

**Strategic Alignment in Data Warehouses
Two Case Studies**

A thesis submitted in fulfillment of the requirements for the degree of
Doctor of Philosophy

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DECLARATION

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

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Date: Feb 10, 2007

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ABSTRACT

Strategic Alignment in Data Warehouses – Two Case Studies

This research investigates the role of strategic alignment in the success of data warehouse implementation. Data warehouse technology is inherently complex, requires significant capital investment and development time. Many organizations fail to realize the full benefits from it. While failure to realize benefits has been attributed to numerous causes, ranging from technical to organizational reasons, the underlying strategic alignment issues have not been studied.

This research confirms, through two case studies, that the successful adoption of the data warehouse depends on its alignment to the business plans and strategy. The research found that the factors that are critical to the alignment of data warehouses to business strategy and plans are (a) joint responsibility between data warehouse and business managers, (b) alignment between data warehouse plan and business plan, (c) business user satisfaction, (d) flexibility in data warehouse planning and (e) technical integration of the data warehouse.

In the case studies, the impact of strategic alignment was visible both at implementation and use levels. The key findings from the case studies are that

- a) Senior management commitment and involvement are necessary for the initiation of the data warehouse project. The awareness and involvement of data warehouse managers in corporate strategies and a high level of joint responsibility between business and data warehouse managers is critical to strategic alignment and successful adoption of the data warehouse.
- b) Communication of the strategic direction between the business and data warehouse managers is important for the strategic alignment of the data warehouse. Significant knowledge sharing among the stakeholders and frequent communication between the

data warehouse managers and users facilitates better understanding of the data warehouse and its successful adoption.

- c) User participation in the data warehouse project, perceived usefulness of the data warehouse, ease of use and data quality (accuracy, consistency, reliability and timelines) were significant factors in strategic alignment of the data warehouse.
- d) Technology selection based on its ability to address business and user requirements, and the skills and response of the data warehousing team led to better alignment of the data warehouse to business plans and strategies.
- e) The flexibility to respond to changes in business needs and flexibility in data warehouse planning is critical to strategic alignment and successful adoption of the data warehouse. Alignment is seen as a process requiring continuous adaptation and coordination of plans and goals.

This research provides a pathway for facilitating successful adoption of data warehouse. The model developed in this research allows data warehouse professionals to ensure that their project when implemented, achieve the strategic goals and business objectives of the organization.

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GLOSSARY

CEO	Chief Executive Officer
CIO	Chief Information Officer
CRM	Customer Relationship Management
DBMS	Data Base Management System
DQI	Data Quality Information
DSS	Decision Support System
ERP	Enterprise Resource Planning
GPS	Global Positioning System
GRAAL	Guidelines Regarding Architecture Alignment
IS	Information Systems
IT	Information Technology
MDD	Multi-Dimensional Database
OLAP	Online Analytical Processing
RDBMS	Relational Database Management System
ROA	Return On Assets
ROE	Return On Equity
ROLAP	Relational OLAP (Online Analytical Processing)
SISP	Strategic Information Systems Planning

1 INTRODUCTION

1.1 Overview

This research explores the role of strategic alignment between business and data warehouse plans in an organization and the role of that alignment in successful adoption of a data warehouse. It addresses the research question – what role does strategic alignment play in the successful adoption of the data warehouse. A data warehouse is a collection of data from multiple sources, integrated into a common repository and extended by summary information for the purpose of analysis (Ester et al., 1998). This repository allows enterprises to collect, organize, interpret and leverage the information (data) they have for decision support (Wixom and Watson, 2001; Gupta and Mumick, 2005; Groth, 2000; Gardner, 1998; Sethi and King, 1994)). It provides the foundation for effective business intelligence solutions for companies seeking competitive advantage (Chenoweth et al., 2006).

The use of information technology in business has transformed over the last several decades from operational utility in the 1960s to that of a competitive weapon (Carr, 2003; Kayworth et al., 2001; Ives and Learmonth, 1984; Bakos and Treacy, 1986) today. This phenomenon has affected the ways organizations are managed as well as the way IT affects the strategic activities of an organization (Pollalis, 2003). The strategic use of information technology has become a fundamental issue for every business as information technology can enable the achievement of competitive and strategic advantage for the enterprise (Kearns and Lederer, 2000; Luftman, Lewis and Oldach, 1993; Jarvenpaa and Ives, 1991).

In today's era of globalization (Breathnach, 2000; James, 1999), the prevailing hyper competitive markets (Eustace, 2003; Gagnon, 1999) bring pressure for businesses to shorten product lifecycles (Bussmann, 1998; Griffin, 1997), quickly identify and penetrate new

market segments and increase operational efficiencies (Krishnan et al., 1999; Mooney et al., 1996). Businesses seek sustainable competitive advantage in these markets by leveraging technology to the fullest extent (Alavi and Leidner, 1999). With strong competition and growing need for information, enterprises are eager to get fast and accurate information for better decision making (Dean Jr and Sharfman, 1996). Companies are continuously investing in processes and technologies that enable better, faster and more accurate decision making (Hurd, 2003). One such enterprise decision making platform is a data warehouse.

1.2 Data warehouse

“Data warehouse is a subject-oriented, integrated, non-volatile, time-variant collection of data in support of management’s decision making process” (Inmon, 1996). The concept of integrated data for management support is not a new one. Management information systems and executive information systems have been around since the early 1970’s (Shim et al., 2002). However, the operational IT environment in most large companies is very heterogeneous as a result of decades of changing technologies (March et al., 2000). Data resides in legacy systems in various technologies and environments, ranging from PCs to mainframes (Robertson, 1997). As a result they are incapable of supporting management decision processes due to a lack of data integration. Data warehouses offer data integration solutions and improved access to timely, accurate and consistent data (Ang and Teo, 2000; Ingham, 2000). A data warehouse equips its users with effective decision support tools by integrating corporate wide data into a single repository from which users can run reports and perform ad hoc data analysis (Meyer and Cannon, 1998). The data warehouse leverages the investments already made in legacy systems, allowing business users the potential for much greater exploitation of informational assets (Counihan, Finnegan and Sammon, 2002). A data warehouse helps reduce the cost, increases value added activities and improves efficiency (Zeng et al. 2003).

The data warehouse provides effective business decision support data to an organization (Poe et al., 1998). Some of the successful companies that have leveraged this data effectively include Wal-Mart (Westerman, 2001), Amazon (Rundenstiener, 2000), Citigroup (Debreceeny, 2005) and Nielsen Media Research. The strength of the data warehouse is its organization and delivery of data in support of management's decision making process (Meyer and Cannon, 1998). The data warehouse supports decision making and business analyses by integrating data from multiple, incompatible systems into a consolidated database (Inmon, 1996).

The data warehouse also allows sophisticated analyses of data. The capability of the data warehouse to perform the analysis has been documented by Srivastava and Chen, 1999. In the data warehouse, data is periodically replicated from operational databases and external providers of data, and is conditioned, integrated and transformed into a read-only database to discern patterns of behavior, support decision support systems and enable online analytical processing. Little and Gibson (2003) state that data warehouses also help in accessing, aggregating and analyzing large amounts of data from diverse sources to understand historical performance or behavior and to predict and manage outcomes.

Data warehouse technology is inherently complex (Gardner, 1998; Chaudhuri and Dayal, 1997), requires huge capital spending (Wixom and Watson, 2001) and consumes a lot of development time. The complexity of data warehouse implementations is a subject of ongoing research (Chen et al., 2000; Lee et al., 2001; Klenz, 2001; Sperley, 1999). The adoption of data warehouse technology is not a simple activity of purchasing the required hardware and software, but rather a complex process to establish a sophisticated and integrated information system (Vassiliadis et al., 2000; Wixom and Watson, 2001). Building a data warehouse consists of a complex process involving data sourcing, data extraction and conversion, population of the data warehouse database, data warehouse administration, creation of

metadata and access of the data warehouse database for decision support and business intelligence (Little and Gibson, 2003; Berndt and Satterfield, 2000; Manning, 1999; Shahzad, 1999; Sullivan, 1996; Watson, Fuller and Ariyachandra, 2004).

1.3 Challenges in data warehousing

In the past decade there has been an explosive growth in products and services offered for the adoption of data warehouse technologies (Datta et al., 1998; Meyer and Cannon, 1998; Koch, 1999). Data warehousing has also been a rapidly growing area in management information systems (Gary, 2004). Vassiliadis (2002) in his study concludes that the area of data warehousing is thriving and there is potential for further growth, but adds that data warehouse projects are very risky. Companies are integrating their data and building data warehouses to create advantages of identifying new markets for products and services, providing improved customer service and retaining customer loyalty (Berry and Linoff, 1999; Rygielski et al., 2002) and for reducing production and inventory costs (Fisher and Raman, 1996). But a review of the literature suggests that a majority of data warehouse projects have a high possibility of failure (Chenoweth et. al., 2006, Hwang et al., 2004; Wen et al.,1997, Watson et. al., 1999, Vatanasombut and Gray, 1999, Kelly, 1997) and many firms are failing to realize the benefits of data warehousing (Johnson, 2004).

Thus, even though data warehouses have emerged as a powerful tool in delivering information to users, creating competitive advantage (Groth, 2000; Berson, Smith and Thearling, 2000; Gardner, 1998) and building support for decision making (Gray and Watson, 1997; Shim et al., 2002) and customer satisfaction (Berry and Linoff, 2004; Xu, Yen and Lin, 2002; Hui and Jha, 2000), its implementation is not always successful. While the data warehousing concept continues to attract interest, many data warehousing projects are not only failing to deliver the benefits expected of them, as discussed above, they are proving to

be excessively expensive to develop and maintain (Manning,1999). According to Koch (1999) fifty percent of these multimillion dollar projects fail to meet the desired levels of success.

The reality of data warehousing is much more risky and difficult than the promise. One of the most recent, high profile and highly visible failures of data warehouses was the Virtual Case File commissioned by the FBI costing more than a \$175 million (Goldstein, 2005). VCF was commissioned as a response to September 11, 2001 incident, to allow US federal agents and intelligence agencies to share vital investigative information, and develop a system to help spot patterns that might signal a future attack by terrorists on the United States of America. This failure has been the subject of a study by Goldstein (2005). He suggests that the organizational structure, communication and implementation were the key reasons of failure. Vassiliadis (2002) in his study of data warehouses has identified sociotechnical and procedural factors as factors contributing to the failure of data warehouses, apart from design and technical factors.

1.4 Purpose of study

The objective of this research is to understand the role of strategic alignment in the success of data warehouse implementation. While researchers have attributed various causes, ranging from technical to organizational reasons for failure of data warehouse, the underlying strategic alignment issues have not been understood in detail. Various researchers have identified different factors that affect successful implementation including, project sponsorship (Hwang et a, 2004), architecture selection (Zhou et al, 2000; Little & Gibson, 2003; Tyagi, 2003; Peacock, 1998; Inmon, 1998; Murtaza, 1998; Sigal, 1998; Hoven 1998), technological sophistication (Triantafillakis et al, 2004; Zeng et al, 2003; Srivastava & Chen, 1999; Shahzad, 1999; Sigal 1998), user participation (Gorla,2003; Guimaraes, Staples & McKeen,

2003; Nah, Tan & The, 2004) and data quality (Lee et al, 2004; Sinn, 2003; Fisher et al, 2003; Armstrong, 1997; Redman, 1995).

