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Critical Success Factors for Data Warehouse Implementation: A Framework for Analysis and Research

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ABSTRACT

Data warehousing is an important area of practice and research, yet few studies have assessed data warehousing practices in general and critical success factors for implementation in particular. A limited number of studies have provided guidelines for implementation but no framework exists that can be used to evaluate the various success factors proposed. This research developed a framework for analyzing these success factors. The utility of the framework was illustrated by classifying success factors discussed in eight academic journal articles. The framework was also used to identify several research opportunities that should benefit the practice and research of data warehousing.

INTRODUCTION

Despite the recognition of data warehousing as an important area of practice and research, few studies have been conducted to assess data warehousing practices in general and critical success factors for implementation in particular (Watson et al. 2001; Wixom and Watson 2001). Numerous case studies have reported factors contributing to the success or failure of data warehousing projects. However, each study would identify certain success factors without relating them to those discussed by other researchers. No analysis or integration of factors across studies has been attempted. The purpose of this paper was to develop a framework to facilitate analysis of success factors across studies. The framework was developed based on the four feasibility tests traditionally applied to information systems projects, as described next.

FEASIBILITY ANALYSIS

It is generally agreed that four feasibility tests be applied to all information systems development projects:

Operational feasibility: a measure of how well the system solution fits the problem. It is also concerned with the role played by the management and the users during implementation and their perceptions of the new system. Many researchers have stressed the importance of having a business driver for the data warehouse (e.g., Baker and Baker 1999; Sammon and Finnegan 2000). Top management support is critical to all major information systems initiatives and is noted for its importance in data warehouse development as well (Watson and Haley 1997; Wixom and Watson 2001)

Technical feasibility: a measure of the availability of technical resources and expertise. It is concerned with both the maturity of the technology and the availability of technical expertise in house. Many companies chose to utilize consultants or third party vendors for their data warehousing projects due to technical considerations. Almost all authors emphasize the technical aspects of data warehousing projects including cleansed data, meta data, standard methodology and project management as very critical to the success of the project (e.g., Baker and Baker 1999; Joshi and Curtis 1999; Sammon and Finnegan 2000; Vatanasombut and Gray 1999; Watson and Haley 1997; Wixom and Watson 2001).

Schedule feasibility: a measure of how reasonable the time allowed for development is. Deadlines may be mandatory or desirable. Mandatory deadlines are usually the results of new laws or regulations and thus do not apply to data warehousing projects. Nevertheless, proper planning and execution of implementation schedule may be critical to data warehousing success (Baker and Baker 1999; Sigal 1998).

Economic feasibility: a measure of the bottom line, also known as cost-benefit analysis. This type of analysis is usually performed for transaction processing system projects that can easily quantify benefits. Data warehouses are mostly created for decision support or strategic applications that do not have apparent measurable benefits. Consequently, economic feasibility has not been a priority in early projects. However, as the technology matures and experiences spread, more companies are conducting some type of cost-benefit analysis (Whiting 1999).

The use of the framework is discussed in the next section. First, studies that described implementation success factors are identified and reviewed. Next, success factors are classified using the framework. Analysis of the factors is conducted and directions for future research are discussed.

METHODOLOGY

The ABI/Inform database was searched using "data warehouse implementation" as keywords. The title of the over 100 citations returned was scanned and abstract reviewed to identify studies that include implementation success factors. Practitioner papers were generally excluded because they normally offer some "how to" pointers on technical issues rather than general guidelines. In the end, eight papers that were published in academic journals were selected for further analysis. Although not an exhaustive sample, the eight studies represent a reasonable collection of implementation guidelines studies.

RESULTS

Table 1 shows the characteristics of the eight studies. As a relatively new phenomenon, data warehousing had not been the subject of academic studies until late 1990's. These studies differed in the methodology used and most studies were based on personal experiences. As the field matures, more comprehensive and rigorous studies are expected to be published. Regardless of methodology differences, the important issue is how those critical success factors compare across studies. Table 2 shows the analysis using the feasibility framework.

As shown in Table 2, the critical success factors covered all four feasibility tests but not all studies included all four feasibility areas. Operational and technical areas have received the most attention, which is not surprising as data warehousing is recognized as a product of business need and technological advances (Wixom and Watson 2001). However, as the technology matures and experiences spread, more attention should be devoted to factors in the schedule and economic areas.

