

# MEASURING THE IMPACT OF ENTERPRISE SYSTEMS ON BUSINESS OBJECTIVES

Donald Chand, George Hachey, James Hunton, Vincent Owghoso, Sri Vasudevan  
*Bentley College, Waltham, MA 02452, USA*

**Keywords:** Enterprise Resource Planning Systems, Balanced Scorecard

**Abstract:** Our team is engaged in a study seeking to develop a holistic framework for measuring the success of ERP systems. The rationale for our project is based on (1) the belief that “nobody invests in ERP systems solely for the sake of improving business processes,” but to achieve better business results and (2) our finding that there is a lack of consensus and clarity in the literature about how to define the success of ERP systems. As part of this study, we analyzed an SAP implementation by a major international aircraft engine manufacturing and service organization, and it revealed that ERP systems impact the business objectives of the firm and the balanced scorecard approach can be adapted to build a holistic framework for identifying success measures that link to company’s goals and strategies. This research-in-progress paper reports our findings on balanced scorecard applicability for assessing the business contributions of ERP systems.

## 1 INTRODUCTION

ERP stands for Enterprise Resource Planning, and the term is used for any software system designed to support and automate the business processes of medium and large businesses. The complexity of implementing ERP systems is well noted and analyzed in the literature [(Ahituv, Neumann & Zviran, 2002), (Bhattacharjee, 2000), (Brown & Vessey, 2001), (Markus & Tanis, 2000), (Markus, Yanis & Fenema, 2000), (Scheer & Habermann, 2000), (Willcocks & Sykes, 2000)]. However, the problem of assessing the benefits of ERP systems is less well understood. Markus and Tanis (2000) suggest that ERP success should consider the firm’s motivations for implementing ERP systems and the time period when the benefits are assessed. Shang and Seddon (2000) suggest that there are different types of ERP benefits that can be classified as IT infrastructure benefits, operational benefits, managerial benefits, strategic benefits and organizational benefits. Rosemann & Wiese (1999) and Rosemann (2001) suggest that the balanced scorecard approach can be used to measure the performance of ERP systems. They view the ERP life cycle in terms of two phases, namely, ERP implementation and ERP use, and they suggest adapting the balanced scorecard dimensions to each

phase as an IT project. In summary, the key learning from the ERP success literature is that ERP benefits should be conducted at different points in time and each assessment should reflect the benefits to the timeframe under consideration.

The Balanced Scorecard, a technique developed by Kaplan & Norton (1996), is a powerful framework for translating qualitative business strategies into quantitative goals, and linking the strategies and goals to internal organizational actions via a robust set of key performance indicators. Several researchers [Martisons et. al. (1999), Van Grembergen & Van Bruggen (1997), Van Grembergen, Saull & Haes (2003)] have suggested that the balanced scorecard may help to evaluate the performance of information systems (IS) and to evaluate IT investments in a holistic manner.

Rosemann (2001) approach of defining an ERP balanced scorecard does not directly connect with the business goals and strategy of the organization because the customers of the ERP system in their approach are primarily the internal users of the organization, the business processes are the IT processes that support the implementation and operation of the ERP system, and the business objectives are the IT objectives for the ERP system. Rosemann and Wiese assume that the cascading balanced scorecards from the ERP systems level, to

the IT department level, to the organization level will link the ERP balanced scorecard to the organizational business objectives. We did not find this to be a satisfactory approach to measure the success of ERP systems. Instead, we decided to use a case study approach to analyze successful ERP implementations to study the impact of ERP systems on the customers, business processes, financial and the learning and innovation dimensions of the organizational balanced scorecard. Thus, the objective of this project is to develop frameworks for aligning ERP implementations and operations with strategic business objectives in a way that will maximize the value-added contribution of ERP systems to organizations.

We are just completing the pilot case study of an engine manufacturing and service organization that claims to be very successful in implementing the first six phases of its SAP implementation in the last three years. Our interviews with the IT managers and business managers brought out sample measures in all four categories of balanced scorecard that have been positively impacted by their ERP implementation thus far. The rest of this paper will describe the SAP implementation and sample organizational success measures that are positively impacted by the SAP systems.

## 2 SAP IMPLEMENTATION

SAP is the dominant ERP vendor. SAP is both a company, founded in 1972 and head quartered in Walldorf, Germany, and software that automates collaborative business processes for all types of industries and for every major market. SAP is being implemented in our case study organization using a phased approach, with a four year planned roll-out for each phase.

