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Assessment & Justification of Data Warehousing from A Competitive Advantage Perspective*

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〈목 차〉

Ⅰ. Introduction

Organizations have been generating and accumulating mountains of transaction data for years. Although data are usually a by-product of business transactions, data, in a sense, can be conceived as a strategic asset of organizations since they are perhaps the only genuinely unique asset which can not be replicated by competitors. Therefore, data can be a true source of competitive differentiation in today's globalizing and dynamic business environment. However, because of the technological difficulties in consolidating data into useful information, much of the data that accumulate in transaction systems have not been easily accessible or had much meaning to users. This phenomenon has resulted in limited exploitation of these data for profitability enhancement, market share increase, and potential new product and service opportunities.

In today's competitive and turbulent market environment, organizations are eager to seek strategic tools to help them make more informed business decisions which will put them on competitive edge for at least a short period of time or help them stay in their

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business. As a way of achieving this goal, many organizations have been investing a considerable amount of resources in a variety of information systems. However, despite all the investments and efforts in information technology (IT) to enhance their performance, many organizations have experienced a "productivity paradox" (Brynjolfsson, 1993; Brynjolfsson et al., 1994; Brynjolfsson and Hitt, 2003). Therefore, careful and thorough assessment and justification is called for before making a commitment to a new IT project.

Data warehousing allows users to navigate large organizational databases in an ad hoc, interactive fashion without impacting mission-critical operational systems. In addition, as the perception of data warehousing as an essential database enabler to support fact-based decision-making (Gray and Watson, 1998; Inmon, 2005) is proliferated, organizations across industries have implemented data warehousing to support decision support systems (DSS) and business intelligence (BI) applications as well as customer relationship management (CRM) and data mining. The popularity of data warehousing is well reflected in the fact that the data warehouse tools market is estimated about $9.6 billion in 2005 and projected to grow more than 10% annually thereafter (Vesset, 2006).

Even with the potential and popularity of data warehousing, studies reveal somewhat contradicting outcomes of data warehousing projects. A survey (Zimmer, 1996) shows that "more than 50 percent of the data warehouse projects are considered to be failures or, at the very least, unsuccessful after 18 months," whereas another study reports an 80% of success rate for real-time data warehousing and business intelligence (BI) solutions (Anonymous-1, 2006). Therefore, considering the contradicting success rates of and large amounts of investment required for data warehousing projects, justification of data warehousing could be one of the major challenges faced by IT managers as well as business managers.

Although it is estimated that building a typical data warehouse costs an average of $1.8 million (Raizada, 2006), studies show that only 9% of organizations have performed an return-on-investment (ROI) assessment of their data warehousing and BI projects (Anonymous-2, 2006) and the business justification for data warehousing has never been fully developed (Chenoweth et al., 2006). Some organizations perform only cost analysis and intuitive benefit analysis for their data warehousing projects (Watson and Haley, 1997). This phenomenon could be attributed to the fact that it is difficult to determine the actual benefits of the data warehousing since it is a IT infrastructure, not an application in itself.

Many organizations consider data

warehousing a strategic investment of IT infrastructure to obtain competitive advantages (Wixom and Watson, 2001; Shin, 2003), but there has been little systematic analysis on justifying data warehousing projects from a competitive advantage point of view. Thus, this study attempts to provide organizations considering data warehousing with a conceptual model for evaluating and justifying their data warehousing projects from a competitive advantage point of view. This study focuses on the question: What kind of DSS and BI applications can be the most justifiable candidates for a data warehousing project from a competitive advantage point of view?

This study is organized as follows. In the next section, the existing literature is discussed. Then, the cases used for this study are analyzed and summarized, and the commonalities among them are identified by applying the concept of competitive advantage. A framework for justification of data warehousing is proposed, and then discussed and illustrated with some real-life cases. Finally, conclusion and contributions of the study are discussed and future research agenda are suggested.

Ⅱ. Existing Literature

Ahituv (1980) classified information system evaluation approaches into two categories; 1) pragmatic assessment such as cost-benefit analysis (CBA), and 2) theoretical evaluation based on decision theory. However, since it is generally agreed that the utility or benefit gained by using an information system is not a unidimensional function, Ahituv (1980) suggested to use a joint utility function in assessing the value of an information system. He also argued that when evaluating the impact or benefit of an information system, organizations must address three fundamental issues: 1) whose value should be evaluated?, 2) what type of value should be measured?, and 3) who is performing the evaluation and when?

Benaroch and Kauffman (1999) showed that option pricing models could be a useful tool in evaluating an IT project investment, since an IT project embeds a real option when it offers management the opportunity to take some future action such as abandoning, deferring, or scaling up the IT project in response to events occurring within the firm and its business environment. They also argued that IT infrastructure investments such as data warehousing and wireless technological infrastructure are often made without any immediate expectation of payback. But, they can trigger a follow-up investment that converts investment opportunities into option's underlying asset, the operational IT projects that support a specific business

process or function which yields measurable revenue.

Peacock and Tanniru (2005) claimed that the reason for the inherent difficulty in justifying IT investments are twofold. First, it is often difficult to arrive at the true costs of some along a common metric. Secondly, there is increasing skepticism regarding the value they provide, primarily due to the fact that many investments are impacting the bottom-line measures only indirectly. Furthermore, organizations have not been effective in relating the investments to profitability through appropriate allocation mechanism. Therefore, to overcome the limitations of previous approaches to evaluating IT investments, Peacock and Tanniru (2005) developed a model based on ABC approaches that can relate IT project investments to the performance of a specific activity. They argue that ABC approaches can be very effective in justifying the investments in IT projects that are intended for a specific (focused) activity and have a low complexity of performance metrics. However, they contend that when the application of IT project (resource) is focused but the measurement complexity is high, ABC approach is not appropriate.