Table 1: Study Characteristics

Study	Journal	Methodology
Watson & Haley (1997)	Journal of Data Warehousing	Survey
Gardner (1998)	Communications of the ACM	Personal experience
Sigal (1998)	Communications of the ACM	Personal experience
Baker & Baker (1999)	Journal of Business Strategy	Personal experience
Joshi & Curtis (1999)	Information Strategy	Personal experience
Vatanasombut & Gray (1999)	Journal of Data Warehousing	Literature review
Sammon & Finnegan (2000)	Data Base	Case study
Wixom & Watson (2001)	MIS Quarterly	Survey

For operational feasibility, as with any information system initiatives, the first question the project team should assess is whether the proposed data warehouse is the right solution to the problem. Data warehousing should be a business rather than a technical driven solution (Baker and Baker 1999; Gardner 1998; Joshi and Curtis 1999; Sammon and Finnegan 2000). Once the business solution issue is clarified, top management support, sponsorship, and even a champion may be critical to the success of the endeavors (Gardner 1998; Sammon and Finnegan 2000; Vatanasombut and Gray 1999; Watson and Haley 1997; Wixom and Watson 2001). User involvement or participation is a conventional success factor and has been suggested by Watson and Haley (1997) and Wixom and Watson (2001) as important to data warehouse implementation. Its effect was not supported in the results reported by Wixom and Watson (2001), however. It will be interesting to conduct follow up studies to determine if and why user participation has no impact on data warehousing success.

For technical feasibility, information technologies such as data quality, meta data, open and scalable platforms are important (Baker and Baker 1999; Joshi and Curtis 1999; Sigal 1998; Vatanasombut and Gray 1999), as are soft skills such as team skills and project management skills (Sammon and Finnegan 2000; Watson and Haley 1997; Wixom and Watson 2001). The use of outside consultants and proper data warehousing tools are also recommended (Baker and Baker 1999; Gardner 1998; Joshi and Curtis 1999; Sigal 1998; Watson and Haley 1997).

For schedule feasibility, Vatanasombut and Gray (1999) stressed the importance of proper identification of the subject areas and data volume, both of which presumably contribute to the on time delivery of the system. General guidelines such as practical implementation schedule and realistic and manageable implementation plan have also been suggested (Baker and Baker 1999; Gardner 1998; Sigal 1998). Similarly, for economic feasibility, most researchers only supply general guidelines such as adequate money resource and funding commitment from the management (Sammon and Finnegan 2000; Wixom and Watson 2001). Baker and Baker (1999) did suggest measurable business benefits be considered. Whiting (1999) provided several examples on how a return on investment analysis can be carried out for data warehousing projects. More research that can provide specific guidelines such as how to set and maintain a practical implementation schedule and how to conduct effective cost benefit analysis for data warehousing projects is needed.

RESEARCH DIRECTIONS

The framework developed in this research was shown useful in comparing and assessing the success factors proposed in eight academic journal articles. The evaluation also highlighted several research opportunities as discussed previously.

Another line of research should validate and then further compare various success factors. The only study that empirically tested its success factors was Wixom and Watson (2001) and not all of their success factors were supported. Validation of *all* success factors is needed before they are taken at face value. Equally important, research should be conducted to assess the relative significance of different success factors.

Table 2: Critical Success Factors

	Operational	Technical	Schedule	Economic
Wixom & Watson (2001)	Management support, Champion, User participation	Team skills, Source systems quality, Development Technology, People resource	Time resource	Money resource
Sammon & Finnegan (2000)	Business driven initiative, Executive sponsorship	Project management & implementation experience, Source data quality, Flexible data model, Data stewardship, Data extraction methods/tools, Knowledge of DW compatibility with existing systems, Hardware/software proof of concept		Funding commitment
Baker & Baker (1999)	Business driven DW	Outsource, Easy-to-use tools, Flexible and scalable tools, Metadata, Multiple platform support, Scalable solution	Realistic and manageable implementation plan, Set implementation priorities	Measurable business benefits
Joshi & Curtis (1999)	Alignment with business objective	Proper warehouse architecture, Data quality, Data loading, Meta data	Scope of project	
Vatanasombut & Gray (1999)	Top management mandate	Clean data, Proper definition/use of meta data, Proper definition of data warehouse, subjects & loading intervals	Proper selection of subject areas and data volume	
Gardner (1998)	Executive support, Specific business problem	Proven technology, Experienced people	Well defined plan	
Sigal (1998)		Standardized technology, Open solutions, Scalable technology	Practical implementation schedule	
Watson & Haley (1997)	Upper management support, User involvement, Business need	User support, Use of Methodology, Good clean data, Defined goals, Managed expectations		

To date, these factors have been discussed as if they were of equal value or weight. However, in practice, different companies or different implementation teams probably give them different weights. A general model that describes the relative importance of each success factor and a contingency model that describes the weights of different factors as a function of some external variables will be valuable.

Finally, data warehousing success warrants more attention. Watson and colleagues proposed a framework that consists of six success variables (Watson and Haley 1997; Watson et al. 2001). Sakaguchi and Frolick (1997) discussed 16 data warehousing benefits. Vatanasombut and Gray (1999) listed 12 goals of data warehousing. More recently, Wixom and Watson (2001) investigated the effects of several implementation factors on three success variables. A framework that can integrate the above success variables will be valuable.

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