The goal of phase I was to demonstrate a quick success, and develop a trusting working relationship among the different SAP implementation partners. A newly acquired engine service depot was selected as the initial site for implementing SAP's materials requisition modules. This phase I implementation ran smoothly using the standard implementation methodology suggested by the business process consulting partner.

In phase II the company made a decision to implement the core financial models next. To avoid customization of SAP code, the company adopted an out-of-box implementation strategy with standard configuration. The financial models were implemented globally.

In phase III, the warehousing and parts tracking modules in SAP were implemented. The inventory tracking system is based on standard bar codes/scanner technology.

In phase IV, the front-to-back supply chain was automated at the initial site. In this phase, full order processing, engine and parts management, labor and material accounting, logistics, parts disposition and invoicing modules were implemented.

In phase V, full project management of engine production assembly was implemented in SAP. In this phase, the process of receiving an engine, giving it an overall inspection, tearing it down into modules, inspecting the modules, repairing parts or acquiring and replacing parts, and assembling, testing and shipping the engine back to the customer became paperless. This implementation also allowed links with external suppliers via an Internet portal.

The goal of phase VI was to deploy the full materials-requisition solution that was successfully implemented at the initial site to engine center sites 2 and 3. The lessons learned in phase IV enabled a very smooth deployment at the site 3 Engine Center.

The organization is now involved in deploying the component repair modules of SAP in all other globally located repair facilities.

## 3 SUCCESS MEASURES

The organization claims to be very happy with its ERP implementation efforts and outcomes. When we asked for specific measures that could illustrate the success of ERP in our case organization, company managers offered the following examples:

- On time delivery of overhauled engines improved from less than 50% to 95%;
- On time delivery of spare parts improved from 30% to 90%;
- The timeliness and availability of information improved dramatically;
- The reliability and integrity of data improved noticeably;
- Internal controls were tightened;
- Work stoppages, caused by lack of parts on the floor, dropped from several per month to an average of one-half per month;
- Enterprise-wide standardization of core finance modules now provides the same financial information to all the different stakeholders;
- The inventory availability rates increased from 60-70% to 95%;
- The cost of engine assembly process has been significantly reduced;

- The later phases of the ERP implementation were executed better than the earlier phases;
- The lessons learned from each phase are now captured, documented and managed across the enterprise;
- Refined training methods are enabling users to adapt to the system quickly and more effectively, mostly due to the innovative involvement of power users in the creation and delivery of training;
- Transfer of implementation process knowledge from external consultants to company managers was very effective.

It is interesting to note that these success measures fall in one or more of the four categories of balanced scorecard, as shown below:

#### Customer-Oriented measures

- On time delivery of overhauled engines
- On time delivery of spare parts

#### Business Process measures

- Timeliness and availability of information
- Reduction in work stoppages (Caused by lack of parts on the floor)
- Little or no business disruption when next ERP phase goes live
- Enterprise-wide standardization of the core finance modules

#### Finance

- Cost of inventory reduction
- Cost of engine assembly process

#### Learning and Innovation

- Later phases are better executed than earlier phases
- Capturing, documenting and managing the lessons learned from each phase
- Effectiveness of training in enabling users to adapt to the system quickly
- Early involvement of power users in the creation and delivery of training
- Knowledge transfer from external consultants into the company

## 4 FINDINGS

Although these examples of success measures in the four BSC categories suggest the applicability of BSC to the ERP domain, they are quite incomplete in the sense there are many more measures in each of the four dimensions. In addition, the granularity of these measures is uneven, and because a balanced scorecard is not just a compilation of all the measures it is not clear whether each of these measures should be included in a balanced

scorecard. However, these measures demonstrate the impact of the ERP system on the business objectives of the firm as discussed below.

### 4.1 Impact on business objectives via the business process category

In the engine service centers, the on-time delivery of engines improved from less than 50% to between 95 to 100%. Similarly, in the engine assembly process, work stoppages due to unavailability of parts dropped from several stoppages per month to an average of ½ per month. Also, the inventory is better managed now with the on-hand-and-available rate improving from 60-70% to 95%. In short, the ERP system has drastically improved productivity and has driven efficiency. Furthermore, the ability to mine corporate data has led to improved human resource planning, better investment spending and higher quality decision-making.