However, each data warehouse system has an organizational specific set of requirements, constraints, issues and implications that need to be addressed. There is no 'one strategy fits all' solution to these problems. It can be easily envisioned that a standard approach to all projects is not feasible. Every data warehouse has its own issues of architecture, design, technology, data quality and user that change with every organization. Addressing these factors alone, as was attempted in the VCF study (Goldstein, 2005), does not guarantee the implementational success of the data warehouse. This research postulates that success depends on being able to align the data warehouse to the business plans and strategy. It explores the question – What role does the alignment of the data warehouse to business plans and strategies have in the success of data warehouse adoption?

The challenge of aligning the data warehouse to the business strategy is at the heart of this research. The achievement of this alignment is important as data warehouses are being built to advance the strategic initiatives of an organization (Raghupati and Tan, 2002; Cooper et al., 2000; Gray and Watson, 1998). Data warehouse technology enables the strategic use of information (Sammon and Finnegan, 2000). According to Counihan, Finnegan and Sammon (2002) data warehousing had emerged as a response to the problems encountered by those trying to implement decision support systems for strategic management. With the substantive and persuasive changes that this technology is enabling, it is no longer possible to have a disconnect between an organization's strategic plans, goals and directions and its IT initiatives, resources and management (Hitt, 2001).

1.5 Strategic Alignment

Organizations allocate considerable resources to data warehouse projects, but there has been very little discussion on how to achieve strategic alignment between the data warehouse and the business plans, to ensure its success. Discussion on managerial or strategic issues of data warehousing have been rare. There is no study that empirically investigates the relationship between strategic alignment and data warehouse success. Though the need for commitment and support from top management has been identified as a critical factor (Wixom et al, 2001), no specific guidelines have been discussed on how to attain this. One of the questions that needs to be answered is whether strategic alignment can resolve managerial and strategic issues in data warehousing.

The number of technologies and software capabilities that exist are more than what a business could ever possibly adopt. The key issue for companies is not the availability of technology but choosing which technology to deploy and to what purpose. Businesses have invested billions of dollars in information technology to date, yet studies like Ryan and Harrison (2000) indicate that over 50 percent of IT implementations actually cost more than twice their original estimates and the same can be said of data warehouse implementations (Wixom et al., 2001). A lack of foresight in the IT investment decision process has been cited for this diminishing payoff (Schniederjans and Hamaker, 2003) while others cite a need to deploy information technologies in ways that are of the most relevance to the businesses and its strategic objectives (Andal-Ancion et al., 2003, Kearns and Lederer, 2003, Talon et al., 2000). This is applicable to data warehouse, too. Data warehouses are large expensive projects (Manning, 1999) often built to address the strategic objectives of an organization (Raghupati and Tan, 2002; Cooper et al., 2000) and have had a high rates of failure (Hwang et al., 2004; Chenoweth et al.) in realizing benefits.

1.6 Current Status of Strategic Alignment Research

The concept of strategic alignment is more than two decades old (McLean and Soden, 1977; Chan et al., 1996; Henderson and Venkatraman, 1990) but improving IS/IT strategic planning continues to rank among the major issues facing IT executives. Strategic alignment has been identified as one of the most critical IS research issues facing academic researchers (Lee and Bai, 2003). IS strategic alignment has been among the top five challenges faced by senior executives over the past few decades (Chan et al., 1996; Chan and Huff, 1993) and continues to be of increasing importance today. The reason for the interest in strategic IS alignment is because it has shown to enhance not only IS success but organizational success as well (Hirschheim and Sabherwal, 2001).

Several frameworks have been proposed in the literature to study and explore alignment between IT and business strategy (Henderson and Venkatraman, 1990; Chan et al., 1996; Shin, 2001; Tallon et al., 2000; Kearns and Lederer, 2003; Prahalad and Krishnan, 2002; Loebbecke and Wareham, 2003; Pollalis, 2003; Bai and Lee, 2003; Eck et al., 2000; Maes et al., 2000; Burns, 2000; Hirschheim and Sabherwal, 2001). The concept of strategic alignment proposed by Henderson and Venkatraman (1990) is based on two building blocks: strategic fit and functional integration. Findings by Chan (1996) lend support to the view that examining isolated components of strategy and performance can be misleading. Shins (2001) research provides empirical evidence for the importance of aligning IT with business strategies such as vertical disintegration and diversification. Tallon et al. (2000) focused on process level measures and found that management practices such as strategic alignment and IT investment evaluation contribute to higher perceived levels of business value.

Studies by Kearns and Lederer (2003) provide an explanatory framework of the alignment-performance relationship within the context of a resource based view and furnish several new

constructs. The issue of flexibility in strategic planning has been explored by (Loebbecke and Wareham, 2003; Prahalad and Krishnan, 2002; Wixom and Watson, 2001). Loebbecke and Wareham (2003) find that strategy and strategic planning needs to embrace greater flexibility to nurture creativity and innovation.

Bai and Lee (2003) investigate the organizational factors that influence the quality of the IT strategic planning process and the organizational mechanisms for success in strategic planning. Burn and Szeto (2000) contend that effective alignment of IT and business strategies can be attained by means of Strategic Information Systems Planning (SISP).

Though many researchers, as shown above have explored alignment between IT and business strategy, researchers in this field have largely confined themselves to theoretical issues and practical generalizations. Notwithstanding the importance of strategic alignment model, it is difficult to apply the model in practice (Van Eck et al., 2004). They contend that given a particular alignment case study, there are no objective, concrete criteria to determine which of the alignment perspectives play a role in the case. No study has focused on how organizations actually achieve alignment.

1.7 The Gap

The gap between practitioners and researchers is widely discussed in the IT community. The situation regarding data warehousing follow the same pattern where practitioners complain that their practical problems are overlooked by research (Vassiliadis, 2002). There is very little reference to alignment issues in data warehousing in the literature. Little research and insight exist to guide the successful development and implementation of data warehouses that align to business goals and strategies. To date, there is no study that has focused on how

organizations actually achieve alignment while developing or implementing a data warehouse project. There are no practical design guidelines to achieve strategic alignment at an operational level. There is little empirical evidence on how to carry out alignment in a large project like data warehouse.

Most researchers focus on the technological and operational aspects of data warehouse. There is very little research addressing the managerial or strategic aspects of data warehouse. These aspects have a significant impact on data warehouse adoptions but have received very little attention so far. This research attempts to address this gap.

1.8 Contribution of this research

This research examines the impact of strategic alignment on successful adoption of data warehouse. The goal of this research is to develop a model to facilitate the alignment between data warehouse and business strategy. Interest in strategic alignment of the data warehouse implementation to the business strategy is warranted because it is argued that organizations are unable to realize sufficient value from their investments in data warehouses (Wixom and Watson, 2001; Frolick and Lindsey, 2003; Wells and Thomann, 1995). It is postulated that alignment of the data warehouse strategy to business strategy would contribute to greater success of data warehouse implementations.

This study reviews existing empirical studies on data warehousing and strategic alignment, and then investigates factors that may be useful in implementing data warehouses. The literature review identifies and classifies factors that may facilitate the alignment between business strategy and data warehouse projects. As data warehouse implementations are expensive and time consuming, concentrating on the strategic alignment factors could result

in economic benefits for the organization. A practical model of how to achieve such alignment could result in significantly improved and successful data warehouse implementations. This study contributes to knowledge through synthesizing a diverse literature on data warehousing and strategic alignment, and by providing a set of comprehensive factors that can be used to study the alignment of data warehouses to business strategy and plans.

This research provides a pathway for facilitating successful adoption of data warehouse. The model developed in this research allows data warehouse professionals to ensure that their project when implemented, achieve the strategic goals and business objectives of the organization. The model presented in this research and the strategic alignment factors identified will guide the data warehouse participants at all levels in uncovering and addressing data warehousing alignment issues that may previously have remained untouched.

A secondary contribution of this research is the development of a set of interview and questionnaire instruments to capture data that impacts the alignment of data warehouse to business strategy. The questions have proven to be effective in eliciting the responses that facilitate the evaluation of the data warehouse in two different industries.

1.9 Research Methodology

The research methodology adopted in this research was the case study research method (Yin, 2003; Stake, 1995; Benbasat, Goldstein and Mead, 1987). The case study approach was found to be particularly suited to address the research question as the case studies provided the organizational context for the study of the relationship between data warehouse technology and business strategy. The case study approach recognized the complexity of the research

question undertaken and assessed the data warehouses in its natural, unaltered setting. It explored in depth into complexities and processes of a data warehouse and its alignment to business strategies and goals.

A two-case case study was conducted versus a single case study to strengthen the robustness, reliability and external validity of the findings. Two cases strengthen the results by replicating the pattern-matching and eliminating chance associations (Eisenhardt, 1991). Two cases in two different industry sectors, media (Nielsen Media Research) and finance (Raymond James Financial) test the applicability of the research model to diverse sectors, making it general and not industry specific. The approach taken in the case studies was in-depth and comprehensive.

Evidence for the case studies was collected from documents, interviews, questionnaires and observation. The interview instruments and the questionnaire were designed keeping the research question and research propositions in mind. Data analysis consisted of examining, categorizing, tabulating and recombining both qualitative and quantitative evidence to address the theoretical propositions made in this study. The individual case study report for each site was reviewed by two participants in each case for completeness and accuracy. The individual case reports analyzed the data and linked it to the research propositions. A cross case analysis evaluated the research propositions and the research model and drew conclusions.

1.10 Organization of Remaining Chapters

The remaining thesis is presented in the following chapters.

Chapter 2 presents a review of current research on data warehousing. It introduces the data warehouse technology and discusses its benefits and features. It discusses the components and complexity of the development process of the data warehouse and presents the data

warehouse architectures. This chapter also discusses the factors affecting the success of a data warehouse.

Chapter 3 reviews existing studies on strategic alignment with respect to IT. It discusses the need for aligning IT with business strategy and presents the Strategic Alignment Model and its constituents. This chapter also discusses recent developments in strategic alignment research and presents the alternatives to the Strategic Alignment Model. It discusses the factors that enable alignment between IT and business and presents the research propositions. Based upon the research propositions, the research model is also proposed in this chapter.

Chapter 4 discusses the research methodology used to conduct this empirical research. It reviews the existing research approaches used in information systems and justifies the choice of case study as an appropriate research method for the current research. It describes the criteria for case selections and the conduct of the case study. It discusses data collection through interviews and questionnaire and the conduct of the interviews. It also discusses the design of the interview instruments and questionnaires.

Chapter 5 presents the findings from the case study conducted at Nielsen Media Research. It presents the data collected through the interviews and questionnaires to the participants. Analysis of the research findings based on the research propositions is also presented in this chapter.

Chapter 6 presents the findings from the case study conducted at Raymond James Financial. It presents the data collected through the interviews and questionnaires to the participants. It also presents the analyses of the research findings, based on the research propositions.

Chapter 7 discusses the research findings based on the two case studies and arrives at conclusions. It also presents the assumption and limitations of this research and makes recommendations for future research.

Appendix 1 discusses the design of the research instruments used to conduct this empirical research. It presents the interview questions and the design of the questionnaires based on the conceptual model.

Appendix 2 contains the interview transcripts from all the participants in the case study conducted at Nielsen Media Research.

Appendix 3 contains the interview transcripts from all the participants in the case study conducted at Raymond James Financial.

Appendix 4 contains the raw questionnaire data from all the participants in the case study conducted at Nielsen Media Research and Raymond James Financial.

