EXPLORING THE INFORMATION GAP BETWEEN ENTERPRISE RESOURCE PLANNING SYSTEMS AND THE STRATEGIC MANAGEMENT PROCESS

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Abstract

In light of their success to solve information-related problems, Enterprise Resource Planning (ERP) systems have gained popularity within the business community. Their ability to fulfill the information requirement in the operations management domain has been well accepted; however, some recent studies suggest that ERP systems only partially satisfy the information needs of a regular Strategic Management Process (SMP). In this paper, we study the extent and nature of the gap between the information provision by ERP and the information requirement in SMP. We adopt a management control system approach and use two control systems, Profit Planning Systems (PPS) and Balanced Scorecard (BSC) to derive the information requirement in SMP. These requirements are contrasted with the information typically available through an ERP system. A mapping of these two information sets clearly reveals an information gap. In summary, most external information about customers, competitors, general economic, and some internal information about employees required by SMP is absent in ERP. This study contributes to a better understanding of ERP's role in the strategic management domain. It also enables IS designers to explore the feasibility of modifying ERP to better support strategic management activities.

1 Introduction

Since their emergence in the early 1990s, Enterprise Resource Planning (ERP) systems have evolved with emerging technologies to integrate isolated multiple information systems and to improve organizations' operations efficiencies. Over the years, much has been learned about the success of ERP systems. Many researches and industry experts claim that ERP provides tremendous support for business planning and organizational objectives (Prasad & Maneesh, 1999; Craig, 1999). However, this is only one side of the ERP story.

In the late 1990s, some researchers began to question ERP's ability to fully satisfy the information requirement in the strategic management domain. Their studies suggest that ERP systems only partially fulfill the information requirement of the Strategic Management Process (SMP), an important managerial activity in organizations (Hoven 2001; Li, 1999). Although these studies, based on empirical experience, industry surveys, or viewpoints of market analysts, provide us with important perspectives, the extent and nature of the gap between SMP's information requirement and ERP's information provision remains unclear for both academic researchers and ERP vendors.

An understanding of the nature and scope of this gap is important in helping us better comprehend and predict the role of ERP in the strategic management domain. It also enables IS designers to explore the feasibility of modifying the design and structure of ERP systems to fully meet the information needs in SMP.

A strategic management process prompts actions that lead to the accomplishment of organizational goals. In recent years, extensive research (e.g. Langfield-Smith, 1997; Simon, 1990; Bealin & Boltin, 2002) has been conducted in the area of strategic management process and the control systems. However, their studies lack a focus on the information component of the process. Lester Digman (1990) attempted to summarize SMP's information requirement by summarizing Critical Success Factors (CSF) and analyzing their information needs. However, there is no theoretical basis for his choice of the CSF. It is our contention that a more sound approach to derive a complete set of information requirement in SMP is to first obtain a list of control variables through adopting a set of control systems that in combination represent the whole SMP; then summarize the information required to determine the value of these variables.

Thus, in this study, we analyze SMP from an information perspective and apply two commonly used strategic control systems, Profit Planning Systems (PPS) and Balanced Score Card (BSC) to study the information requirements in the two stages of the strategic management process. To reveal the gap between ERP's information provision and SMP's information requirement, we compare this list of information requirement with the list of information provision that we obtained by combining the information provided by the modules of SAP and Oracles' ERP products.

A comparison of the two information sets clearly reveals an information gap. Our principal conclusion is that ERP provides abundant internal and external operational information, but is unable to fulfill the information requirement in strategic management domain. More specifically, much external information about customers, competitors, general economic conditions and some internal information about employees required in SMP are absent in ERP.

2 ERP Systems

ERP is defined as module-based integrated software packages that control all the personnel, material, monetary and information flows of a company (Granlund & Malmi, 2002). Viewed as a company-wide information system that integrates all aspects of a business, ERP promises one database, one application, and a unified interface across the entire enterprise. Currently, ERP systems have open client/server architectures and are real-time in nature (Prasad & Maneesh, 1999). This allows users to access the same information almost instantaneously through one unified user interface.

The concept of ERP represents a significant step forward in the history of Information Technology. Historically, business processing was considered to be simply data or transaction processing. The proliferation of ERP systems pushed IT from a restricted business-reporting scenario to a much larger and more complex realm of business planning. Jacobs & Bendoly (2003) pointed out that ERP systems should not be viewed simply as traditional information tools that have a fixed and measurable output. Instead, ERP is a technological infrastructure designed to support the capability of all other tools and processes used by a firm.

