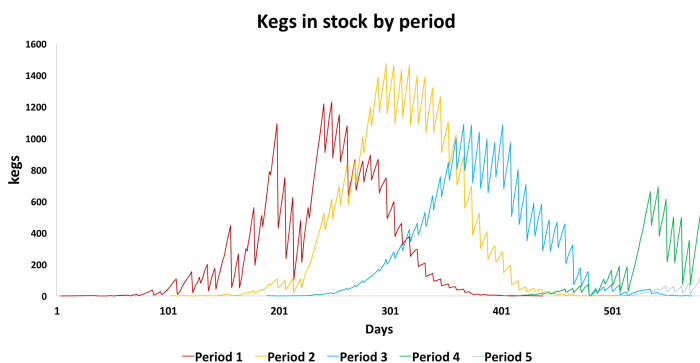
Once the simulation is run, the results of each scenario are compared.

The different times in market spent by the kegs in the supply chain are represented so as to determine if they follow a particular distribution. This data is also compared with historical data provided by the Company.

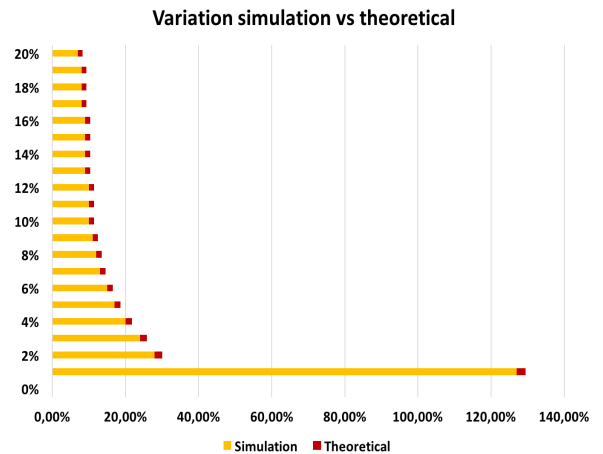


Historical data has been scaled to match the simulation data and as exhibited, strong differences appear between the results. These differences may be due to different collection criteria, sample size or lack of knowledge of the dynamics within each stage along the supply chain.

The following simulation shows how RFID would provide supply chain visibility by tracking the number of kegs that enter or exit the brewery's stock and within which departure time period. This would allow the firm to better control the number of new kegs that are needed to satisfy the demand and other variables such as seasonality.



A confidence interval is designed to help decide the percentage of kegs that are going to be tagged so that the RFID implementation provides a significant amount of benefits. Given the size of the entire keg population, the probability of loss and the accuracy ratio, the tagged sample would be reflected in the following theoretical graph where the variation between the estimated amount of tagged kegs and the actual number is simulated. However, this theoretical calculation differs strongly compared with the results obtained after the simulation of scenario 3, where different percentages can be seen amongst the estimated number of kegs in the brewery's stock compared with the real number of kegs.



## Potential Financial Implications of RFID Implementation

After assessing the technical results, the business case framework is discussed in order to determine if the RFID implementation makes economic sense. It is important to consider the financial impacts if RFID is deployed Company-wide across each phase of implementation, as the Company would plan to integrate the technology in stages to better control for results and minimize initial costs.

It is also important to note that many assumptions are made regarding costs and proxy numbers have been used based on best estimates from industry benchmarks. Assumptions and best estimates have been made regarding the number of facilities involved with the implementation at each phase and may differ from the eventual real-life implementation. Additionally, certain costs in real-life, such as equipment and installation costs, may benefit from economies of scale and see a marginal decrease in price increments as the Company rolls the project out. Other costs, such as labor, have been roughly estimated by proxy wages and an estimate of number of individuals and/or man-hours may be needed for phased implementation.

Given that there may be a disconnect between immediate results from technology implementation and longer term corporate value creation of this capital investment, this study applies the following phased approach to analyzing potential benefits and creating value.

Phase/Year 1: Tagging and tracking (current stage of study)

Phase/Year 2: Assimilating RFID data into Company's own system (further in the future, possibly after a pilot)

Phase/Year 3: Utilizing RFID data to improve business processes (Data Analysis – Analyze Phase)

Phase/Year 4: Long-term value creation

Net present value (NPV) is defined as “the sum of the present values (PVs) of incoming and outgoing cash flows over a period of time. Incoming and outgoing cash flows can also be described as benefit and cost cash flows, respectively.” As the RFID project is a capita budgeting project, NPV calculations were performed based on the aforementioned assumptions and estimations. Given the phased approach as the Company plans to implement the pilot first then expand accordingly over time, a five-year discounted NPV calculation is performed based on incremental improvements each year with Phase 1 through 5, assuming 100% of keg float is implemented with RFID at the end of year 5.

To begin, general information and assumptions were input into an NPV model as customized to the Company’s situation and specific value drivers, as well as rough estimates for projected costs.

	Year 1
Additional annual revenues due to RFID	\$729,409
Additional annual profit due to higher revenues (Margin*Add. Rev)/(1	\$153,711
Additional annual profits directly through RFID	\$14,029
Benefit due to reduction in costs	\$1,026,912
RFID related costs	\$1,261,000
Net Benefit using RFID	\$66,348
Discounted benefit	-\$66,348
<b>5-year discounted NPV</b>	<b>\$148,985,147</b>

As can be seen, based on rough estimates and assumptions, the five year discounted NPV is over \$140,000 and thus justifies the expenditure of the project. Once again, the model is highly theoretical given the lack of actual costs and accurate implementation structure.

In addition, the theoretical model indicates that additional benefits such as operational efficiencies can also be improved due to RFID implementation.

Once the Company has obtained real-life data, the information can be input into the model to replace the proxy numbers and obtain a more realistic result. The primary purpose of showing these proxy results are to highlight the implications of RFID implementation from an economic perspective and its relationship with important financial metrics.

### Conclusions

Preliminary findings reveal that RFID is the most viable technology for tracking and identification purposes for Company needs. More importantly, the success of any proposed technology depends largely not only on the technical features, but also the training and adoption by Company personnel and other key stakeholders across its supply chain. Simulation results reveal key areas to measure along the supply chain for potential improvement in bottleneck delays by improved tracking.

For the implementation of RFID technology there are several factors that need to be taken into consideration. Given the keg’s nature and the bulk reading objective, UHF technology is the most appropriate frequency at which to operate and the

tags need special characteristics to be feasibly read in metal/liquid conditions. Given the worldwide scope of the Company’s operations, it would be reasonable that different RFID vendors are used depending on geographic location. It is crucial that the company to pay special attention to the solution’s interoperability. A comprehensive and in-depth understanding of the standards provided by the solution will be useful when ensuring streamlined and seamless operations across different vendors.

The implementation of new procedures in an existing supply chain requires a detailed knowledge of the functions along each step in the chain. The clearer these functions are, the more accurate forecasts can be regarding the project’s achievements and areas for improvement. Another critical consideration is the minimizing impact and/or avoiding shocks to the existing system by a new system. Although RFID could be easily implemented with the capacity of reading each individual tag, the result would significantly slow the speed of the supply chain and consequently negate any efficiencies gained through increased visibility.

The studies into existing RFID systems installed by other industry counterparts found limited quantification of the installation costs and benefits, thereby affecting the ability to obtain reliable data to establish a robust model that could be used for future expenditures. Through interviews with key technology suppliers, as well as evaluation of comparable organizations that currently operate RFID, this study established the key costs and benefits of RFID systems for breweries. These proxy figures were used as a basis of a business case framework to be used for making future purchases of RFID systems. To support the business case this study also provides a means to further assess the long-term benefits of RFID systems.

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