Clemons (1995) argued that since developing a strategic IT application is significantly different from IT investments undertaken to automate the back office to reduce expenses, organizations must consider alternative approaches to evaluating strategic investments in information technology. He made a number of suggestions, such as ranking alternatives, balancing many forms of risks, and managing the risks, for evaluation of strategic investments in information technology like decision support systems, since many of the benefits of decision support systems are difficulty to measure and intangible. Keen (1981) also suggested the use of "value analysis" for justification of IT investments, especially for decision support systems, focusing on the value from the use of the system first and cost second.

In an attempt to gain a competitive advantage, some organizations are motivated to be the first implementor of new information technology. However, the first implementor is usually exposed to a high level of risk and the costs of implementing the new information technology decline over time. On the other hand, for other organizations, there is also an incentive to delay implementation of the new technology in order to avoid the high risk associated with the new technology. Therefore, organizations must evaluate this trade-off and choose the best implementation timing to reduce the implementation costs while gaining a decent amount of competitive advantage. To deal this dilemma effectively, Post et al. (1995) developed mathematical models that can help organization evaluate

strategic information systems and choose the best implementation strategy in terms of timing and costs. They found that many small firms opt for a cost-reduction strategy while larger firms choose a competitive strategy, in part due to the capital requirements for an IT implementation.

Organizations usually have limited amount of resources to invest in any aspect of their business. By the same token, they can invest only a certain amount of resources in IT projects. Therefore, management has choices to make and the decision process should be understandable and meaningful to both business and IT managers. Shelly et al. (2006) categorize the benefits of information systems into tangible and intangible. Ahituv et al. (1994) contend that "the benefits of information systems for middle- and top-level management are seldom tangible." Despite the alleged high ROIs on data warehousing (Rigney, 1996; Farrell, 2004), many of the benefits of data warehousing are difficult to measure because a data warehouse is actually a database component of DSS and BI applications such as CRM and data mining intended for middle- and top-level management or knowledge workers. In addition, Adelman and Moss (1999) claim that "the effects of costs and revenues may be difficult to assign to the impact of data warehousing." Furthermore, reported high ROIs vary significantly from one study to another (Rigney, 1996; Farell, 2004) and, in many cases, benefits cannot easily be converted to dollar terms, simply because DSS provide "better, more timely information."(Sprague and Watson, 1996) and because the benefits often ripple through the organization to the bottom-line at a much later time (Peacock and Tanniru, 2005).

When IT investments are infrastructure in nature such as data warehousing that affects many applications in various functional areas, organizations often treat them as overhead. In other words, IT infrastructure investments are general in their application and the complexity of their performance metrics is high, so that activity-based costing approach is not appropriate for data warehousing (Peocock and Tanniru, 2005). Although it is claimed that option pricing models could be a useful tool for justifying IT infrastructure investments ((Benaroch and Kauffman, 1999), they also have limitations in their application in data warehousing because it is difficult to estimate *ex-ante* the costs and benefits associated with the IT applications that would use data warehousing as their database component.

Traditional approaches such as net present value (NPV), payback period, and ROI are useful in justifying IT investments for transaction-based applications. However, traditional approaches that fail to incorporate the dynamics of customer response, rivalry,

and the dynamics of IT industry will tend to make incorrect assessment for strategic IT applications (Post et al., 1995; Peocock and Tanniru, 2005). Thus, existing approaches alone may not be appropriate for assessing and justifying investments in IT infrastructure such as data warehousing. Keen (1981) also points out the weaknesses of the traditional CBA approach to measuring IT value and suggested the use of "value analysis" for DSS justification. Therefore, a complementary method is needed to help businesses and IT managers make more informed decisions on assessing and justifying data warehousing projects. Furthermore, because data warehousing is considered a strategic investment to get competitive advantages, a non-traditional approach derived from a competitive advantage point of view could be a useful tool for organization in assessing and justifying data warehousing projects and thereby complement the traditional approaches to IT investment evaluations.

Ⅲ. Analysis Methodology

Twenty-six successful data warehousing cases from fifteen different industries, in a time span of 1992-2006, were collected mainly from popular IT-related trade journals. To be included, a case has to address usage of data warehousing along the "value activities" of Porter and Millar's (1985) value chain model. Detailed descriptions of the cases are available in Appendix. According to Porter and Millar's (1985), a firm's activities can be classified into primary activity and support (secondary) activity. They further contend that the value chain model can be used as an analytical framework to disintegrate a firm into technologically and economically distinct, but interdependent activities that can add value to its raw materials and bring the firm's product or service to the customer. Therefore, the concept of the value chain model enables a firm to analyze where and how it can add value to its' products or services and where it can reduce costs. In other words, the value chain model can help a firm identify strategic opportunities as well as IT opportunities, since IT applications can be utilized in support of both primary and secondary activities. By the same token, the contribution and strategic uses of data warehousing can be better understood and identified by using the value chain model.

After a thorough analysis of the cases adopted for this study, the contribution and strategic uses of data warehousing are plotted along the activities of the value chain model by industry in <Table 1>. One obvious point is that among the various activities in the value chain, the most prominent area for competitive advantages derived from data

<Table 1> Summary of strategic uses of DW along the simplified value chain activity

Industry	Product/Service Development or Differentiation	Manufacturing (Operations)	Distribution (Logistics)	Marketing & Service
Airline		X		X
Apparel			X	X
Banking	X	X		X
Credit Card	X			X
Education		X		X
Food				
Health Care		X		X
Investment & Insurance	X	X		X
Manufacturing		X		X
Parcel Delivery		X		X
Personal Care Products			X	X
Public Sector		X		
Retail Chain			X	X
Steel		X		X
Telecom.	X	X		X

warehousing seems to be the marketing function for trends analysis, buying patterns, and sales promotions. As described in the Appendix, data warehousing has been widely accepted and used by many organizations across industries and it has shown strategic usefulness in various functional areas of an organization. A summary of strategic uses of data warehousing in various functional areas by industry is presented in <Table-2>.