Although the current ERP systems have greatly improved the quality and availability of information, some problems still remain unsolved. Little is understood about how and in what way enterprise managers rely upon ERP. Granlund and Malmi (2002) concluded that there has been no major direct impact so far by ERP systems on management accounting and

management control systems of a firm. This is surprising because, logically, since ERP systems can be viewed as the repository of information about the enterprise, it would seem that such systems should play an important role in strategy management and control. Li (1999) suggests that the information ERP currently provides is mostly limited to "internal information". External information that is critical to a company's success in light of increased strategic uncertainties (Simons 1990) such as globalization and mergers and acquisitions) is ignored by ERP.

Our conceptual hypothesis is that there exists an information gap between the information typically available from ERP systems and that required in the SMP. This gap has not been fully described in the previous literature. A first step to understanding this gap is to examine what information ERP does and does not provide.

ERP Packages and Their Information Provision

Since ERP systems are normally large and complex, a well-designed ERP system will have separate packages to control data related to each aspect of an enterprise's operations while still providing an overall or integrated view of the entire enterprise. According to an ERP survey of Swedish manufacturing firms (Olhager & Selldin, 2003), the current commercial ERP packages mainly include the integration of such information flows as financial and accounting information, human resource information, supply chain and operation information, as well as customer information.

In Table 1, we summarized a list of information ERP provides within each package and module. The four packages and their corresponding modules, as listed in the first and second column of this table, are summarized based on Umble et al. (2003)'s work. Such classification is also adopted by most ERP vendors, such as SAP and Oracle. The third column outlines the information items provided by each module. We obtained this list by searching through SAP and Oracle's publication and product descriptions, summarizing and combining the information provisions by these modules.

Package	Modules	Information Provided
Financials and Accounting	Accounts receivable and payable	Records of customer and vendor accounting data collected from business transaction.
	Asset accounting	Analysis of fixed assets according to accepted rules
	Cash management and forecasting	Cash transactions, opening and closing balances, cash flows, and the receipts and payment totals
	Cost-element and cost-center accounting	Actual costing expanding upon the functionality of the application components
	Financial consolidation	Financial statements, and comparison between assets and capital
	General ledger	Records of all business transactions, inventory values, and all goods movements
	Product-cost accounting	Cost information broken down by each step of the production process
	Profitability analysis	Evaluation of market segments and business areas
	Profit-center accounting	Profit or loss from internal areas of responsibility
	Standard and period-related costing	Real-time information about the costs of goods manufactured in all plants
Human Resources	Human-resource time accounting	Information about employees' time accounts
	Payroll	All payroll information and processes
	Personnel planning	Personnel data, job requirement, job identification, and employee development
	Travel expense	Information about travel expense
Operations and Logistics	Inventory management	Goods receipts, goods issues, stock categories and stock information
	Materials management	Contract management, inventory controlling, and etc.
	Plant maintenance	Preventive maintenance and inspection of the equipment
	Production planning	Production plans across multiple locations, customer demand, product standard, and requirements of resources
	Project management	Business requirement, expectations, capacity and production rate, and project schedule
	Purchasing	Demand plan, supply network, and vendor-managed inventory accounts
	Quality management	Completeness and correctness against standards, defined production process, standardized format
	Routing management	Daily management information
	Shipping	Controlled distribution of sales, and goods delivery information
	Vendor evaluation	Information about suppliers
Sales and Marketing	Order management	Records of orders, and balance between orders and production
	Pricing	Pricing schedules
	Sales management	Sales performance, key customer relationships, and key sales indicator, such as order values and sales revenues
	Sales planning	Schedule and evaluation of sales

Table 1 the scope of information provision by an ERP system

3 The Strategic Management Process and Its Information Requirement

In this section, we define SMP from an information perspective and study its information requirement through the lens of management control systems.

Strategic Management Process (SMP)

Corporate strategy refers to how a company competes in a given business environment and positions itself among its competitors (Simons, 1990). In general, SMP is the organizational procedure of transforming an organization's mission or objective into a strategy and controlling the implementation of that strategy to accomplish its original goal.

