

Measuring the Impact of Information Technology on Value and Productivity using a Process-Based Approach: The Case of RFID Technologies

Brian Subirana, Research Assistant
MIT Sloan School of Management & IESE Business School

Chad Eckes, George Herman,
MIT Sloan School of Management

Sanjay Sarma,
MIT Department of Mechanical Engineering

Michael Barrett,
Cambridge University

Introduction

The attention given to radio frequency identification (RFID) has been going up steadily throughout the past years given the remarkable benefits it can provide. In particular, the application of RFID to the consumer packaged goods (CPG) supply chain has been one of the first to capture large scale adoption, with companies like Wal*Mart mandating their top 100 suppliers to begin sending cases and pallets of goods with RFID/EPC (Electronic Product Code) tags by the year 2005. This mandate will cause these suppliers to invest in new RFID and IT infrastructure. For each supplier there are many options: tag cases at the exit doors, tag all cases in the supplier's warehouse entry doors, tag a certain section of the warehouse, etc.

With this challenge in mind, we set out to find a methodology for quantifying the value of RFID for a consumer packaged goods company (CPG). Through our summer 2003 study of a major CPG company exploring RFID for one of their warehouses, we were able to come up with a methodology.

Our objective was to develop a conceptual methodology for prioritizing the various options related to IT investments while providing an estimate of the value of the productivity improvements that can be obtained with each option.

In IT investment projects, the manager can be faced with the task of quantifying the value of such investments, and insuring their organization that a positive return will be achieved.

Business Process Analysis and the MIT Process Handbook

The starting tool we used in our endeavor was business process analysis. By looking very closely at the processes performed in the company's warehouse, we determined ways in which RFID could clearly improve efficiency and accuracy within material goods handling. Furthermore, we married cost and productivity data to our process analysis, which led us to a concrete financial model that shows the value of RFID for a single business process.

In any business process analysis project, one must utilize a process mapping tool for documenting and understanding processes. In our case, we employed the MIT Process Handbook. This tool provided us with a way of thinking about processes that proved quite useful. In particular, the MIT Process Handbook uses the metaphor of a compass, to depict how processes are related to one another, allowing the user to look at decompositions and uses of a process, as is common in most tools, but also enabling the definition of generalizations and specializations¹.

Methodology for Quantifying the Value and Productivity of IT investments

To help describe the methodology in more detail, we will use an example based on the real situation we studied this summer, where RFID was being considered by a major consumer packaged goods involving a fork truck operator receiving and moving pallets of goods, and also entering data manufacturer as a possible value-generating IT

¹ Malone, Thomas W., Crowston, Kevin, Lee, Jintae, Pentland, Brian. "Tools for inventing organizations: Toward a handbook of organizational processes." *Management Science*, March 1999, 45(3), 425-443.

investment. In particular, we describe a process about the pallet into a warehouse management system, via manual data entry and barcode scanning

1. Determine objective of modeling effort including executive decision to be addressed

In our field work with a CPG company, we wanted to address the following question:

“To what extent does it make sense to invest in RFID?”

The modeling question also implied we were interested in understanding what some of the cost savings and other value generation opportunities may be.

2. Analyze MIT Process Handbook data and develop preliminary reference model

Given that the MIT Process Handbook already contains over 5000 activities including some related to supply chain management, we studied the various types of warehousing activities and what some of the essential components of warehousing processes may be.

3. Study, decompose and document current process in earnest

After studying existing entries in the Process Handbook, we turned our attention to studying a real process in a warehouse. In particular, we studied a routine process of receiving pallets into the warehouse, involving a fork truck, a computer terminal and a barcode scanner. Through observation, reading through training manuals, videotaping, and interviewing fork truck operators and their supervisors, we acquired a deep understanding of the environment and process.

4. Define the future state of RFID

We next needed to envision a future world within the warehouse, where RFID would be utilized and would replace various manual steps within our process.

For our study, we defined the future world to be:

- Case-level tags read with 100% accuracy
- Pallet identification barcode labels replaced by RFID tag

5. Decompose and document future process

After understanding what RFID “world” we wanted to live in, we proceeded to think about and document what the process would turn into with RFID in place. In this particular situation, we mostly eliminated parts from the original process, added a couple of new steps, and only inherited a few.

6. Gather current performance metrics for the process

We completed our documentation of the “as-is” and “to-be” processes and set out to find metrics that described the current process.

7. Apply metrics to process decompositions

Given cost and productivity metrics that represent the “typical” effort and time it takes to perform the process, we then attempted to spread the metrics – in particular, the time it takes for one iteration of the process – across the many steps in the process decomposition. Instead of performing separate timing studies for each step, we used our detailed knowledge of the process to estimate how much time each step took, relative to the other steps in the process.

After allocating the time across the “as-is” process, we turned our attention to the “to-be” process. This exercise was relatively straightforward, since our “to-be” process only contained a fraction of the original steps from the original process. Moreover, there were very few additional steps that needed to be added. Thus, we simply had to *inherit* the values we had assigned in our “as-is” process, as well as estimate values for the new steps we had added.