Parker et al (1988) classified the value of IT into six categories: 1) ROI, 2) strategic match, 3) competitive advantage, 4) management information, 5) competitive response, and 6) strategic IS architectures. They define competitive advantage as "the value derived from creating a new business strategy, a new product, or a new approach to overcoming a competitive force or hurdle." The competitive advantage dimension assesses the degree to which the proposed IT project provides an advantage in the marketplace. That is, competitive advantage focuses on the competitive value of computing and IT to the line of business and enterprise. Porter and Millar (1985) also assert that a new IT technology can transform not only the nature of products or services, but also the competition in an industry and they identified three basic objectives that a company must

<Table 2> Summary of Strategic Uses of DW in Functional Areas

Industry	Functional Areas of DW Uses	Uses of DW on DSS and BI for Competitive Advantages
Airline(2)*	Operations, Marketing	Crew assignment, Aircraft deployment, Mix of fares, Analysis of route profitability, Frequent flyer program
Apparel(1)	Distribution, Marketing	Merchandising, Replenishment
Banking(3)	Product development, Operations, Marketing	Cost Management, Customer service, Trend analysis, Promotions, Reduced IS expenses
Credit Card(2)	Product development, marketing	Customer service, New information service, Fraud detection
Education(2)	Operations	Planning and analysis of productivity, Student financial aid, Admission effectiveness, Research fund management
Food(1)	Marketing	Sales promotions
Health Care(2)	Operations, Marketing	Reduced operational expenses, Customer service
Investment & Insurance(3)	Product development, Operations, Marketing	Cost management, Risk management, Market movement analysis, Customer tendency analysis, Portfolio management
Manufacturing(2)	Operations, Marketing	Trend analysis, Product performance, Tax and accounting management
Parcel Delivery(1)	Operations	Cost management, Customer service
Personal Care Products(1)	Distribution, Marketing	Distribution decision, Product promotion, Sales decision, Pricing policy
Public Sector(2)	Operations	Intelligence gathering, Tax revenue management
Retail Chain(2)	Distribution, Marketing	Trend analysis, Buying pattern analysis, Pricing decision, Inventory control, Sales promotions, Optimal distribution channel
Steel(1)	Operations	Pattern analysis (Qulaity control)
Telecom.(1)	Product development, Operations, Marketing	Promotions, IS budget management, Profitability analysis

* The number in parentheses indicates the number of cases analyzed in this study from the industry

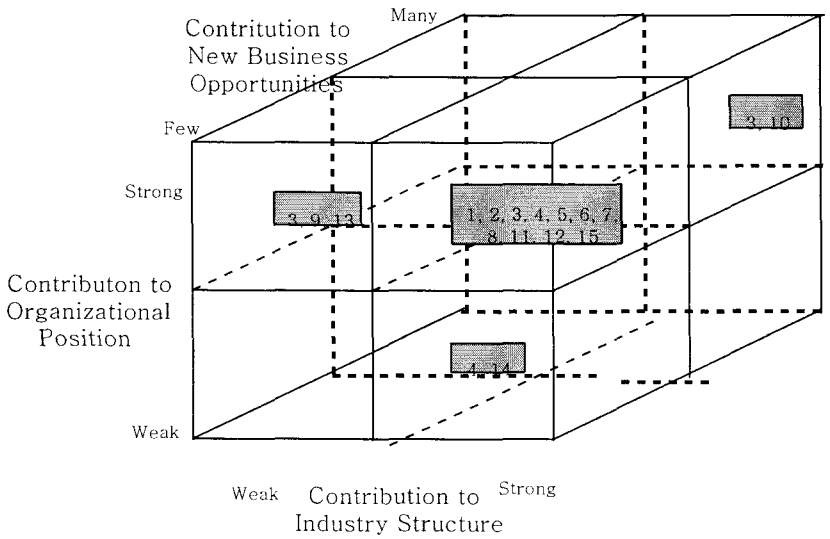
achieve if it is to gain a competitive advantage, which also measures the extent to which an IT project contributes toward the following goals:

1. Altering the industry structure by changing the degree to which buyers, suppliers, new entrants, substitutes, or rivals influence competition.
2. Improving the organization's position in its existing businesses by differentiating its products or services, or changing the competitive scope of its business.
3. Creating new business opportunities su ch as the sale or use of information as a by-product of the current business and the use of internal information processing

capabilities to start a new line of business.

Since data warehousing is considered by many organizations as a strategic investment of IT infrastructure to get competitive advantages (Wixom and Watson, 2001; Shin, 2003), we can anticipate some competitive advantages by successfully implementing a data warehousing project. To identify the potential sources of competitive advantages deriving from data warehousing, a framework was constructed based on the above three basic objectives of an organization and then the cases were plotted into it <Figure 1>.

As shown in <Figure 1>, data warehousing can affect competition in three dimensions: changing industry structure, improving organizational position in existing businesses, and creating new business opportunities. According to the analysis of the cases analyzed for this study, except for the banking and credit card industries, data warehousing does not seem to provide many new business opportunities. In other industries, data warehousing can mainly help organizations improve their position and change industry structure. Thus, when assessing and justifying a data warehouse project in terms of competitive advantage, business managers must mainly measure how the proposed data warehousing project through its supporting applications of DSS, CRM, and data mining tools can affect the relationship of the



1. Airline, 2. Public Sector, 3. Banking, 4. Health Care, 5. Retail, 6. Apparel, 7. Insurance & Investment, 8. Personal Care, 9. Steel, 10. Credit Card, 11. Telecom, 12. Manufacturing, 13. Education, 14. Food, 15. Parcel Delivery