Figure 1 illustrates the strategic management process from an information perspective. It describes how an organization's missions and objectives are transformed into intended strategies and subsequent realized strategies. The whole process starts with a corporate mission and vision and goes through two major stages, strategy formulation and strategy execution. Rather than a straightforward process starting from planning and ending with implementation, the strategic management process is circular.

The first stage, strategy formulation is a planning process that transforms an organization's mission into strategic plans. It involves the development, evaluation, and selection of intended strategies. Internal and external information provides management with a basis for formulating strategies that would capitalize the organization's strengths, overcome the weaknesses, utilize the external opportunities, and avoid potential threats. The second stage, strategy execution involves activities that translate intended strategies into actions. The incorporation of internal information on performance and external information on emerging changes in the external environment allows management to initiate any modifications to the original strategy in order to achieve intended goals.

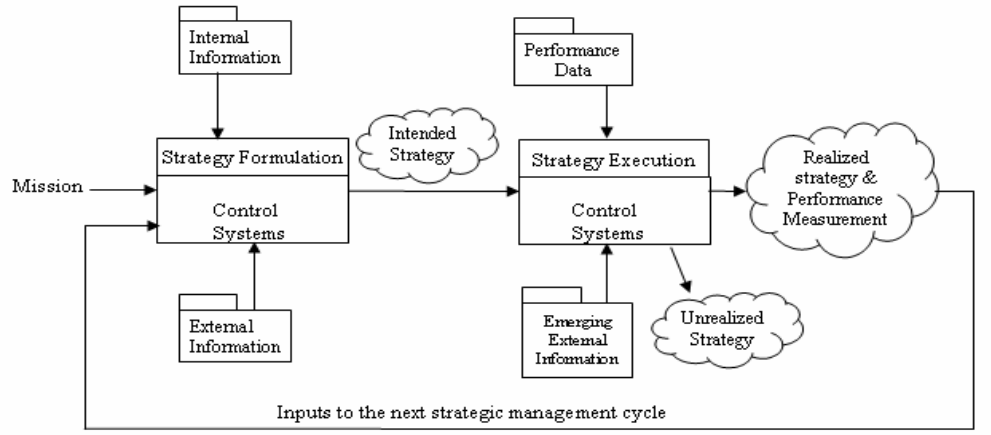

Figure1 Strategic Management Process

Selecting Strategic Control Systems

Extensive amount of internal and external information is needed throughout the strategic management process. However, the SMP model itself does not suggest what information is required to formulate and implement strategies. In both stages, specific strategic control

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systems are employed to ensure that resources are obtained and used effectively to accomplish the organization's objectives. For instance, ABC costing system, budgeting system, asset acquisition systems are used in the formation stage; total quality control systems, brand revenue systems, business excellence model, intelligence systems, and market share monitoring systems are often used in the execution stage. These control systems use control variables to monitor the formation and execution of strategies. When these control systems and their control variables are selected wisely and monitored properly, they can improve the probability that the organizational strategies are developed and implemented despite the unpredictable and dynamic business environments. Specific information items are required by each control variable to operate the control system and monitor strategy formation and implementation. Thus, one approach to derive the information requirement in SMP is to select proper control systems that in combination represent the whole SMP and study their information requirement.

Furthermore, there are many control systems that a company can choose in each stage of the SMP based on its specific needs, and studying the information needs of all existing control systems is impractical. Thus, in this study, we choose two control systems, Profit Planning Systems (PPS) and Balanced Scorecard (BSC), to represent the two stages of the strategic management process and then study the information needs from the two systems.

Building a profit plan is the planning activity that all profit-seeking organizations will perform regardless of their different nature and specific goals. Although companies may choose other control systems in the strategic planning stage, for instance, a production planning system or an asset acquisition system, these planning activities are included in the process of profit planning. Thus, studying the information needs of PPS is sufficient to cover the information requirement in the strategic planning stage of the SMP.

Along the same line, many control systems can be used to monitor strategy implementation. However, these control systems are similar in nature and their information requirement often overlaps. Among these control systems, BSC is the most widely accepted and frequently used. To implement a BSC requires a large set of information that is inclusive of other competitive control systems. Thus, studying the information requirement of BSC is sufficient to summarize the information requirement in the strategic implementation stage of SMP. In conclusion, by analyzing the information needs of PPS and BSC, and combining their information requirements, we can therefore describe the major internal and external information that is involved in strategic management process.