2 LITERATURE REVIEW ON DATA WAREHOUSE

The objective of this research is to study the impact of strategic alignment on the successful adoption of data warehouses. This chapter introduces the data warehouse technology at the focus of this research. It presents a review of existing research and literature on the data warehouse. This chapter is divided into seven sections. The first section discusses the benefits of a data warehouse. The second section presents the features of a data warehouse. The third section differentiates between data warehouse and traditional operational systems. The fourth section discusses the components and complexity of the development process of the data warehouse. The fifth section presents the data warehouse architectures. The sixth section discusses the factors affecting the success of a data warehouse. The final section summarizes the review.

2.1 Benefits of a data warehouse

William Inmon (1996) defined data warehouse as “A subject-oriented, integrated, non-volatile, time-variant collection of data in support of management’s decision-making process”. A data warehouse equips its users with effective decision support tools by integrating corporate wide data into a single repository from which end users can run reports and perform ad hoc data analysis (Meyer and Cannon, 1998). A data warehouse helps reduce costs, increases value added activities and improves efficiency (Zeng et al. 2003). It is said to provide enhanced data storage and data access functionality.

Organizations are increasingly recognizing the possibilities and implications of data warehousing. Data warehousing has been found to be a useful technology for a large number of modern applications (Rundensteiner et al., 2000). Such applications range over diverse domains such as business, leisure, health (Schubart and Einbinder, 2000), science, libraries and education. Today, improved access to timely, accurate and consistent data needs to be

shared easily with team members (Little and Gibson, 1999), decision makers and business partners for efficient decision making. Many companies have recognized the strategic importance of knowledge hidden in their large databases and have therefore built data warehouses (Ester et al., 1998). Data warehouses provide the foundation for effective business intelligence solutions for companies seeking competitive advantage (Chenoweth et al., 2006). The data warehouse provides five main benefits to an organization:

Decision Support – The strength of the data warehouse is its organization and delivery of data in support of management’s decision making process (Meyer and Cannon, 1998). Traditional databases are incapable of handling the demands for increasing online information retrieval, access, update and maintenance. These limitations affect the managements’ efficiency and ability to make reliable decisions in a timely manner (Hwang et al., 2004). A data warehouse is an effective way to provide business decision support data by integrating information and making it available for querying and analysis (Widom, 1995). It is a way of organizing business information that can provide better visibility to management and more insight than the traditional information systems used to support day-to-day operations (Williams, 1999).

Data analysis – Data warehousing is gaining popularity as organizations realize the benefits of being able to perform sophisticated analyses of their data (Srivastava and Chen, 1999). The data warehouse provides opportunities for performing data mining tasks such as classification and clustering (Ester et al., 1998). The advantage of a data warehouse in an organization is that it allows decision makers to analyze data without interfering with the transaction processing system. In a data warehouse, data is periodically replicated from operational databases and external providers of data, and is conditioned, integrated and transformed into a read-only database to discern patterns of behavior, support decision support systems and enable online analytical processing (Little and Gibson, 2003). Data warehouses also help in

accessing, aggregating and analyzing large amounts of data from diverse sources to understand historical performance or behavior and to predict and manage outcomes.

Enhanced integrated data – A data warehouse supports decision-making and business analyses by integrating data from multiple, incompatible systems into a consolidated database (Meyer and Cannon, 1998). In a data warehouse the data is not only integrated across different functional units of the organization but also includes external entities such as customers and suppliers. Data warehouse minimizes data redundancies and eliminates inconsistencies in data. The data warehouse also integrates data across time to provide views obtained from trend analysis of the data.

Improves efficiency - The importance of data warehousing rests on many aspects and results in many organizational benefits. The data warehouse provides a ‘single version of the truth’ (Agosta, 1999; Watson et al., 2004) and better data analysis. The data warehouse can shrink the information delivery time between an event’s occurrence and business decision making. Data warehouses can save time for its users, facilitate the development of new applications and provide support for customer focused business strategies. The data warehouse empowers users as it supports end user analytical activities (Zeng et al., 2003).

Customer management - A data warehouse provides the foundation to build a customer relationship management (CRM) strategy. Tyagi (2003) contends that a successful business will be one that understands its customers’ behavior at the most granular level. CRM involves capturing customer data, consolidating, integrating, analyzing data and using the results to respond to the current and potential needs of the customer (Praskey, 2001). The payoffs from a CRM include not only acquisition of new customers (Dyche, 2002) but

increased customer retention (Berson et al., 2000) as well as revenue (Swift, 2000) from existing customers.

The above discussion highlights the importance of a data warehouse to an organization. It shows that a data warehouse can have a strategic as well as long term value for an organization. However, building a data warehouse is a complex process (Chaudhuri and Dayal, 1997; Gardner, 1998). Designing a data warehouse requires techniques completely different from those adopted for operational information systems (Chaudhuri and Dayal 1997; Golfarelli and Rizzi 1998). The complexity of its development and implementation lies in the unique features of a data warehouse. The features of the data warehouse, the differences between a data warehouse and traditional operational systems, and the data warehouse components and development process, are examined in the following sub-sections.

2.2 Features of a data warehouse

Over the years various researchers have refined the definition or broadened the scope of the data warehouse definition, but the essential characteristics still remain the same. According to Ester et al. (1998) a data warehouse is a collection of data from multiple sources integrated into a common repository and extended by summary information for the purpose of analysis. Similarly, Rundensteiner et al. (2000) find that data warehouses have emerged as one key technology for the integration of distributed information sources. Gardner (1998) defines data warehousing as “a process, not a product, for assembling and managing data for the purpose of gaining a single, detailed view of part or all of a business”. The main features of a data warehouse are summarised below:

Subject oriented - In a data warehouse, data is organized according to subject instead of applications (Chaudhuri and Dayal, 1997; Gardner, 1998; Tryfona, et al., 1999). A subject area identifies and groups processes that relate to a logical area of the business.

Integrated - The warehouse contains integrated data about a particular subject instead of the ongoing operations of the organization (Debevoise, 1999; Inmon, 1996; Rahm and Do, 2000). In a data warehouse the data is not only integrated across different functional units of the organization but also includes external entities such as customers and suppliers.

Time variant - A major strength of data warehouse lies in the time-variance of its data (Pedersen and Jensen, 1998; Han et al., 1998). The value of the operational data archived in the data warehouse is a function of time and changes on the basis of time. A data warehouse gives an accurate picture of operational data for a given time and changes in the data in the warehouse are based on the time based changes in operational data.

Historical - Unlike operational systems that require real time views of data, data warehouse applications generally deal with long term, historical data (Chaudhuri and Dayal, 1997; Ballou and Tyagi, 1999; Gardner, 1998). Data warehouses generally contain a greater volume of more detailed information over a longer period of time (Zeng et al., 2003). They contain both atomic (Gardner, 1998; Chaudhuri and Dayal, 1997) and summarized (Widom, 1995) data. Atomic data (such as source data or raw data) is data that has not been processed for meaningful use. Summary data represents data that has already been aggregated (for example a summary table containing total sales by product by year). The storage and manipulation of summary data reduces the amount of processing required by a query. The warehouse data is non-volatile in that the data that enter the database are rarely, if ever changed.

2.3 Difference between data warehouse and traditional operational systems

The following table adapted from Sperley (1999) presents a comparison between the characteristics of a data warehouse versus those of an operational system.

Table 2.1 Comparison of data warehouse and operational systems.

DATA WAREHOUSE SYSTEMS	OPERATIONAL SYSTEMS
Used by management	Used by front-line workers
Strategic value	Tactical value
Supports strategic direction	Supports day-to-day operation
Used for on-line analysis	Used for transaction processing
Subject oriented	Application oriented
Stores historical data	Stores current data only
Unpredictable query pattern	Predictable query pattern

As seen in the table above, the data warehouse is an decision support tool used by management (Chau et al., 2003; Chaudhuri and Dayal, 1997; Wixom and Watson, 2001) unlike operational systems (Sumner, 2000) used for transaction processing (Jiang et al., 2000). Operational systems are designed and optimized to handle the transactions of running the business (Klenz, 2001). Operational systems do not analyze data to allow higher-level decisions to be made as in a data warehouse. Data warehouses supply information to managers, in the form of periodic reports (Chen et al, 2000) to support decision-making.

The data warehouse has strategic value for information management and decision support in organizations (Cooper et al., 2000; Shin, 2002; Watson et al., 2002) such as gaining competitive advantage or customer relations advantage. Operational systems, on the other

hand have tactical value in the organization (Schmidt, 2000; Shapiro, 2001; Talluri, 2000), for example, cost efficiency, accuracy, ease of processing order entry or speedup/reduce paperwork.

Whereas operational systems handle day-to-day workings of the business, a data warehouse supports the strategic direction (Cooper et al., 2000; Watson and Haley, 1998) of the organization.

The operational database which continuously produces operational data is based on on-line transaction processing applications, whereas a data warehouse is based on online analytical processing applications (Lee et al, 2001). On-line analytical processing enables the data warehouse end-user to gain insight into data through fast, consistent and interactive access to a wide variety of possible views of information that has been consolidated and transformed from raw data (Vassiliadis and Sellis, 1999). The concept of normalizing data in a transaction system is not applicable to data warehouses (Gray and Watson, 1998). A data warehouse continuously produces analytical information for business users. Since search and analysis efficiency is more important in a data warehouse, data warehouses are not fully normalized and contain derived or calculated data that would not be included in a transaction based database (Moody and Kortink, 2000).

In an operational system, data is organized around functional organizations within a business, to satisfy the immediate functional processing requirements of the business (Gardner, 1998). On the other hand, a data warehouse stores data that is subject oriented with an enterprise view, integrating information from across functional units (Gardner, 1998). A data warehouse collects information from multiple systems and stores it in a fashion that allows end users to have faster, easier, and more flexible access to key information (Edwards, 1994).

A data warehouse stores mass volumes of historical data in its data base system for fast analysis and reporting (Anton, 2000; Berndt et al., 2003) unlike operational systems that contain current transactional data (Chau et al., 2003; Moody and Kortink, 2000).

The data warehouse can support unpredictable queries (Moody and Kortink, 2000) unlike an operational system that employs predictable query patterns. The Online Analytical Processing (OLAP) system in a data warehouse provide an information structure that allows an analyst to have a flexible access to data, to slice and dice data in numerous ways, and to dynamically explore the relationship between summary and detailed data (Hristovski et al., 2000).

As discussed above, a data warehouse differs in many ways from a traditional operational system. The data warehouse supports management decision-making and plays a role in supporting the strategic direction of the organization, It also integrates enterprise-wide data and provides sophisticated analyses of the data (Srivastava and Chen, 1999) facilitating business understanding (Inmon, 1996; Sullivan, 2001). Therefore, it appears that for an effective implementation of the data warehouse in an organization, aligning the data warehouse to business goals and strategies would be an appropriate and necessary measure.

The day-to-day management of the data warehouse is also different from the management of an operational system (Chaudhuri and Dayal, 1997), because the volumes can be much larger (Chaudhuri and Dayal, 1997; Gardner, 1998) and require more active management (Hammer et al., 1995), such as creating/deleting summaries, or rolling data on/off the archive. In essence, a data warehouse is a database that is continually changing to satisfy new business requirements (Gardner 1998).

In practice, data warehouses must be designed to change constantly to adapt to changes in the business arena (Armstrong, 1997). In order to provide this flexible solution, Anahory and Murray (1997) have found that the process that delivers a data warehouse has to be fundamentally different from a traditional waterfall method. The waterfall method is a sequential software development method in which development flows downwards (like a waterfall) through the phases of requirement analysis, design, implementation, testing, integration and maintenance. The underlying issue with data warehousing projects is that it is very difficult to complete the tasks and deliverables in the strict, ordered fashion demanded by a waterfall method. This is because the requirements are rarely fully understood, and are expected to change over time (Mohania and Dong, 1996; Strong et al., 1997). The development process of the data warehouse and its complexity is discussed in the next section.