<Figure-1> The sources of competitive advantage of data warehousing

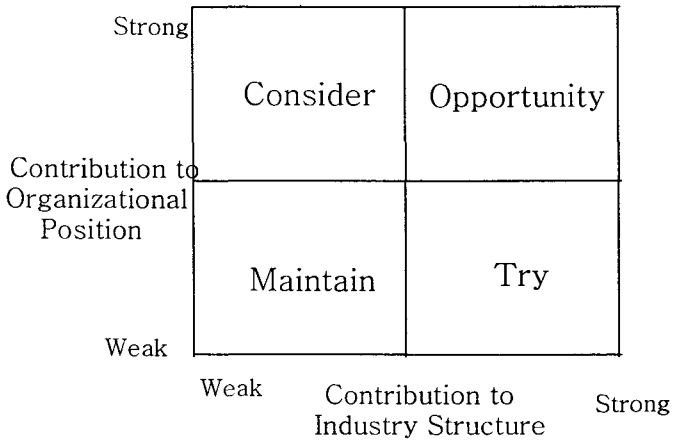
company with its buyers, suppliers, new entrants, substitutes, or rivals, and how it can differentiate the company's products or services, or change the competitive scope of its business. That does not necessarily mean that data warehousing does not provide any potential for new product or service opportunities. That just emphasizes that with a limited amount of resources, business managers and IT managers should give a higher priority on data warehousing or data mart project supporting DSS or BI applications which can affect the industry structure and/or the organization's position in its existing industry.

IV. A Framework for Justification of Data Warehousing

As the competitive advantage derived from data warehousing has been recognized across the industries, data warehousing has been widely accepted as an effective and efficient database architecture to support DSS and BI applications. In addition, the availability of easy-to-use BI software products, serving as front-end tools for data analysis and providing query management functions, has furthered the popularity of data warehousing. As mentioned earlier, many organizations implement data warehousing to obtain competitive advantages (Wixom and Watson, 2001; Shin, 2003). Therefore, it is worthwhile to assess and justify data warehousing projects from a competitive advantage point of view in order to complement the existing justification approaches.

Based on the two main sources of competitive advantages, *the contribution to organization position and industry structure*, identified in <Figure 1>, a framework, *justification of data warehousing from a competitive advantage perspective*, can be built to assess the potential for a data warehousing project to give a competitive advantage <Figure 2>. The framework contains four quite different competitive environments. Each of them is discussed in terms of justifying data warehousing projects that will used as a database component of DSS or BI applications for competitive advantage. The proposed framework is intended specifically to help organizations assess and justify data warehousing projects for the potential sources of competitive advantage during the justification process. Each quadrant in the framework is discussed below and real-life cases used for this study illustrate the competitive advantages resulting from the use of data warehousing for DSS or BI applications.

Opportunity: DSS and BI applications in the "opportunity" quadrant can have a significant impact on an organization's position in the industry and its relationship



<Figure 2> Justification of data warehousing from a competitive advantage perspective

with its buyers, suppliers, potential new entrants, substitutes, and intra-industry rivals. A data warehouse intended to support those DSS and BI applications have a good chance to give competitive advantage, if implemented properly. Therefore, business and IT managers should not hesitate to approve a data warehousing project if they regard their DSS and BI applications as a strategic system for their organizational position and industry structure. For example, British Air[1] (BA) built a 200 gigabyte data warehouse to support its DSS and uses it to improve its asset utilization and air-fare pricing decision. With the help of data warehousing, BA can more effectively answer questions such as what mix of fares will be used on which routes, who flies where, and for what price. This can improve BA's relative position in the airline industry in terms of aircraft deployment (or operational efficiency) and thus give a competitive edge over its competitors. BA can also differentiate its service by offering lower rates of air-fare and thereby get more bargaining power over its competitors.

Wal-Mart deployed the world's largest data warehouse to support its decision-support needs. Its retail stores around the country pour daily transaction data into its data warehouse, from which Wal-Mart can analyze what is selling, where it is selling, even when it is selling, and to whom it is being sold. Its data warehouse thus helps managers in various functional areas determine optimal pricing and inventory levels, as well as the most effective way of promoting each store's products. It can, thus,

1) Details of examples cited in this section are available in Appendix.

respond effectively to sales trends and buying patterns of customers and thereby maintain a competitive advantage. In other words, the use of the data from the data warehouse helps Wal-Mart offer its customers an opportunity for one-stop shopping and in turn lock in its customers, thereby tipping the bargaining power to its favor. In addition, the analysis of the data from the dada warehouse allows Wal-Mart to find optimal pricing scheme effectively and thus enables Wal-Mart to offer "everyday low price" products. This can help Wal-Mart strengthen its position in the retail industry.

Try: DSS and BI applications in the "try"quadrant are vital for an organization to obtain a competitive edge and thus influence the state of competition in an industry, although they don't have much potential for improving the organization's relative position in the industry. Thus, a data warehouse intended to support DSS or BI applications in this quadrant deserves justification and, if successfully implemented, it can help the organization build, for example, an "entry barrier." However, in order to minimize the risk, it is recommended that management approve a scaled-down version of data warehousing, *a data mart,* for a strategic business unit (SBU) on a trial basis, instead of launching a full-scale data warehousing project (Chenoweth, 2006). Based on the outcome of the trial version afterward, management can further justify a full-scale data warehousing project. Since many of hot applications of data warehousing are in marketing function due to the potential for an immediate payback in terms of increased revenue (Raizada, 2006), catalog manufacturers, for example, can use data warehousing to match personal characteristics to purchases of specific items as part of their customer relationship management (CRM) efforts.