Information Requirements in PPS

A profit plan creates a foundation to link economic goals with leading indicators of strategy implementation. It is often used to formulate strategy and translate goals into strategies. A profit plan development process involves determining the values of five decision variables: (1) estimated sales and production (2) estimated operating expenses (3) asset investment projection (4) cash flow analysis and (5) profitability ratio analysis. Extensive external and internal information is required in determining the values of these variables (Simons, 1999).

Table 2 describes the scope of the information required to perform profit planning. (a more specific list of information will be provided later in Table 4). Since later we will compare this information needs with the information provisions by ERP (as summarized in Table 1), here we map the information needs into four categories as we did earlier in Table1. These four

categories are Financial and Accounting, Human Resource, Operations and Logistics, and Sales and Marketing.

Decision Variables	Determinants	Required Information Type
Budgeted sales and productions	Historical sales level	Sales & Marketing Technology & Innovation
	Estimated demand	
	Estimated product price	
	Customer price sensitivity	
	Brand loyalty	
	Price level of competing products	
	Market share and competitiveness	
	Technology advancement	
	Sales seasonality	
Forecast expenses	COGS	Finance & Accounting Operations & Logistics Human Resources
	Labor market condition	
	Material market condition	
	Government regulation	
	Environmental factors	
Asset investment plan	Economic useful life of existing and new assets	Finance & Accounting Operations & Logistics Human Resources
	Technology advancement	
	Labor adaptability to new technology	
	Acquisition costs	
	Available founding	
	New product development plan	
Cash flow analysis	Balance in Cash, A/R, A/P accounts	Finance & Accounting Sales & Marketing Human Resources
	Debtor and creditor payment policy	
	Employee payroll policy	
ROE and profitability analysis	Fixed and variable assets	Finance & Accounting
	Equity	
	Sales revenue	

Table 2 Scope of Information Requirement in PPS

Information Requirement in BSC

Kaplan and Norton's Balanced Scorecard (BSC) is the most frequently used control system to monitor the implementation of strategies in the strategy execution stage. BSC categorizes performance measures into four perspectives: financial perspective; customer perspective; internal business perspective; and innovation and learning perspective (Kaplan & Norton, 1996). The financial perspective focuses on examining how we appear to shareholders; the customer perspective ensures that the organization is serving its customers well; the internal business process perspective urges managers to identify the critical internal processes for which the organization must excel in implementing its strategy; and the learning and growth perspective focuses on measuring and inspiring technological advancement and product/process innovation.

According to Kaplan and Norton (1996), a major step in creating a BSC is to analyze the measurability of many performance variables: the ones that are not measurable are discarded regardless of their usefulness. Thus, information plays a significant role in measuring the critical performance variables and ensuring that each perspective is well monitored. The following table summarizes the scope of information requirement underlying a "generic" balanced scorecard.

Perspective	**Critical Performance Variable**	**Required Information Type**
Financial	Profitability	Finance & Accounting
	Payback Period	
	Cash Flow	
	ROE, ROCE, ROA, ROI	
Customer	Customer Satisfaction	Sales & Marketing
	Customer Loyalty	
	Customer Relationships	
Internal Process	Cycle time measures	Operations & Logistics Human Resources
	Quality Index	
	Supplier Relation	
	Employee Satisfaction Index	
Training and Innovation	Continuous Improvement	Human Resource Operations & Logistics
	Product & Service Innovation	
	Workforce Empowerment	

Table3 the Scope of Information Requirement in Balanced Scorecards

4 The Information Gap

By combining the information requirements of PPS and BSC and eliminating the duplicates, we can now obtain a full list of information requirement in SMP. We identify a set of more specific information items based on the variables we have summarized in the former section. To compare the information requirement in SMP and information provision by ERP, we map the two information sets by category. For every information item required in SMP, we examined whether it is provided by or may be derived from ERP packages. The result of this comparison is provided in Table 4. The first column of the table lists the four information categories; the second column summarizes the information items in SMP within each information category; and the last column indicates whether these information items are provided by the corresponding ERP packages. We group the information items in the second column according to whether they are provided by the corresponding ERP packages to highlight the information gap within each information category.