2.4 Data warehouse development process

The core business processes of many organizations are becoming more dynamic and complex because of globalization and evolving technology (Landry et al., 2004). Agosta (1999) asserts that data warehousing is a system architecture, not a software product or application. Similarly, Manning (1999) believes that the data warehouse was intended to provide an architectural model for the flow of data from operational systems to decision support environments. Building a data warehouse requires the integration of many tasks and components and coordination of efforts of many people (Kimball, 1998). A number of researchers (Murtaza, 1998; Meyer and Cannon, 1998) have identified various data warehousing components and dimensions. However, these dimensions are often overlapping. The following section organizes the essential components for defining and understanding data warehouses and supports a methodical approach to present the data warehousing process.

A data warehouse can be categorized into six major components as:

- Data Sourcing
- Data conversion and extraction
- Data warehouse DBMS
- Data warehouse administration
- Business intelligence tools and
- Metadata

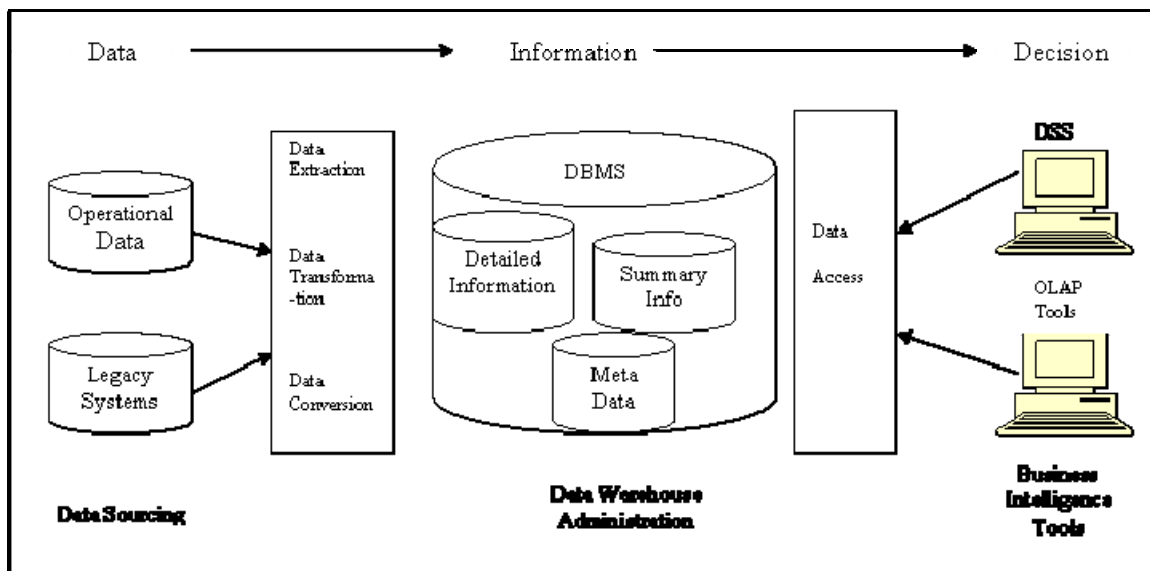


Figure 2.1 Architecture of a Data warehouse

These data warehouse components and their strengths are discussed in this section. Figure 2.1 illustrates the overall architecture of a data warehouse by identifying the major components and how data flows through the system.

- *Data sourcing*- Building a data warehouse is a complex and lengthy process. To build a data warehouse, first, the information needs of the organization have to be identified. This in turn helps to determine the data requirements that fulfill these information needs. These requirements are used to develop a data model that provides business

reasons for building a data warehouse (Little and Gibson, 2003). Sources of data are then identified in the transactional legacy systems, Enterprise Resource Planning (ERP) and e-commerce systems.

- *Data extraction and conversion* - The next step in building the warehouse is data preparation and data cleansing. It involves the extraction of source data, transformation into new forms and loading into the data warehouse environment. As organizations realign their information infrastructure toward integrated data warehouses and decision support systems, the complex problem of accurately identifying and merging databases becomes critical (Berndt and Satterfield, 2000). According to Manning (1999), the cost of extracting, cleaning and integrating data represents 60-80% of the total cost of a typical data warehousing project. Ensuring high quality data is one of the most difficult challenges faced in data warehousing (English, 1999; Wixom and Watson, 2001).
- *Data warehouse Database* - At the core of the data warehousing system lies a good data management system. The database server used for a data warehouse is responsible for the provision of robust data management, scalability, high performance query processing and integration with other servers (Shahzad, 1999). Warehouse servers can be categorized into two types: Relational Database Management System-RDBMS (Gardner, 1998; Vassiliadis, 2000) and Multi-Dimensional Database-MDD (Dinter et al., 1998). The implementation of RDBMS is based on a two-dimensional relationship of related data called tables (Blaha and Shen, 1994; DeFazio et al., 1995). MDD can be viewed as a cube, where information is piled on the various axes or dimensions of the cube (Buzydlowski et al., 1998; Li and Wang, 1996; Niemi et al., 2003). It is a technique that allows multi-part questions to be posed of the database.

For example, instead of a report on revenue by branch, MDD might report revenue by branch, sub divided by product lines and by region (O Sullivan, 1996). RDBMS has an edge on MDD when considering its huge data storage capacity, portability issues or security. MDD is popular for its instant response, implementation ease and integration with meta data (Shahzad, 1999).

- *Data warehouse administration* – Data warehouse brings many complex administration issues that are different from transactional or decision support applications (Benander et al., 2000). Data warehouse administration keeps the data warehouse environment working. With the number of subject areas and amount of historical data, a data warehouse requires significant amounts of disk storage and extensive planning (Chaudhuri and Dayal, 1997; Gardner, 1998). Data warehouse administration provides query management (Gupta et al., 1995; Widom, 1995), access control (Date, 1999; Gardner, 1998; Roussopoulos, 1998), disaster recovery (Armstrong, 1997; Sen and Jacob, 1998), tool integration (Armstrong, 1997; Freude and Konigs, 2003; Muller et al., 2000; Sen and Jacob 1998), directory management, security (Gardner, 1998; Katic et al., 1998), request control (Agrawal et al., 1997), capacity planning (Chaudhuri and Dayal, 1997), data usage auditing (Gardner, 1998; Vassiliadis et al., 2000), and user administration (Chaudhuri and Dayal, 1997; Katic et al., 1998). Effective governance is considered a key to data warehouse success (Watson et al., 2004).
- *Access and business intelligence tools* - Once the data is loaded into the database, various access tools are used for end user interaction. Gray and Watson (1998) define access tools as decision support tools that allow users to analyse information with ease. The selection of the right end-user tool is important as the ease of use and range

of functions provided by the access tools determine the user's perception of the value and success of the data warehouse. These tools could be a set of query generation and reporting tools. The main goal of these tools is to remove the SQL generation of the query from the end-user and make the data easily accessible (Armstrong, 1997). Or they could be more sophisticated OLAP and ROLAP (relational OLAP) tools for multi-dimensional analysis and data mining (Meyer and Cannon, 1998). OLAP operations roll-up (increase the level of aggregation), drill-down (increase details), slice-and-dice (selection and projection) and pivot (re-orient) the multi-dimensional view of data (Chaudhuri and Dayal, 1997). ROLAP enhances query performance by selecting and materializing in summary tables, appropriate subsets of aggregate views that improves overall aggregate query processing (Dehne et al., 2003; Kotidis and Roussopoulos, 1998).

Being able to consolidate and analyse data for better business decisions can often lead to competitive advantage. Business intelligence tools uncover and leverage these advantages (IBM, 1999). The most common business intelligence tool used by organizations is data mining. Mining the data warehouses provides new insights into value adding business processes, customer buying patterns, fraudulent activity and product profitability. *Data mining* can be defined as analyzing the data in large databases to identify trends, similarities, and patterns to support managerial decision making (Zorn et al., 1999). Data mining models fall into three basic categories: classification, clustering, and associations and sequencing. Data mining allows end users direct access and manipulation of data from within the data-warehousing environment without intervention of customized programming (Oakley, 1999). Data mining incorporates a variety of tools and processes that can work independently or

together to analyse and discover relationships in collections of data (Landry et al., 2004).

Landry et al. (2004) divide data mining into primarily two types. The first, *directed* data mining, is designed to test and measure expected patterns of business behavior. The second style, *undirected* data mining, seeks patterns or relationships without any preconceived expectations or hypotheses. Data mining then lets users search large volumes of data for patterns that can be generalized in order to improve future decisions.

- *Metadata* - Another important component of a data warehouse is the *metadata*. Metadata is data about the data. It is data that is used to describe other data. It indexes information and monitors its use (O Sullivan, 1996). It plays an important role in the loading, organization and utilization of data all through the data warehouse life cycle (Shi et al., 2001). Kimball et al. (1998) define metadata as “all the information in the data warehouse environment that is not the actual data itself”. Organizations need metadata for tool integration, data integration and change management. In the context of the data warehouse, Sen (2004) describes metadata to be of two kinds: back room metadata and front room metadata. The back room metadata guides the extraction, cleaning and loading processes. The front room metadata is more descriptive and helps query tools and report writers.

In the last 30 years there has been a tremendous growth in the use of metadata in developing information systems, especially in the world of databases and data warehouses (Sen, 2004). But it has largely been perceived as a technology solution. Meta data management has become increasingly important in data warehousing since

organizations view data as a strategic resource and data warehouses make it available for decision making. Gatzui et al. (1999) point out that only if data is linked to clear business terms, it obtains meaning for the end-user of the data warehouse. Shankaranarayan and Even (2004) point out that while the benefits of metadata and challenges in implementing metadata solutions are addressed in practitioner publications, explicit discussion of metadata in academic literature is rare.

In a data warehousing environment, the end-users access data directly using query tools rather than relying on reports generated by IT specialists. Since metadata empowers the data warehouse users by helping them meet their own informational needs, finding where data exists, what it represents and how to access it (Lee et al., 2001), managing changes in metadata becomes important to keep the data warehouse aligned to business needs. A flexible data warehouse would remain more resilient to changes in analysis requirements over time (Moody and Kortink, 2000) and therefore better aligned to business needs and strategies.

To manage change in metadata, Sen (2004) proposes that a metadata warehouse be designed to store metadata and manage its changes, for organizational decision support. Little and Gibson (2003) contend that the metadata model must be sustainable for many years, to provide consistency. The metadata model should be flexible enough to provide growth of the data warehouse while consistently providing integrity for data mining and DSS.

A data warehouse plays an important role in integrating enterprise information. Shankaranarayan and Even (2004) contend that integrated management of metadata has not been adequately addressed by researchers. As data warehouses aggregate vast

amounts of information, integrating data warehouse with its metadata offers an opportunity to create a more adaptive information system. Lee et al. (2001) have proposed a metadata oriented data warehouse architecture that consists of seven components: legacy system, extracting software, operational data store, data warehouse, data mart, application and metadata. They point out that metadata must be integrated with data warehousing systems because without metadata, the decision support of data warehouse is under the control of technical users. As data warehouse evolves, extracting data from online transaction processing systems to data warehouse becomes more complex. If metadata is integrated with data warehouse, the extraction can be automatic.