In the intensively competitive telecommunications industry, the key factor to beating the competition is to get the right information to decision makers more quickly. GTE telephone units use their data warehouse to answer business managers requests quickly. Previously, when business managers needed to determine the viability of a product or service offering, it usually took weeks for them to get their answers because data from various sources had to be accessed, integrated, and reconciled. The new data warehouse allows them to draw information quickly from various disparate data sources and help them make more timely decision on product viability. This can help GTE find more marketable products or services and thus cater to customer needs effectively. As a consequence, GTE can possibly lock in customers and thereby get more bargaining power over its customers. This can help GTE, in a sense, build an "entry barrier" in terms of more responsive product or service offerings.

Once the data warehouse turn out to be successful, GTE can scale it up to an enterprise data warehouse to support DSS or BI applications in other functional areas.

Consider: DSS and BI applications in the "consider"quadrant are usually intended to improve an organization's position in an industry by differentiating its products or services, or changing the competitive scope of its business. Therefore, management can consider and must justify a data warehouse project to support DSS or BI applications mainly for internal operations, such as product quality improvement.

For Bethlehem Steel Corp. in Pennsylvania, pattern processing is the key to steel quality. The company is using its data warehouse for pattern processing to improve its steel quality. At Bethlehem, the data about the variables related to the production of steel products such as content, temperature, sequence, and speed are scattered on many information systems and stored in conflicting format. making data analysis difficult. To solve this problem, the company created a data warehouse from which it can extract and maintain integrated operational data that Bethlehem's engineers and managers need to maintain quality consistency. By analyzing data collected on numerous variables of high- and low-quality products, engineers are able to discern patterns in production that lead to consistently high-quality steel. In addition, engineers are able to determine what to avoid and what to strengthen in the process so that they can manufacture quality products. The information derived from the data warehouse eventually led to better quality of steel products and helped Bethlehem differentiate its products from those of its competitors, thus strengthening its position in the steel industry.

Piedmont Hospital in Atlanta utilizes its data warehouse to control its operating costs and thus can submit more competitive bids for corporate accounts. As a result, this helps the hospital improve its position in health care industry by offering low cost health care services and thereby obtain a competitive advantage over its competitors for corporate accounts.

Maintain: The impact of DSS and BI applications in the "maintain" quadrant on an organization's position in an industry and on industry structure is relatively insignificant, compared with that of DSS and BI applications in other quadrants. Therefore, it is relatively difficult to justify the proposed data warehousing project designed to support "maintain" DSS or BI applications from a competitive advantage point of view. Thus, other economic justification approaches, such as cost-benefit analysis (CBA) or activity-based costing (ABC) approaches, if DSS and BI applications are focused and performance measurements are not complex,

must precede any strategic justification. Or, the needs for "strategic necessity" have to be recognized (Kettinger et al., 1994), if the organization is really willing to pursue the benefits of data warehousing.

In sum, the above framework for justification of data warehousing identifies the appropriate quadrant to which DSS or BI applications belong, and assesses the contribution which DSS or BI applications make to organizational position and industry structure when data warehousing is used as a database component for DSS or BI applications. Examples cited in discussion of each quadrant illustrate how data warehousing as a database component of DSS or BI applications can help organizations get more bargaining power and strengthen their position in their respective industry. As mentioned in the previous section, data warehousing can help organizations alter its industry structure, improve the organization's position in its industry, and/or create new business opportunities. However, from an asset utilization point of view only two main sources of competitive advantage of data warehousing were incorporated in the proposed framework.

V. Concluding Remarks

Data warehousing has been adopted and used as IT infrastructure in various organizations, both in the private and public sectors, to support DSS and BI applications for fact-based decision-making (Gray and Watson, 1998; Inmon, 2005; Shin, 2003; Wixom and Watson, 2001). Data warehousing has proved that it delivers timely information critical in tracking business patterns and trends, facilitates forecasting planning efforts, and helps improve the quality of products or services. This thereby enables organizations to make more informed business decisions and eventually obtain a competitive advantage by altering the state of competition in an industry, improving an organization's position in the industry and/or creating new business opportunities. However, studies show that the success rates of data warehousing implementations are quite contradicting (Zimmer, 1996; Anonymous-1, 2006). In addition, although data warehousing is a costly commitment, only a small percentage of organizations has performed an ROI assessment on their data warehousing. Therefore, considering the limited amount of resources that organizations can invest in IT projects, thorough and cautious assessment and justification of data warehousing projects are called for.

A number of approaches such as NPV, option pricing model, joint utility function, and ABC method have been proposed and/or used in justifying various information systems and

information technologies. However each of them has its own limitations in justifying information systems and information technology. In addition, researchers (Keen, 1981; Peocock and Tanniru, 2005) pointed out that traditional CBA approaches alone is not adequate to assess and justify non-transaction-based information systems. Furthermore, since data warehousing is IT infrastructure in its nature and regarded as a strategic IT investment, a complementary approach from a competitive advantage viewpoint. to make data warehousing assessment and justification more effective.

By analyzing twenty-six successful implementations of data warehousing projects and their uses, this study proposed a conceptual framework, *justification of data warehousing from a competitive advantage perspective,*, to assess data warehousing projects from a competitive advantage point of view. The main contribution of this study is that the proposed framework incorporates the concept of competitive advantage in the assessment and justification process of IT project investments. Another contribution of it is that the proposed framework can complement the existing methods or approaches to assessing and justifying the investments in IT projects, especially for "strategic" systems. For organizations considering data warehousing, the proposed model in this study can be a useful guide for justifying data warehouse projects from a non-traditional point of view. However, it is recommended that organizations use the framework as a complementary approach to traditional CBA approaches or other methods in justifying their data warehouse projects, since it is mainly developed to assess and evaluate *"competitive"* advantages which may or may not be quantifiable.

The results of analysis and the proposed framework in the study are based on a small sample (cases) of organizations that vary in size and scope. Only success stories were considered in developing the proposed model. In addition, the analysis is based on almost entirely in anecdotal or somewhat subjective information from popular IT-related trade journals. The factors used in determining the impact on the state of competition in an industry and on industry structure were somewhat judgmental. Therefore, more objective measures of the impact on organizational position and industry structure should improve the proposed model.