8. Calculate estimates for value and productivity performance metrics of RFID process

Now that we had numbers for the amount of time it would take to perform the process without RFID and

with RFID, we could marry those with our cost data, to determine what cost savings RFID would generate.

9. Create executive report using estimates

Once the value and productivity process performance metrics had been estimated, they could be put to work to support the objectives of the modeling effort.

Given the large number of steps eliminated from the “as-is” process, it was no surprise that RFID generated value. What we had to do next was compare that value to the estimated investment required to enable the warehouse with RFID. Thus, we set out to create a value model, which we envisioned as being a 7-year analysis of costs and benefits, discounted back to the present time period, in order to account for the time value of money. In other words, a discounted cash flow (DCF) analysis.

Our modeling effort was broken up into three steps:

Step 1 – Determine input variables

In order to make the model representative of the significant number of unknowns associated with RFID, we created a list of input variables that, when changed, would result in the bottom-line value figure changing. These input variables were broken into two types: constants and year-over-year variants.

Step 2 – Create discounted cash flow model

As mentioned above, we decided to measure the value and costs of RFID over a 7-year time horizon. Our first step in creating the DCF model was to input the value created by RFID in year 1, and grow that value annually by the annual sales increase percentage (which was an input variable).

What we believe is essential is that the choice of variables and use of the model be done in conjunction with those that are going to make decisions based on it. In some cases, the existing accounting practices may not enable the capture of all the benefits associated to a given technology, within their current cost categories. It will be necessary then to refine those and maybe challenge the firm’s current performance practices. In many cases it may be unrealistic to assume that all the potential cost savings would

actually be realized in this way. For example, time savings of a person that is already underutilized may not result in the reduction of actual expenses at all. For large warehouses, involving hundreds of employees, this may not be a big issue. In general, more analysis should be done to estimate which portions of the efficiency gains should be counted towards value creation and which ones should not.

Step 3 – Run sensitivity analysis

At this point, we were basically done. We had achieved our goal of quantifying the value of RFID. Still, we wanted to show how sensitive the NPV and ROI could be to changes in our input variables. We therefore ran a number of trials with different input variables.

10. Include findings in the MIT Process Handbook for future use

The final step in our methodology is to report back to the MIT Process Handbook the results found. Part of the results can be included in the current version of the MIT Process Handbook. For example, the various ways in which RFID can be introduced in the warehouse can be captured within a specialization tree. Other findings will require changes in the code of the MIT Process Handbook if the analysis above is to be conducted and reproduced without the help of a spreadsheet program.

Other areas of value opportunity enabled by RFID

Our research suggests RFID could create value for one particular process within a warehouse. We found that most of the value RFID generates, when introduced in a process, comes from one of two sources. First, the effect that RFID has in the internal value metrics of the process, such as the time to complete the receiving process, the quality of the shipped orders in the shipping and handling (S/H) processes, or the labor costs of the warehouse processes. Second, the use of RFID in a process can also have an impact in the performance metrics of *other* processes, given the interdependencies between processes. For example: assigning EPC codes to cases and pallets has an impact in the accuracy of the cycle count processes; verifying cases in the receipt process has an impact in the accuracy of the put away process; putting RFID tags

in the warehouse permits lowering the costs of the customer's warehouse management processes.

The following list provides some of the sources of value we encountered in our study. We have not done detailed performance metrics estimates of all these sources. In combination, the value they may generate could be vastly larger than the one derived from our analysis.

- Improved efficiency in the warehouse including less time spent on: receiving; put away; picking; checking/counting, shipping; exception handling, returns from other DC's and customers
- Reduced labor and material costs due to improved efficiency
- Reduced transportation costs
- Reduced inventory on hand in the warehouse, and throughout the supply chain
- Reduced shrinkage in the supply chain, due to reductions in: theft, spoilage and product diversion
- Improved sales, due to lower out of stock

Conclusion

We have introduced a methodology to estimate process performance metrics and to quantify the value IT can bring to a given process. The methodology provides a systematic approach that can help companies predict the impact of IT investments in process performance based on their own metrics and eventually those of others, if the MIT Process Handbook is extended to incorporate reference metrics. This may help direct resources to the areas where RFID has the most potential to generate value. In particular, we have shown how the methodology can be applied to estimating the impact of RFID on warehousing management processes.

We have also demonstrated that the MIT Process Handbook can be used for detailed analysis. In our field work, the number of activities in the warehouse, measured by the thousands, is comparable to the whole content developed over the last 10 years and currently present in the handbook. This further builds our confidence that the MIT Process Handbook is a good tool to capture business knowledge of many different types and for many different goals.

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CONTACT INFORMATION

MIT Center for eBusiness
 MIT Sloan School of Management
 3 Cambridge Center, NE20-336
 Cambridge, MA 02142
 Telephone: 617/253-7054
 Facsimile: 617/452-3231
<http://ebusiness.mit.edu/>

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