2.5 Data warehouse Architectures

Data warehouse has emerged as a key technology for integration of distributed information sources (Rundensteiner et al., 2000) within an organization. Since data warehouses support the strategic direction of an organization, an architectural choice for building the data warehouse driven by business strategy would align the data warehouse more closely to the business strategy and goals. There is a range of architectural approaches available for building a data warehouse. According to Murtaza (1998) the scope of the business vision can dictate the architectural approach. A short - term vision would require a lower budget, quick return on investment and implementation with small resource requirement, as offered by data marts. More strategic objectives of long term gain and full organizational control would necessitate the enterprise data warehouse architecture (Murtaza, 1998). Long term success needs a forward thinking approach that aligns data warehousing technology with an organizations strategic objectives (Weir et al., 2003). The most popular architecture choices outside the enterprise warehouse model are the operational data store, DSS data warehouse and the data mart. These alternatives and the enterprise model itself are summarized below.

In an *enterprise data warehouse*, all business data from different operational and functional departments of an enterprise is integrated and stored in a single database with a single enterprise model (Zhou et al., 2000). It consists of a huge subject area and vast amounts of different operational sources.

An *operational data store* is a rudimentary data store that provides a collected, integrative (Inmon, 1993) view of volatile transactional data from multiple operational systems (Samos et al., 1998). Analysis is done by querying (using structured query language or off the shelf query tools) and reporting, without impacting the performance of the production systems. The drawback of operational data store is that because it has not been designed for decision support applications, complex queries may result in long response times and heavy impact on the transactional systems (Murtaza, 1998).

The *decision support data warehouse* architecture simply consists of snapshots of corporate information with low level or highly summarized data (Murtaza, 1998). This method has the advantages of minimal infrastructure costs, access to nonvolatile data, quick deployment time and no repetitive data stores. But the main disadvantage with this architecture is its inherent lack of flexibility to handle complex decision support analysis. The decision support data warehouse provides good historical data but fails to optimize access to the data.

The *data mart* appears to be the most common data warehouse application today. Data marts store nonvolatile, time-variant and summarized information used to serve the information needs of the business unit (Murtaza, 1998). It differs from a data warehouse in that a data mart contains customized data to support particular analysis requirements (Moody and Kortink, 2000) whereas the data warehouse data is truly corporate (Inmon, 1996). Peacock (1998)

explains the difference between a data warehouse and a data mart further. A data warehouse is an enterprise level data repository that draws its contents from all critical operational systems and selected external data sources. The data warehouse is based upon a data model which is a time and resource consuming cross-functional effort. A data mart in contrast, is a functional, subject area or departmental data repository that draws its contents from systems that are critical to the department and from selected external sources.

O' Sullivan (1996) points out that the scope of the system determines whether it is a data warehouse (enterprise-wide) or a data mart (departmental or functional). Depending upon the architecture chosen, a data mart can be constructed as individual components within the scope of a comprehensive data warehouse plan (top-down design) or due to cost and time restraints, built independently of data warehouse initiatives (bottom-up design). A major drawback of the bottom up approach as pointed out by Peacock (1998) is that the architecture of the data mart may be inconsistent with the architecture of other data marts and the data warehouse when it is finally built. Proliferation of independent data marts can yield fragmented, inconsistent data that could inhibit future development of cross-functional information. But the advantage of a data mart over a data warehouse is that it offers lower entry costs and faster implementation than a data warehouse, which typically involves a data modeling effort encompassing enterprise-wide information requirements (Sigal, 1998). Hoven (1998) points out that a data mart can be a practical first step to gain experience towards building and managing a data warehouse. Data mart could be built as a sub-set of a data warehouse (Moody and Kortink, 2000), focusing on delivering value to a specific business area. With proper planning, these data marts can be gradually consolidated under a common management umbrella to create an enterprise data warehouse.

Even though organizations can select data warehouse architectures that support their strategic vision, it has been seen that implementation efforts often fail (Vatanasombut and Gray, 1999). Implementation efforts may fail due to difficulty in use (Guimaraes et al., 2003), lack of support from management (Hwang et al., 2004) or inability to respond to business changes (Armstrong, 1997). The next section discusses factors that affect the implementation and adoption of the data warehouse in organizations.

2.6 Factors influencing the success of a Data warehouse

Success of an information system has been measured by researchers in various ways, including user satisfaction (Chen et al., 2000; DeLone and McLean, 1992), data quality (Ballou and Tayi, 1999; McFadden, 1996), return on investment (Cooper et al., 2000; Shin, 2003) and perceived benefits (Ballou and Tayi, 1999; DeLone and McLean, 1992). Weir et al. (2003) and Watson and Haley (1998) have noted that it is difficult to put a financial value on an intangible benefit such as data or information. Wixom and Watson (2001) point out that data warehouses have unique characteristics that may shift the importance of factors that apply to it. Schubart and Einbinder (2000) have focused on future usage and perceived effectiveness as measures of success for a data warehouse. Long term success of the data warehouse is dependent upon the organization's ability to use the data warehouse to fulfill its strategic milestones (Weir et al., 2003).

According to researchers (Hwang et al., 2004; Wen et al., 1997), data warehouse projects have a high possibility of failure. Wixom and Watson (2001) estimate that one-half to two-thirds of all data warehousing fail. Though there is a fundamental change in the business environment, with demands on gathering new data, new levels of data integrity and consistency, just building data warehouses is not the solution. An organization needs to thoroughly understand the impact of a data warehouse on its operation before writing a single

line of data warehouse code. For example in a banking environment one needs to know exactly what kind of data will be required for compliance and reporting, for measuring performance and for calculating compensation before embarking on a data warehouse project (Dembo, 2004).

Companies are integrating their data and building data warehouses to create advantages, send new products and services to markets faster, provide improved customer service and reduce production and inventory costs. But many firms are failing to realize these benefits (Johnson, 2004). For some, data warehouses created to integrate data from multiple sources have a user interface that is difficult to navigate (Watson and Haley, 1998) or else there are misunderstandings about expected service levels. For others, the data generated turns out to be inaccurate or irrelevant to the user's needs (Ballou and Tayi, 1999; Strong et al., 1997), or delivered too late to be useful. As a result, it is essential to understand the factors that ensure a successful adoption of data warehouse technology. Most of the researchers in the literature review focus on the technological and operational aspects. There is very little research considering the factors at the managerial or strategic levels. This research seeks to address this weakness.

This section of the literature review identifies and discusses the factors that influence the success or failure of a data warehouse. The data warehouse literature review identifies numerous success factors that affected the implementation of data warehouses. These factors have been grouped under four broad categories by the author to facilitate a comprehensive discussion. The categories have been defined as: (a) organization factors, (b) user factors, (c) technology factors and (d) data factors. The following section discusses these factors.

2.6.1 Organization factors that influence success of a data warehouse

In the organizational dimension, factors such as the size of the organization, top management support, existence of a champion, team skills, organizational barriers and organizational culture can all affect the adoption of a data warehouse technology

Hwang et al. (2004) point out a strong correlation between the degree of business competition and the adoption of new information technology. Enterprises try to raise their perceived competitive advantage by adopting new technology, especially if their competitors have adopted or are adopting this new technology. Based on a study of the banking industry in Taiwan, (Hwang et al., 2004) conclude that the larger the *size of the organization*, the more resources and capital can be allocated to adopt new information technology.

The greatest potential benefits from data warehousing is when the data warehouse is used in the redesign of business processes and to support strategic business objectives (Watson and Haley, 1998). Securing top-level management's commitment and support, is essential before embarking on a data warehouse project. *Support and commitment from the top management* is considered important to secure the required capital, human support and internal resources during the adoption and development process (Chenoweth et al., 2006; Hwang et al. 2004). As standardization of information is a key rationale for a warehouse, inadequate co-ordination of participants can be its downfall (O'Sullivan, 1996). A strong mandate from senior management is needed to impose standards, as different areas within a company may resist changing their ways.

In many companies the decision making environment reflects a fractured approach. In these organizations different departments create separate small databases to support disjointed operational systems (Oates, 1998). Vital information exists in dozens of separate and

unrelated databases making an integrated view of the business impossible (Hurd, 2003). An enterprise wide approach to information management in the form of a data warehouse can address this problem to some extent by integrating these islands of data (Chen and Popovich, 2003).

But, often information silos exist in organizations for reasons that have nothing to do with information technology. Individual departments many times have little control over the budget for an enterprise wide approach to information management, but a great deal of control over the budget for their own silo within the company. Breaking down these *organizational barriers* is often more difficult than surmounting the technical ones. Hurd (2003) suggests that strong leadership is required to drive individuals within an organization to overcome traditional constraints and work together with one another. *Champions* are important to data warehousing as well as other IT projects as they actively promote the project and provide information, material resources and political support (Counihan et al., 2002; Hwang et al., 2004; Sammon and Finnegan, 2000; Watson et al., 2002; Wixom and Watson, 2001).

In the project planning dimension the *skills of the data warehousing development team* can have a major influence on the outcome of the project (Cooper et al., 2000; Hwang et al., 2004; Wixom and Watson, 2001). A highly skilled project team is better equipped to manage and solve technical problems. Hwang et al. (2004) point out that the selection and inclusion of appropriate users in the project team is also important. End user participation has a direct impact on the adoption of data warehouse technology (Wixom and Watson, 2001). User participation is essential for better communication and coordination of the users' needs as this ensures the system's successful implementation. End-user participation helps manage users' expectation and satisfy user requirements.

A data warehouse requires detailed *planning* involving internal operational procedures and workflow reconfiguration (Ang and Teo, 2000). A data warehouse implementation is a major event and is likely to cause organizational perturbations. Management issues pertaining to the data warehouse project provide important considerations for the project team. In the project planning dimension coordination of organizational resources including money, people and time ensures completion of the project and ultimately affects the adoption of data warehouse technology.

Cultural factors affect the planning, implementation and operation of IT applications. In organizational cultures that are data driven and data accountable, users will demand the richness of information housed in a data warehouse (Schubart and Einbinder, 2000). *Organisational culture* consists of the shared assumptions, beliefs and values that exist within an organization and how the behavior of the people is influenced by it (Doherty and Doig, 2003; Pliskin et al., 1993). With increasing integration of the global economy, one cannot ignore the cultural issues. Shanks and Corbitt (1999) suggest that culture plays a significant role in information systems while requirements gathering and in the construction of quality practice. Many IT projects fail due to a poor fit with the prevailing culture or a failure to build a culture to support change (Pliskin et al., 1993). According to (Pliskin et al. (1993) failure may occur when there is a clash between the cultural presumptions embedded in the system design and the actual culture of the implementing organization.

On the other hand, technology and information systems have had a marked impact on the way work is organized, allotted and accomplished in modern organizations (Cooper et al., 2000). Doherty and Doig (2003) suggest that implementation of data warehouses can have a significant impact upon the host organization's culture. Major changes and improvements to the flow and quality of information may have the potential to modify organizational culture,

particularly in the areas of customer service, flexibility, integration and empowerment. Doherty and Doig (2003) in their study of data warehouse implementations, found that to realize these benefits, changes were required in working practices and employee behavior, which could in turn have cultural implications.

2.6.2 User factors that influence success of a data warehouse

Data warehouses provide decision support to organizations with the help of analytical databases and OLAP tools. A data warehouse by itself does not create value (Watson and Haley, 1998). Value comes from the use of the data in the data warehouse. One of the important determinants to new technology acceptance is the perceived ease of use and perceived usefulness (Guimaraes et al., 2003; Nah et al., 2004). It has been observed (Gorla, 2003) that despite the potential benefits of data warehousing, corporations often do not provide tools to end users that they can use easily, resulting in users not utilizing the tools, millions of dollars of unused software and unrealized return on investment.