### 4.2 Impact on business objectives via customer category

A common requirement in the engine manufacturing and service business is *ad hoc* requests for a spare part. This happens every time an airplane has engine problem and local diagnostics reveal a part failure that needs replacement. Prior to the deployment of the ERP system, there was no way to directly track and locate the exact warehouse in which the required spare part is located, hence, customers had to call each warehouse individually until the part was located. This process took a significant amount of time and the delay costs were considerable. Today however, the ERP system shows every warehouse where each spare part is located, and this allows the customer to select and order delivery of the part from the nearest warehouse, thus improving the delivery time on spare parts. Similarly, the implementation of the ERP system in the engine service centers has streamlined the engine overhaul process leading to improved engine turn-around time to the customer. Thus the impact of process efficiency in this case is improved customer satisfaction.

### 4.3 Impact on business objectives via finance category

The company also indicated that the cost of doing business has been dramatically reduced. The

reduction of work stoppages, the timeliness of data availability and better controls have improved corporate performance and promoted labor efficiencies. Also, better inventory and supply chain management has resulted in decreased costs. Simultaneously, the ability to make accurate commitments to trading partners and improve turn-around time has increased the after market business, thereby resulting in increased revenues.

#### 4.4 Impact on business objectives via learning and innovation category

The end-user training process developed by the SAP business process consultants relied on the standard SAP business processes. The training materials were narrative, documented in very thick books and cumbersome. By phase III of the implementation, the organization realized that the training process was not effective because many interventions were required to get the users become reasonably proficient in using the new system. The organization developed a new innovative training process that required power users from each user groups to work with the new system for 4 - 5 weeks and help develop training materials for peers. A work-step instruction book with 10 pages of PowerPoint slides was developed for each module. Users were allocated to appropriate training classes where they sat in front of computer terminals in a classroom facilitated by the power user on selected production data to learn how to use the systems and its features. This new training process has been very effective and has replaced the old training process.

An example of learning and innovation in the user domain involves the design and modification of ERP input and output screen for the hourly workers. Most of the hourly workers are not computer literate and the multiple screen user interfaces of SAP were challenging for these workers. The implementation team developed simplified task-driven screens for this audience.

## 5 CONCLUSION

This research-in-progress paper has illustrated that ERP systems impact the business objectives of the firm and, therefore, the balanced scorecard approach can be used to assess the value and success of an ERP system. We have now developed a holistic business scorecard framework for identifying the

success measures for ERP systems. The details of this framework will be reported in our next paper.

## REFERENCES

- Ahituv, N., S. Neumann and M. Zviran., 2002. "A Systems Development Methodology for ERP Systems, *Journal of CIS*, Spring, 42, 3, pp. 56-67.
- Bhattacharjee, A., 2000. Beginning SAP R/3 Implementation at Geneva Pharmaceuticals, *CAIS*, Vol. 4, Article 2.
- Brown, C. and I. Vessey, 2001. NIBCO's "BIG BANG", *CAIS*, Vol. 5, Article 1.
- Kaplan, R. & D. Norton, 1996. The Balanced Scorecard: Translating Strategy into Action, HBS Press.
- Markus, L and C. Tanis, 2000. "The Enterprise Systems Experience—From Adoption to success." In R.W. Zmud (Ed.) *Framing the domains of IT research: Glimpsing the Future Through the Past*, Cincinnati, OH, Pinnafles Educational resources, Inc.
- Markus, L., C. Yanis, and P. C. van Fenema, 2000. "Multisite ERP Implementations," *CACM*, 43, 3, 42-46.
- Martisons, M., R. Davison & D. Tse, 1999. "The Balanced Scorecard: A foundation for Strategic Management Information Systems" *Decision Support Systems*, Vol. 25, 1, pp.71-81.
- Rosemann, M. & J. Wiese, 1999. "Measuring the performance of ERP software: A Balanced Scorecard Approach," *Proceedings of the 10<sup>th</sup> Australasian Conference on Information Systems*, Wellington,
- Rosemann, M., 2001. "Evaluating the Management of Enterprise Systems with the Balanced Scorecard." In: *IT Evaluation Methods and Management*. Ed. W. van Grembergen. Idea Group Publishing, pp. 171-184.
- Scheer, A. & F. Habermann, 2000. "Making ERP a Success," *CACM*, 43, 4, 57-61.
- Van Grembergen, W. and R. Van Bruggen, 1997. "Measuring and improving corporate technology through the balanced scorecard technique," *Fourth European Conference on the Evaluation of Information Systems*, Delft, 163-171.
- Van Grembergen, W. R. Saull, and S. De Haes, 2003. "Linking the IT balanced scorecard to business objectives at a major Canadian Financial group," *JITCA*, 5, 1, 23-45.
- Willcocks, L. & R. Sykes, 2000. "Multisite ERP Implementations," *CACM*, 43, 4, 32-37.