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Appendix-1 Descriptions of Cases

Marketing and Resource Management in the Airline Industry

British Air (BA), one of the largest IT users in Europe, has built a 200 Gigabyte data warehouse and uses it as part of a strategic information system. To meet customers' needs and improve its asset utilization, BA needs to be able to answer questions such as what mix of fares will be used on which routes, who flies where, for what price, and to what extent different countries and agencies are selling different mixes of the same products. In addition, from the information available through its data warehouse, BA has a better idea about its route profitability and how to deploy its fleet efficiently.

Another example from the airline industry can be found in USAir's frequent flyer program. To better focus sales and marketing campaigns, airline companies need to know the answers to questions such as whether offers made to frequent flyers are accepted. Can a model of good customers be built? In order to obtain answers to these questions, USAir originally tried to create a data-mining system that accessed the company's on-line transaction processing (OLTP) environment directly. But, as soon as they started data mining, they slowed down the transaction processing rate unacceptably, and realized that a data warehouse was needed to meet their information needs for the frequent flyer program. Since building a data warehouse, USAir's OLTP system is no longer bogged down and analysts get needed information for its frequent flyer program.

Intelligence Solution and Revenue Management in the Public Sector

Government agencies also use a data warehouse for strategic business information. The middle and senior management of the Department of Defense (DOD) plan to use business intelligence software, utilizing a data warehouse, for quantitative applications. For example, the Defense Acquisition and Technology Data Center (DATDC) uses LightShip from Pilot Software to establish access for the integration and analysis of critical time-sensitive information such as environmental costs by state, transportation training and performance data, daily congressional activities, and foreign direct investments in U.S. firms. The DATDC's business intelligence applications also provide end-users with a means to access internal and external data sources from legacy systems.

In Iowa, state tax officials found that state and federal tax data was so widely scattered in data depositories. Thus,, even in the simplest cases, revenue agents would have to be sent to interview taxpayers on routine matters. Such visits were labor-intensive and costly. An analysis of the problems found that

by implementing a data warehousing system, the tax agency could bring in an extra $28 million in uncollected revenue in the first three years, which paid the costs of the new system. The system now generates $10 million more in annual tax revenue.

Cost Management, and Marketing and Product Development in the Banking Industry

Facing turbulent economic conditions, increased competition from other financial service providers, and the rising expectations of customers, banking institutions realize that improving the utilization of transaction data is one solution to these challenges. Accurate, complete, reliable, speedy information is one of the most significant factors for success in the banking industry. From this perspective, data warehousing is good news because it provides an efficient way for flexible, easy access to customer and account information. Data warehousing enables them to perform extensive business analyses quickly, thereby enhancing customer services and improving sales strategies and capabilities.

Under shareholders' pressure to reduce its expenses in information systems, the Chase Manhattan Bank North America decided to build a 500 Gigabyte data warehouse to support its $10 billion credit card portfolio. The system is expected to help Chase Manhattan manage 22 million records on 15 million credit card accounts on one database instead of on the existing 54 databases. Chase used to spend $18 million annually to run its creditcard decision-support operations on an Amdahl Corp. mainframe. Now that the shift to a massively parallel data warehouse enables the bank to handle queries more cost-effectively, they expect to reduce the bank's expenses for credit card decision-support from $18 million to $4 million annually.

Bank of America (BoA), San Francisco, implemented a data warehouse in 1986 to ease the strain on its IS resources from answering queries and to improve customer service. Its data warehouse had grown from 15 Gigabytes in 1986 to 800 Gigabytes in 1995. With its data warehouse, BoA could reduce the elapsed time per query from 2 hours to 3 minutes, allowing its workers nearly instantly to answer to their information requests while the customer is still on the line. Also queries per day had increased from 5 to 2,000, while the cost per query was reduced from $2,430 to $24. Furthermore, BoA utilize its data warehouse as a strategic decision making tool. For example, based on the information derived from its data warehouse BoA makes decisions whether it has to eliminate the credit card annual fee for those customers with both credit card and checking account.

Drawing from 40 different legacy systems, Chemical Bank also created a data warehouse

for its profitability analysis and customer service. By analyzing data from its data warehouse, Chemical knows how much profit, or loss, each business line, product, and even each individual customer contributes to its bottom line. For example, with information obtained from its data warehouse, Chemical Bank found that a bundled checking and savings product that it introduced at a reduced fee was actually losing money unlike its initial expectation of the product. Thus, Chemical Bank unbundled the checking and savings products and priced them separately, making each of them profitable. The information made available from its data warehouse puts Chemical Bank strategically well ahead of those banks that have only a vague idea of how and where they are making, or losing, money.

Applying the information from the data warehouse, Chemical Bank is suggesting to its customers less costly methods of accessing bank services such as ATMs and telephone- or PC-based home banking systems instead of conducting all business through tellers. This kind of enhanced customer service improves Chemical Bank's image as a customer-oriented banking institution and differentiates it from its competitors, thus allowing it to gain competitive advantages.

Cost Management in the Health Care Industry

Piedmont Hospital in Atlanta, Georgia, a 500-bed facility, built a client/server data warehousing application to help it win business and cut costs. Its 20 Gigabyte data warehouse stores financial data and patient information, and is used by 40 hospital managers to determine the cost of treating patients and the effectiveness of those treatments. The information obtained through the data warehouse is strategically important to Piedmont Hospital because it is an effective way to track and control costs. For example, the data revealed that one neurosurgeon was spending 20 to 30 percent more than his colleagues to perform operations. They traced this difference to the brand of supplies he was using in the operating room. Piedmont Hospital increasingly has been asked to bid for corporate accounts and the data warehousing application is helpful in formulating bids, thus increasing the probability of winning the bid.