Nah et al. (2004) in their investigation on *end-users' acceptance* of enterprise systems found that factors such as perceived compatibility, perceived ease of use and attitude were significant determinants in the adoption of a system. They found that in order to create positive acceptance among end users, organizational interventions should focus on the issue of compatibility as well as the issue of technology fit with organizational context. In order for a system to be accepted by its end users, the system must not only be perceived as useful and easy to use, it is also important that the end-users perceive the system to be compatible with their values and past experiences, and to be a good fit with the organizational context.

The success of a data warehouse depends heavily on *end-user satisfaction* (Ang and Teo, 2000; Chen et al., 2000; DeLone and McLean, 1992; McFadden, 1996; Wixom and Watson,

2001). Developing a data warehouse is a difficult endeavor, but realizing significant benefits is much more difficult (Ang and Teo, 2000). As such users must undergo continual, formal and systematic training to get the most from the data warehouse. Technical system quality is important to the success of a data warehouse, but just as important is the need to understand and address the human issues involved.

The importance of user related factors like *user participation*, user training and user acceptance in the success of a system is also recognized by Guimaraes, Staples and McKeen (2003). They recognize the importance of user training as a significant factor for user participation and promote user/developer communication during the system development process to reduce user conflict.

Apart from user satisfaction, the growth of the user base is perceived as a key indicator of the success or failure of a data warehouse (Armstrong, 1997). If the data warehouse is seen as providing timely access to valuable information, then the user base grows rapidly. On the other hand, if the system is perceived as low in information value, difficult to use or lacking in capability, there will be no growth in the user community. Growth in the number of users could be the actual user community, number of users logged on to the system or the number of concurrently active users.

2.6.3 Technology factors that influence success of a data warehouse

Other reasons for failure of data warehousing projects have been the *complexity of large-scale data warehousing* and the conflicts arising from data mart activities of business units that cannot resolve conflicting objectives. To address these problems, Sigal (1998) suggests a hybrid deployment strategy. Due to business objectives and cost, time and skills restraints, he advocates a faster bottom-up data mart deployment strategy combined with a top-down high-

level data model. Such a hybrid deployment approach begins with the development of one or more data marts on a staged basis. Capabilities of cross-functional processing are anticipated during the planning phase and are implemented incrementally as the system grows.

Prototyping the data warehouse as part of the implementation process is an important factor in the success of a data warehouse. A typical prototyping practice in a data warehouse implementation involves the construction of a small data mart for an important area for which the data warehouse is being implemented. A prototype supports better understanding and functioning in an important area within the organization and helps obtain buy-in on data warehouse usefulness by organizational personnel (Little and Gibson, 2003). Tyagi (2003) adds that implementing a well designed pilot helps in anticipating costs and identifying potential stumbling blocks. Using a phased-in implementation increases the chance of success because it enables managers to monitor data integrity and system quality issues step-by-step. Companies also need to avoid ‘scope creep’ once a warehouse project has been implemented (Johnson, 2004).

Standardization in the technology platform can realize several benefits as well. Having fewer different technologies will result in faster and less costly implementations, because there will be fewer interfaces and incompatibilities. The number of project failures will be reduced because of better familiarity with technology and its capabilities. Time spent on evaluating, selecting and learning new technologies would also be saved (Sigal, 1998).

A basic requirement for a data warehouse is the ability to provide users with *accurate* (Cui and Widom, 2003; Rahm and Do, 2000) and *timely* (Inmon, 1996; Kimball, 1996; Schubart and Einbinder, 2000; Squire, 1995) *consolidated* (Chaudhuri and Dayal, 1997; Golfarelli and Rizzi, 1998; Moody and Kortink, 2000) information as well as a fast query response time

(Bernardino and Madeira, 2000; Datta et al., 1998). For this purpose stored result sets or materialized views are used where a query is answered more quickly against the materialized view than querying directly the base data stores (Mistry et al., 2001; Yang et al., 1997). A materialized view is a snapshot or replica of a target master from a single point in time. These materialized views need to be updated consistently (Gupta and Mumick, 1995). In contemporary organizations this becomes an important issue as more firms are engaging in business- to- business commerce and data exchange for seamless decision making across the value chain (Triantafillakis et al., 2004). Boundaries of organizations have become more fluid and the data sources are no more entirely internal. In these extended enterprises, data from outside the organization has to be integrated into a single repository.

One key stumbling block to rapid development of data warehouses is *warehouse population* (Srivastava and Chen, 1999). The general conclusion is that it is labor intensive, error prone and generally frustrating, leading to a number of data warehouse projects being abandoned mid-way through development. Problems arise in integrating the data due to semantic discrepancies, scalability issues and incremental updates. Semantic discrepancies arise when integrating data instances from multiple sources. Semantic discrepancies could manifest as problems in entity identification or attribute value conflicts (Srivastava and Chen, 1999). Scalability tasks can be very complex and encompass the capacity to store immense data, the ability to efficiently process queries, the capability to perform data management operations and delivering business critical availability, all at huge scale (Shahzad, 1999). Problems with incremental updates arise when data is added to an existing warehouse and must be integrated with pre-existing data (Srivastava and Chen, 1999).

The growth of the Internet has changed the way information is managed and accessed today. The availability of commercial data on the Web has given rise to the need to analyse and

manipulate these data to support corporate decision making (Bhowmick et al., 2003a; Bhowmick et al., 2003b; Kosala and Blockeel, 2000). The convergence of data warehousing and World Wide Web leads to the rise of *Web warehousing* (Bhowmick et al., 2004; Bhowmick et al., 2003b; Madria et al., 2003; Zaiane et al., 1998). A web warehouse delivers the same kinds of applications like a data warehouse solution delivers but via the web technology as opposed to client-server technology (Tan et al., 2003). The web technology adds the capability to perform the operations of search, statistical analysis and mining with business related non- data objects made up of pictures, sound graphics, video and more. Web based technologies are rapidly becoming a part of the business fabric (Jones and Kochtanek, 2002). With the rapid evolution of Internet and growth of B2B e-commerce (Zeng et al., 2003), many organizations will look to new and innovative data-mining and data warehousing technologies, such as virtual data warehousing to meet the increasing demands (Genesereth et al., 1997).

As business needs change over time, a data warehouse needs to be responsive to these changes, to be successful. A data warehouse provides customers with information to run their business. If the data warehouse can not adapt to changes in the environment, then the company loses the advantage that the information provides (Armstrong, 1997). A warehouse needs to be built with a solid foundation that is *flexible* (Rundensteiner et al., 2000; Wixom and Watson, 2001) *and responsive to business change* (Armstrong, 1997). According to Armstrong (1997), this concerns three main areas: the database, the application middleware and tool integration. In order for the data warehouse to have a long term success, all these three areas must have scalability, high availability and robust manageability. Change management (Bliujute et al., 1998) would span all the components of a data warehouse and would play a vital role in the development and overall success of a data warehouse (Jensen, 2001). To successfully manage a data warehouse, Sen (2004) argues that two conflicting goals

need to be managed: maximizing the use of the data warehouse asset while consistently achieving user expectations by continuously monitoring the effect of business change.

2.6.4 Data factors that influence success of a data warehouse

The data warehouse is an environment for the collection, management and distribution of data from various sources to the end-users (Armstrong, 1997). It allows users to ask questions across cross-functional data and gain insight when the need arises. Nevertheless, many data consolidation projects under-perform because of bad data. As data warehouses evolve, myriad *data quality* issues emerge in the form of repetition, different formats, different metrics, and multiple business definitions (Sinn, 2003). In data warehouse projects, data quality is an ongoing concern. According to Redman (1995) errors in data can cost a company millions of dollars, alienate customers and make implementing new strategies difficult. He proposes a three-step strategy to improve data quality. These steps are: (a) identifying data quality problems, (b) treating data as an asset and (c) applying quality systems to the process that create data.

Sinn (2003) suggests a *data stewardship program* as a solution to ensure good quality data. The main function of a data stewardship program is the management of an organizations data assets in order to improve and maximize the data's accessibility, reusability and quality. Data stewardship is accomplished by ensuring the engagement of senior management and the building of cross-functional teams comprising of business and technical sides. Cross-functional teams ensure that everyone understands their role in maintaining the quality of data. By increasing their awareness of what data exists and where they can find it, active use of the data is more likely. Moreover, the technical staff gains insights that allows them to fully align their work priorities with the company's overall business strategy. Similarly Armstrong

(1997) points out that the issue of data quality must be viewed from a business wide sense as it is only when the data is compared to other elements that the quality is known.

Evaluation is another way to deal with poor data quality. Examining overall data quality, performing gap analysis to identify areas that lead to bad data and reviewing existing data management programs can all help towards improving data quality (Sinn, 2003). Johnson (2004) lists eight metrics to evaluate data warehouse performance. They are: the percentage of data tables completed; data integrity; the usage rate of data tables and reports; the delivery time for requested data tables; the number of days the IT group needs to resolve problems; the number of times per day the users 'hit' the data warehouses' databases and the run time.

Despite various attempts, data quality problems continue to persist in data warehouses. Poor quality data enters from operational databases and other sources of data into the data warehouse. The conventional practice is to apply *data integrity* practices as a one time process when the data enters the database. The failure to link integrity rules to organizational changes is one of the reasons that data quality problems persists. One mechanism to solve this problem is to embed data integrity in a continuous data quality improvement plan. Lee, Pipino, Strong and Wang (2004) suggest an iterative data quality improvement process as data integrity rules are defined, violations of these rules are measured and analyzed, and then these rules are redefined to reflect the dynamic and global context of business process changes.

The effectiveness of decision-making is influenced by various factors like time constraints, time pressures and data quality. Experienced decision makers who have worked in a particular milieu for a sufficient period of time, develop a feel for the nuances and eccentricities of the data used and intuitively compensate for them. As organizations move to stored repositories like data warehouses, this intuitive feel is not preserved for many who extract data from it. As

users are increasingly removed from any personal experience with data, knowledge that would be beneficial in judging the appropriateness of the data for the decision to be made is lost (Fisher et al., 2003). *Data tagging* is a way to capture some of the knowledge regarding the data's quality and origin along with the actual data values. This is accomplished by incorporating technical metadata directly into the data warehouse design and architecture. These technical metadata tags are referenced at row level of granularity in the data warehouse. Data Quality Information (DQI) is metadata that can be included with data to provide the user information regarding the quality of that data. Fisher et al. (2003) find that it is expensive in general to generate and maintain such information. Their overall conclusion is that DQI should be made available to managers without domain-specific experience. It should only be incorporated into data warehouses used on an ad hoc basis by managers.

2.7 Summary

Data warehouse has emerged as a powerful tool in delivering information to users, creating competitive advantage and building support for decision making and customer satisfaction. Yet, Wixom and Watson (2001) point out that few academic empirical studies have been conducted on data warehousing.