Information Category	Information Requirement (SMP)	Information Provision (ERP)
Finance & Accounting	Sales revenue and sales returns	YES
	COGS	
	Selling and admin expenses	
	Other expenses	
	Operating profit	
	Balance in A/R, A/P, cash Account	
	Cash collection/disbursement schedule	
	Cash disbursement schedule	
	Late/on-time payment	
	Balance in assets/liability, equity	
	Financing agreement	
	Assets amortization schedule	
	New asset investment plan	
	Financing plan	
	Income tax	
Sales & Marketing	Existing customer profile	YES
	Current market share	
	Profitability analysis by customer groups	No
	Changes in customer preference	
	Customers' response to marketing campaigns	
	Brand image and customer loyalty	
	Emerging customer payment behavior	
	Service reliability	
	Elasticity of demand	
	Empathy and trust	
	Quality reviews	
	Degree of customer concentration	
	Multidimensional customer expectations	
	Number of direct and indirect competitors	
	Form of competition	
	Location of Competitors	
	Technological advancement of competitors	
	Competing product characteristics	
	Competitor brand loyalty and customer base	
	Likely competitor moves	
	Emerging competitors and their new products	
	Competitors' marketing-related emerging strategies	
Operation & Logistics	Inventory management	YES
	Material management	
	Production plans, project schedule	
	Production rate	
	Supplier information	
	Supply management	
	Plant maintenance	
	Supplier account payment policy	

Information Category	Information Requirement (SMP)	Information Provision (ERP)
	Delivery statistics	
	Waiting times	
	Inspection time	
	Throughput time	
	Valued-added time	
	Non-value-added time	
	Conformance to specifications	
	Conformance to cost budget	
	Rework required	
	Percentage/cost of scrap	
	Percentage of items returned to vendors	
	Vendor performance rating	
	Out-of-stock percentage on key items	
	Rate of process improvements made	
	Quality improvement program	
	Number of new products developed	
	Labor intensity	NO
	Labor adaptability to new technology	
	Marketing intensity	
	Discretionary cash flow	
	Emerging supplier relations	
Human Resources	Absenteeism	YES
	Payroll information	
	Job requirement and identification	
	Employee performance profile	
	Complains/grievances	
	Retention	
	Employee morale	NO
	Employee job satisfaction	
	Intellectual capital	
	Industry level of labor education and work efficiency	

Table 4 the Information Gap

According to Table 4, ERP does a good job in providing information about finance and accounting as well as operation and logistics. Such information is mostly internal and operational in nature and is easily captured and stored by ERP systems. However the opposite is true when it comes to sales and marketing: most information about customers, competitors and the business environment required in SMP is absent in ERP. Such information is mainly external and contemporary in nature. It is generally concerned with the outside business environment which may change rapidly and its effect on a company is uncertain. Yet, we have to note that this is not to say ERP provides all internal information that SMP requires. Specifically, ERP fails to deliver sufficient internal information about employees. Such absent information includes intellectual capital and employee morale or job satisfaction. Consequently, due to the significant information gap, SMP cannot totally rely on ERP systems for all its information needs.

5 Conclusion and Future Research Directions

The objective of this research was to describe the information gap between ERP and SMP from a conceptual perspective. We summarized ERP's information provision by combining the information provided by the modules of SAP and Oracles' ERP products. We then analyze SMP from a control system perspective to describe the information requirement of SMP. Two commonly used strategic control systems, Profit Planning Systems (PPS) and Balanced Score Card (BSC), were chosen to represent the two stages of the strategic management process. The key control variables of these two systems are analyzed to derive the information requirement to operate these control systems. We then summarized and combined the information requirement of these two control systems to derive the information requirement in SMP.

Our study results suggest that although ERP may be efficient in allocating resources within an organization, it is not efficient in coordinating an organization's activities to its business environment. There exists a clear information gap. Typical ERP systems do not provide sufficient external information about customers, competitors, suppliers, general economic and some internal information about employees as required by SMP. The extent and scope of this information gap, as described in Table 4, can help both ERP researchers and ERP vendors to determine how ERP systems may be improved to better meet the information requirements of organizations' strategic management process.

Our study points to several promising directions for future research. First, an empirical study to investigate whether and if so how companies are using ERP systems to support their strategic management process can be conducted. Second, the literature on ERP is replete with accounts of major implementation failures. On the other side, there is also a growing literature on the challenges of implementing the BSC. To what extent is the information gap described in our paper is a contributing factor in these situations? A study that seeks to answer this question will bridge the information systems and management accounting fields and can help advance our knowledge in both of these disciplines.

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