Marketing in the Retail Industry

In January 1995, Wal-Mart deployed the world's largest commercial database system to support its decision-support needs. Its 2,729 retail stores around the country pour daily transaction data into its data warehouse, from which Wal-Mart can analyze what is selling, where it is selling, even when it is selling, and to whom it is being sold. Its data warehouse thus helps managers in various functional

areas determine optimal pricing and inventory levels, as well as the most effective way of promoting each store's products. It can, therefore, respond effectively to sales trends and buying patterns of customers and thereby maintain a competitive advantage.

Longs Drug Stores, Inc. installed a client/server DSS backed by a data warehouse. Although the detailed impacts of its data warehouse were not provided, CIO Brian Kilcourse said that "Longs Drug has increased inventory turns, reduced inventory investments, and generally streamlined its procurement and planning operations as a result of being able to examine data gathered from the stores sooner." .

Merchandising and Replenishment in the Apparel Industry

In the apparel industry, the creation and stocking of garments for retail sales is an involved process, with designs chosen, samples made, orders taken, and production levels established before manufacturing and shipment begin.During this time, styles can change, thus dating large quantities of stock before they ever reach the retail floor. A style can also become enormously successful, thus causing severe shortages. In these situations, it is not unusual for retailers to be out of 30 percent of their stock at any time.

VF, a retail apparel company based in Wyomissing, PA, saw that the company's retailers needed to have apparel styles and stock replenished more quickly. To accomplish this goal, VF created the Market Response System (MRS), a product cycle-tracking system that analyzes POS data from participating retail stores, which is stored in its data warehouse at its computer center in Greensboro, NC. The information available from the new system, used to maintain inventory down to the style/color/size level, is then shared among VF's designers, fabric buyers, manufacturers, and retailers. MRS reduced the conventional 100- to 125-day product development cycle to about 35 days, allowing manufacturers and retailers to change designs within the same selling season. The information from MRS helped VF to convince its retail partners of what was and was not selling. VF accomplished its objective of "continuous merchandising and steady replenishment." Its data warehouse project helped reduce the out-of-stock problems by 50 percent, and increased VF's sales by 10 percent.

Cost Management, and Risk and Portfolio Management in the Investment and Insurance Industries

CNA Insurance Co., Chicago, implemented data warehousing projects to reengineer itself. As a result of its data warehousing, it could integrate a number of information systems into a "one stop shopping"database to achieve

its vision of making the company national in scope, but regional in focus. The company expected to save $900,000 in 1996 in its DSS operations, as well as to reduce by 50 percent the time and cost dedicated to producing information and meaningful data. In addition to that, it was able to identify patterns in its customer behaviors, and in turn introduce and evaluate new products at both national and regional levels in more effective way.

Previously, brokers and dealers never knew their risk exposure until the next morning because the information on the five trading systems (equity, government, municipal bonds, new issue underwriting, and money market) were processed in batch mode at the end of each business day. Therefore, they sought a solution to overcome the danger of assessing risk only once every 24 hours. Also, many Wall Street investment banks and securities firms realized that islands of information systems made it nearly impossible for them to assess risk industry wide; thus, they began building data warehouses as a way of collecting operational data from disparate information systems and rearranging the data in a centralized relational format

With data warehousing, brokers and dealers now analyze risk across the five disparate trading systems, distribute the information on a LAN to a risk management server, and reduce the risk involved in trading. In addition, investment firms like Sumitomo Bank and Prudential Insurance Co. have finished building data warehouses to analyze market movements, assess company-wide risk, manage portfolios, track customer tendencies, calculate customer profitability, and settle trades. With their data warehouses, these firms now can concentrate on analyzing the data and responding more swiftly to market changes and customer needs.

Distribution and Sales Decisions in the Personal Care Products Industry

Helene Curtis Industries, Inc. in Chicago produces and markets Suave, Finesse, and Salon Selectives shampoos and conditioners. It developed a sales automation system using a client/server-based data warehouse. The core of the decision-support operation lies within the 25 Gigabytes of data stored at its data center. It stores syndicated market data from A.C. Nielsen Co. about the $20 billion personal care products industry, as well as product information from the field, and internal data on logistics, promotions, sales, and order entry. The system allows sales representatives to react to market changes faster by providing daily access to constantly updated customer and product information.

Now the sales forces have daily access via laptops to constantly updated information that once took several weeks to assemble and distribute. By utilizing the sales automation system, Helene Curtis has a better grasp of

the effectiveness of its distribution channel and is more effective in launching marketing campaigns.

Pattern Processing in the Steel Industry

For Bethlehem Steel Corp. in Pennsylvania, pattern processing was the key to steel quality. At the end of each month, Bethlehem's systems were full of information about the thousands of variables tracked, such as content, temperature, sequence, speed, production location, gauge, width, and so on. But because the data were scattered and originally collected in conflicting formats, it was difficult to analyze. To solve this problem, the company created a data warehouse from which it can extract and maintain integrated operational data that Bethlehem's engineers and managers need to maintain quality consistency. By analyzing data collected on numerous variables of high- and low-quality products, engineers are able to discern patterns in production that lead to consistently high-quality steel. In addition, engineers are able to determine what to avoid and what to strengthen in the process so that they can manufacture quality products. The company moved to pattern processing only by gaining control over the existing data it used to run day-to-day operations.

New Information Services in the Credit Card Industry

Two major credit card companies, Visa USA Inc. and MasterCard International Inc., plan to build data warehouses out of mountains of credit card information. Then, they plan to provide affiliate banks with on-line access for a fee. MasterCard's data warehouse service called "MasterCard On-Line"will take up 1 Terabytes, and Visa's data warehouse service called "VisaVue" is expected tobe about 300 Gigabytes to 500 Gigabytes. The plan, which will give banks access to detailed information about an estimated 23 million Visa and MasterCard transactions every day, is expected to bring their member banks many business opportunities.