The literature review reveals data warehouse have unique features that make them different from other decision support applications. Data warehouse also differs from traditional operational systems. The data warehouse implementation process described in this review shows that the data warehouse has an enterprise wide impact on the infrastructure of the organization. The literature review reveals that researchers have investigated factors that affect data warehouse implementation applying IT implementation knowledge. Researchers have identified various success factors for data warehouse implementation. These include organization factors (project sponsorship, champions, management commitment, team skills,

organizational culture) user factors (user acceptance, user participation, perceived benefits) technology factors (availability of resources, complexity, architecture selection, standardization, consolidation, warehouse population, flexibility) and data factors (data quality, evaluation, data integrity). But data warehouse implementations are still known to fail. This may be because each data warehouse system has organization specific set of requirements, constraints, issues and implications that need to be addressed. The data warehouse needs to be linked to the organizations objectives (Poon and Wagner 2001). Not all problems relevant to warehouse creation have yet been solved, and a number of research issues remain.

One such issue is the problem of aligning the data warehouse to the business strategy. A data warehouse is built to address the strategic needs of an organization. Organisations have allocated considerable resources to data warehouse projects, but there has been very little discussion on how to achieve a strategic alignment between the data warehouse and the business needs, to ensure its success. Discussion on managerial or strategic issues of data warehousing have been rare. There is no study that empirically investigates the relationship between strategic alignment and data warehouse success. Though the need for commitment and support from top management has been identified as a critical factor, no specific guidelines have been discussed on how to attain this. One of the questions that needs to be answered is whether strategic alignment can resolve managerial and strategic issues in data warehousing.

The next chapter examines the theoretical concepts and current research on strategic alignment. It provides a theoretical grounding to explore and examine whether strategic alignment between data warehouse and the business lends itself to a successful implementation of the data warehouse.

3 STRATEGIC ALIGNMENT

Researchers have not focused on strategic alignment with respect to data warehouse per se, hence this chapter reviews existing studies on strategic alignment with respect to IT as a starting point. This chapter provides a theoretical grounding to explore and examine whether strategic alignment between data warehouse and the business lends itself to a successful implementation of the data warehouse, which is discussed in the next section.

3.1 Literature review on strategic alignment

The first section of this chapter review existing literature on strategic alignment to identify factors that affect the strategic alignment of the data warehouse to business plans and strategies. The second section presents research propositions and a conceptual research model for the strategic alignment of the data warehouse.

This first section is divided into five sub-sections. The first sub-section discusses the need for aligning IT with business strategy. The second sub-section presents the Strategic Alignment Model and its constituents. The third sub-section discusses recent developments in strategic alignment research. The fourth sub-section presents the alternatives to the Strategic Alignment Model. The fifth sub-section presents the factors that enable alignment between IT and business and is followed by the conclusion.

3.1.1 Need for strategic alignment between IT and business

The use of information technology in business has transformed over the last several decades from operational utility in the 1960s to that of a competitive weapon today (Bakos and Treacy, 1986; Pollalis, 2003). This phenomenon has affected the ways organizations are managed (Brynjolfsson and Hitt, 2000) as well as the way IT affects the strategic activities of

an organization (Brynjolfsson and Hitt, 2000; Loebbecke and Wareham, 2003; Luftman et al., 1993). Technology is enabling and causing changes that are so substantive and persuasive that it is no longer possible to have a disconnect between an organization's strategic plans, goals and directions and its IT initiatives, resources and management (Hitt, 2001).

The prevailing hyper competitive markets (Kandampully and Duddy, 1999) bring pressure for businesses to shorten product lifecycles (Griffin, 1997; Lee, 2002; Lee and Whang, 2001; Calantone and Benedetto, 2000), quickly identify and penetrate new market segments (Kaplan and Norton, 1992; Srivastava et al., 1998), increase operational efficiencies (Karkkainen and Holmstrom, 2002; Vennet, 2002; Sarkis, 2000) and disintermediate supply chains and distribution channels (Rabinovich et al., 2003; Tillquist, 2002; Ho and Au, 2003). Businesses seek sustainable competitive advantage in these markets by leveraging technology to the fullest extent. In these markets, alignment between the business strategy and information technology is not a luxury but is a cost of entry (Bruce, 1998).

The number of technologies and software capabilities that exist today are more than what a business could ever possibly adopt. The key issue for companies is not the availability of technology but choosing which technology to deploy and to what purpose. Businesses invest billions of dollars in information technology yet studies like Ryan and Harrison (2000) indicate that over 50 percent of IT implementations actually cost more than twice their original estimates. A lack of foresight in the IT investment decision process has been cited for this diminishing payoff (Schniederjans and Hamaker, 2003). Others cite a need to deploy information technologies in ways that are of the most relevance to the businesses and its strategic objectives (Andal-Ancion et al., 2003, Kearns and Lederer, 2003, Talon et al., 2000).

The concept of strategic alignment is not new. It is more than two decades old (McLean and Soden, 1977; Chan et al, 1996; Henderson and Venkatraman, 1990) but improving IS/IT strategic planning continues to rank among the major issues facing IT executives. Strategic alignment has been identified as one of the most critical IS research issues facing academic researchers (Lee and Bai, 2003). IS strategic alignment has been among the top five challenges faced by senior executives over the last decade (Chan, 1996) and continues to be of increasing importance today. The reason for the interest in strategic IS alignment is because it has shown to enhance not only IS success but organizational success as well (Hirschheim and Sabherwal, 2001). Despite the recognition of the importance of strategic IS alignment, insufficient research has been conducted on how to achieve and sustain it. The difficulties in achieving and sustaining alignment have been underestimated and the path towards alignment is not an easy one.

As Henderson and Venkatraman (1989) note, strategic IT planning has evolved over the last three decades. IT planning first focused on effective allocation of the firm's resources to IT (Teo and Ang, 1999; Lederer and Mendelow, 1988). IT planning focused on the automation of processes (Mukhopadhyay et al., 1997; Bresnahan et al., 2002). The planning process employed a functional model of the business as a frame of reference. The IS planning product was a set of functional applications like marketing systems (Glazer, 1991), financial systems (Krishnan et al., 1999; Brynjolfsson and Hitt, 1995). IT architecture was developed and implemented through a series of segmented projects.

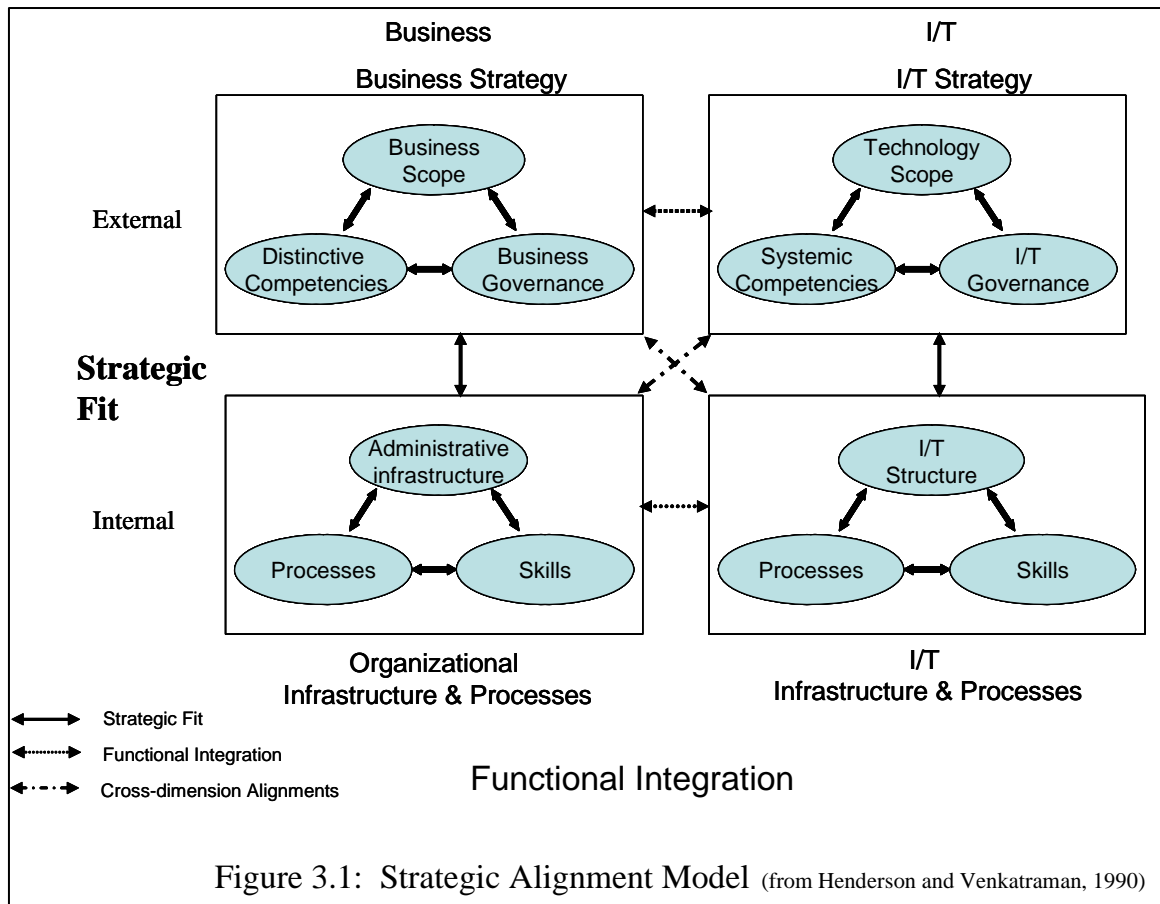
In the next era, the enterprise was the context of IS planning (Davenport, 1998, Umble et al., 2003) and cross functional integration (Fiedler, Grover and Teng, 1994) became the primary focus. IT planning decisions were extended beyond the project level. It called for an integrated strategy that explicitly recognized the potential for IT to enable business strategy.

Henderson and Venkatraman (1989) note that IT strategy is now in a third era where business strategy is not viewed as stable. The organization is viewed as facing a dynamic environment. The information technology market at the same time is also dynamic. IT is viewed as an opportunity to enhance the competitive capability of the firm (Boynton and Zmud, 1987; Ives and Learmonth, 1984). The IT planning process now must not only leverage emerging technology which is vital to business strategy but also organize the delivery of IT products and services to meet business goals. This era of IT planning has been defined as *Strategic Alignment*. The strategic alignment model combines the traditional notion of functional integration with the concept of strategic fit (Henderson and Venkatraman, 1989). Today, business and IT strategy are viewed as critical aspects of the firm's overall strategic position (Eisenhardt and Schoonhoven, 1996).

3.1.2 The Strategic Alignment Model

The strategic alignment model (Henderson and Venkatraman, 1989) is composed of four domains: (a) Business strategy (b) Organizational infrastructure and processes (c) IT strategy (d) IT infrastructure and processes. Each of the domains is composed of three components. These 12 components determine the extent and type of alignment within a corporation.

The concept of strategic alignment is based on two building blocks: strategic fit and functional integration (Figure 3.1). The *strategic fit* axis recognizes the need for any strategy to address both external and internal domains (Henderson et al., 1996). The external domain – business strategy is concerned with (a) business scope (b) distinctive competencies and (c) business governance. In contrast the internal domain is concerned with (a) the administrative structure (b) business processes and (c) the development of human resource skills.



The strategic alignment model proposes that an IT strategy should be defined in terms of an external domain – how the firm is positioned in the IT marketplace – and an internal domain - how the IT infrastructure is configured and managed. In the external dimension, IT strategy is driven by (a) Technology scope (b) Systemic competencies and (c) IT governance. The internal IT domain is concerned with (a) IT architecture (b) IT processes and (c) IT skills.

Functional integration recognizes the dynamic relationship between IT and business strategies. The strategic alignment model identifies two types of integration between business and IT domains. One is at the strategic level, looking at the potential for IT to both respond to and shape business strategy. The other is at the operational level focusing on the general organizational and IT organizational aspects of the firm.