Visa and MasterCard hope that by providing the information available through their data warehouse, they can strengthen relationships with their banking partners in the increasingly competitive credit card business. Currently, MasterCard On-line, about one-half Terabytes in size, is being rolled out in modules, and Visa was scheduled to connect its member banks to VisaVue in summer 1996. Once MasterCard and Visa provide that kind of on-line service, the information should give banks a big boost in creating new products and marketing programs.

Marketing and Service Development in the Telecommunications Industry

In the intensively competitive telecommunications industry, the key factor to beating the competition is to get the right information to decision makers more quickly. GTE telephone units use their data warehouse to answer business managers requests quickly. Previously, when business managers needed to determine the viability of a product or service offering, it usually took weeks for them to get their answers because data from various sources had to be accessed, integrated, and reconciled. The new data warehouse allows them to draw information quickly from various disparate data sources. For example, it usually took weeks for business managers to get the report on a query such as "white households in New York City with a median income of more than $50,000 that generated more than $100 per month in telephone toll revenue during the fourth quarter of 1995."

GTE also expects its data warehouse to increase the efficiency of both IT and the business. On the IT side, with the data warehouse, they make resources available that were previously committed to extraction, replication, and reporting. By improving these processes, GTE reduces its costs and lessens the need for outside contractors. The cost reduction helps the company to offer its services at lower rates which are essential to maintaining its competitive position. On the business side, people in business functions now focus on their real jobs: analyzing and responding to decision data, rather than struggling to access it.

Other Cases

In addition to these successful implementations of data warehouses, several other organizations in various industries have also used data warehouses strategically: Advocate Health Care, Bose Corporation, Stanford University, and Sara Lee Meat Group.

Advocate Health Care in Oak Brook, Illinois, a leading Midwest provider of health services, is using a data warehouse to assess system-wide patient care quality and to respond to patient needs more effectively. It also utilizes its data warehouse to predict market needs for organizational planning, including customer and staffing needs.

Bose Corporation in Framingham, Massachusetts, is a leading worldwide supplier of audio components and other audio equipment. It consolidates data from its twelve different systems onto a Sybase data warehouse and utilizes the data to analyze market trends and product performance to enhance business decision making, thereby resulting in more revenues and improved customer satisfaction.

Consumer goods maker 3M Corp. has implemented a data warehouse and used it to learn more about its business after compiling the data it had previously stored in a variety

of operational systems across the company. 3M found that it had been paying taxes it didn't owe because of inaccurate data that was cleaned up as part of the project.

Stanford University in Stanford, California, is one of the world's leading academic institutions. The planners and financial analysts at Stanford use their data warehouse, which stores financial and administrative data, to enhance overall effectiveness and productivity. Rensselaer Polytechnic Institute implemented a data warehouse to facilitate data sharing among departments and to provide reliable and up-to-date information for various decision making. Implementing a data warehousing and BI applications has resulted in more accurate, data driven decision that provide competitive advantages in the areas of student financial aid, admission effectiveness, and management of research funds.

The Meat Group of Sara Lee, with about $3 billion in annual sales, manufactures and distributes meat products. It uses the information obtained through its data warehouse to develop and execute sales and promotional strategies.

United Parcel Service of America Inc. (UPS) in Atlanta built a data warehouse for the marketing department in 1995. To justify the investment UPS looked at both tactical and strategic benefits. The biggest tactical benefit was a sharp decrease in the cost of programmers: that is, roughly half of the 130 programmers on staff were not required after the data warehousing project. However, although the marketing group was using the information in many ways to satisfy customers a lot better, strategic benefits could not be pinpointed because the strategic value remains intangible.

박용태(Yong-Tae Park)

영남대학교 경영학과를 졸업하고, 미국 Ball State University에서 경영학 석사를 받았으며, Claremont Graduate University에서 경영정보학 전공으로 박사학위를 취득하였다. California State University, San Marcos와 Claremont Graduate University에서 겸임교수를 역임하였으며, University of Illinois, Springfield에서 조교수, 그리고 California State University, Fullerton에서 부교수로 근무했고, 현재 울산대학교 경영대학 경영학부 조교수로 재직하고 있다. 최근의 주요 연구 관심분야는 전자상거래, 정보화전략, 데이터 웨어하우징, 정보시스템의 전략적 이용 등이다.

<요 약>

경쟁우위적 관점에서의 데이터 웨어하우징 평가 및 정당화

박 용 태

전통적인 비용수익 분석법 (CBA approach) 과 활동기준원가계산 방법 (ABC approach)과 같은 지금까지의 방법으로는 전략적 정보시스템이나 정보 하부구조를 효과적으로 평가하고 정당화하는데 한계가 있다고 지적되어왔다. 따라서, 본 논문은 정보시스템의 하부구조를 이루고 있는 데이터 웨어하우징을 스물여섯 개의 데이터 웨어하우징 성공사례 분석을 통해서 데이터 웨어하우징이 가치사슬 모델의 각 활동에 어떻게 활용되고 있는지를 분석하고, 경쟁우위적 관점에서 이들 사례들의 공통점을 찾아내어, 데이터 웨어하우징을 경쟁우위적 관점에서 보다 효과적으로 정당화할 수 있는 모델을 제시하고 있다. 이 모델은 기존의 정보시스템 정당화에 사용되어왔던 방법들의 단점을 보완하여, 기업들이 데이터 웨어하우징이나 경쟁우위를 확보하기 위해서 구축하는 다른 정보시스템들을 경쟁우위적 관점에서 정당화하고자 할 때 유용한 도구로써, 기존의 방법들과 병행해서 사용하면 보다 효과적으로 정보시스템들을 평가하고 정당화할 수 있으리라 생각된다.

Keywords: 데이터 웨어하우스, 데이터 웨어하우스의 정당화, 정보기술의 정당화

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