Given the importance of strategic fit and functional integration, the use of *cross domain alignment* permits both strategic fit and functional integration to be addressed simultaneously (Papp, 2001). When this is done using a triangle construct, eight cross –domain alignments are possible. Each perspective is unique in terms of the driver or anchor domain and the related conditions. It has been argued (Henderson and Venkatraman, 1990) that four such perspectives are of particular importance to the discussion of strategic alignment. These are strategy implementation, technology exploitation, technology leverage (competitive potential) and technology implementation.

Strategy implementation is the most common and widely understood perspective corresponding to the classic hierarchical view of strategic management (Gupta and Govindarajan, 1984; Galbraith and Kazanjian, 1986; Bourgeois and Brodwin, 1992; Chaffey et al., 2000). It reflects the view that business strategy is the driver for both organizational design and IT infrastructure choices (Roth et al., 1991). The technology exploitation perspective is concerned with the exploitation of emerging IT capabilities to impact business scope and influence key attributes of strategy as well as develop new forms of relationships (Armstrong and Sambamurthy, 1999; Bharadwaj, 2000). Technology leverage is a cross domain perspective that involves developing an IT strategy in response to a business strategy and using the corresponding choices to define the required IS infrastructure and processes (Johnson and Scholes, 1993). It seeks to identify the best possible IT competencies through appropriate positioning in the IT marketplace. Technology implementation perspective focuses on the need to build an excellent IS service organization (Henderson and Venkatraman, 1989). This perspective is viewed as necessary to ensure the effective use of IT resources in a growing and fast changing world (Bharadwaj, 2000; Powell, 1997).

The strategic alignment model provides a framework to understand the substantive knowledge required to align business and technology strategies. But it does not reflect the dynamic aspect of alignment. Henderson et al., (1996) have identified four management methods for executing, evaluating and tracking different aspects of strategic alignment. These four alignment mechanisms are value management, governance, technological capacity and organizational capability. Value management is the organizational mechanism for ensuring that IT resources invested throughout the organization deliver anticipated or greater returns. The governance mechanism specifies the allocation of decision rights for IT activities to the various decision makers within the organization as well as to outside partners. It is not concerned with the day to day operational decisions but with the distribution of decision rights that is consistent with the logic and perspective of strategic alignment. Technological capability deals with the administrative process for creating the required IT capability for supporting and shaping the business strategy. Organizational capability deals with the administrative processes for creating the required human skills and the capability for supporting and shaping the business strategy.

Research that systematically investigates how to strategically align the data warehouses using these mechanisms seems non-existent. These four alignment mechanisms, value management, governance, technological capacity and organizational capability could be useful in aligning the data warehouse to business goals and strategies. Their use for achieving technical integration of the data warehouse is discussed in a later section in this chapter.

The strategic alignment model also identifies four theoretical attributes of effective IT planning process as consistency, completeness, validity and comprehensiveness. The effectiveness of the planning process increases in direct proportion to increases in planning process consistency. Validity is the degree to which a planning process can be systematically

biased. A complete and valid planning process will be most effective. Comprehensiveness focuses on the level of detail required to complete the analysis. A consistent planning process can be carried out at various levels of comprehensiveness. The level of detail generated during the process accounts for planning system performance.

The model also reflects the impact of various types of risk on planning effectiveness. Henderson et al. (1996) observe that a major reason for dissatisfaction with the level of integration between business and IT domain, and possibly the absence of value derived from IT investments, lies in the lack of understanding of the enabling strategic choices that bind a business strategy to the IS infrastructure. This may also be true in the case of data warehouse implementations as a large number of data warehouse implementations have been known to fail (Hwang et al., 2004; Wixom and Watson, 2001).

3.1.3 Developments in Strategic Alignment Research

Various attempts have been made to improve the understanding of the concept of IS strategic alignment and to extend upon it. Instruments to measure IS strategy and IS strategic alignment have been developed and evaluated (Chan et al., 1997; Chan, 1996). These instruments have been used within organizations to examine existing IS strategy and to highlight IS alignment “gaps”. Findings lend support to the view that examining isolated components of strategy and performance can be misleading. Companies with high IS strategic alignment seem to be better performing companies. Alignment between business and IS strategic orientation is linked to IS effectiveness and business performance.

Shin (2001) in his research considers business strategies in conjunction with IT investments in the analysis of financial performance. His research provides empirical evidence for the importance of aligning IT with business strategies such as vertical disintegration and

diversification. The study shows that investment in IT does not in itself ensure profitability for an organization. IT can improve business performance when used in conjunction with vertical disintegration and diversification. Although IT is an essential component (it facilitates better coordination and productivity) it is not sufficient in itself and should be coupled with organizational changes. Increased IT spending improves net profit but not performance ratios such as return on assets (ROA) and return on equity (ROE). Similarly Davis et al. (2003) in their studies on competitive advantage, find that payoffs from investments in information technology are difficult to recognize and a sustained competitive advantage from IT-enabled strategies is difficult to distinguish from temporary competitive advantage. Shin (2001) finds that by improving scope economies and coordination, IT can shape appropriate business strategies and at the same time the economic benefits of IT can be leveraged by such business strategies.

Responding to a call for a more inclusive and comprehensive approach to measuring IT business value, (Tallon et al., 2000) focused on process level measures and found that management practices such as strategic alignment and IT investment evaluation contribute to higher perceived levels of business value. They argue that interest in strategic alignment is especially warranted because firms' inability to realize sufficient value from their IT investments is due in part to an absence of strategic alignment. IT evaluation techniques help firms to improve strategic alignment, which in turn contributes to higher IT payoffs. The pursuit of strategic alignment is not the sole responsibility of the IS function. Involvement of business executives in IT investment decisions is important and desired since they, as the main clients of the IS function will be the ones who benefit the most from being able to direct IT resources to better support the business strategy. Kearns and Lederer (2003) on the other hand argue that although CEOs highly value IT as a strategic tool, CEO participation in IT planning is weak.

Knowledge sharing in the alignment process contributes to the creation of superior organizational strategies (Kearns and Lederer, 2003; Brazelton and Gorry, 2003). Knowledge sharing that stems from collaborative development of business and IT plans, ensures the use of tacit and explicit organizational knowledge (Alavi and Leidner, 1999; Kearns and Lederer, 2003; Glazer 1993). As this knowledge is firm specific, it is capable of rendering a competitive advantage (Porter and Millar 1985). For firms dependent upon information, processes that assimilate and use information in a superior manner have the potential for creating a sustainable advantage. Information intensity is the significance of the information component in value chain activities (Hu and Quan, 2003; Kearns and Lederer, 2003). As information is valuable and costly, and knowledge is considered as the most important resource, sustainable competitive advantage lies in what employees know and how they apply that knowledge to business problems (Glazer 1991).

Glazer (1993) argues that the capacity to recognize information as a firm's primary strategic asset becomes the mechanism through which firm's are able to link IT strategy to business strategy and implement a strategic alignment concept. Studies by Kearns and Lederer (2003) provide an explanatory framework of the alignment-performance relationship within the context of a resource based view and furnish several new constructs. They show that information intensity is an important antecedent to strategic IT alignment, that strategic IT alignment is best explained by multiple constructs that operationalize both process and content measures, and that alignment between the IT plan and business plan is significantly related to the use of IT for competitive advantage.

Researchers have also addressed the issue of flexibility in strategic planning. The securing and maintaining of alignment between business strategies and information systems (IS)

strategies is frequently cited as a critical concern of IS managers (Burn, 1996). Managers are being continually confronted with new and ever-changing competitive pressures from deregulation, globalization and convergence of industries and technologies. Strategy and strategic planning need to embrace greater flexibility to nurture creativity and innovation (Loebbecke and Wareham, 2003). A rigid information technology infrastructure will frustrate even the best strategic initiatives, making it difficult to introduce change in cost and time efficient ways (Prahalad and Krishnan, 2002). Flexibility is particularly important for decision-support applications (Wixom and Watson, 2001). One such decision-support application is the data warehouses. A data warehouse needs to be flexible and responsive to business change (Armstrong, 1997).

The gap between emerging strategic direction and IT's ability to support it can be debilitating. The reasons for infrastructure lags are not purely technical. Organizational issues like IT governance and senior managers' approach to IT investment are equally responsible. A shared understanding and a shared agenda between business managers and IT managers is required to create this flexibility. As data warehouses are built to address business problems, it requires careful planning and alignment between IT department and business users (Gardner, 1998). In the data warehousing environment, collaboration between IT department and business users could enhance the chances of successfully building data warehouses. Cooperation and support from executive management could lay the foundation for collaboration between the IT department and business users (Gardner, 1998).

Strategic alignment between business and IT can have a positive business impact if an organization's IT components are a part of a well integrated organizational system. Pollalis (2003) in his research develops a strategic co-alignment model which examines three types of integration that impacts planning process and overall performance of information-intensive

organizations: technical integration, functional integration and strategic integration. According to (Calvanese et al., 1999) integration is one of the most important aspects of a data warehouse. Data integration (Widom, 1995; Rahm, 2000), source integration (Calvanese et al., 1998), architectural integration (Nemati et al., 2002) are important issues affecting performance of data warehouses as well. Organizations with consistent levels of strategic alignment process and output, perform better than similar organizations when they have a high degree of technical integration and IT-based functional coordination in place. Communication of the strategic direction within the organization is also necessary. Organizational communication can be improved by integrating the various information resources within an organization.

Other researchers like Bai and Lee (2003) have investigated the organizational factors that influence the quality of the IT strategic planning process and the organizational mechanisms for success in strategic planning. Organizational mechanisms like group interaction, knowledge management, organizational learning and change management can be integrated into the IT strategic planning frameworks to enhance the effectiveness of such planning. Group interaction incorporates heterogeneous perspectives and reduces conflicts among stakeholder groups. Knowledge sharing, be it tacit or explicit in nature, is necessary to IS strategic planning. Business knowledge, organization specific knowledge, IT knowledge and managerial competencies need to be integrated during IS/IT strategic planning (Lee and Bai, 2003; Bai and Lee, 2003). Organizational learning leads to increased understanding of IS opportunities and constraints and a shared view of IS utilization. As a data warehouse is primarily used for organizational decision making (Chaudhuri and Dayal, 1997) and has significant organizational impacts (Wixom and Watson, 2001), these organizational mechanisms could enhance data warehouse planning as well.

In the data warehousing environment, the degree to which the data warehouse technology supports the business issues relevant to the organization can influence the acceptance of the data warehouse technology (Chenoweth et. al., 2006). A lack of knowledge of a technology could lead to difficulties in using the technology. The perceived availability of the data warehouse development team as a support group enhances the users understanding of the purpose of the data warehouse and reduces the difficulty in learning how to use the data warehouse (Chenoweth et. al., 2006).

Regardless of the IS/IT strategic planning approach chosen by the organization, it has to be modified to fit the organizational environment, its culture and skills. Andal-Ancionet al. (2003) in their studies to locate specific drivers that determine best strategy for competitive advantage, found that organizational learning was involved when implementing new business methods. Caldow and Kirby (1996) in their studies conclude that effective performance results only when business culture is matched to the goals and strategies of the firm. They identified four specific business cultures and argued that when these business culture forms are aligned to appropriate business strategy – entrepreneurial for invention, hierarchical for mass production, partnership for continuous improvement and modular for mass customization – effective performance will result.

3.1.4 Alternatives to the Strategic Alignment Model

As shown by the discussions in the section above, alignment of IT strategy and architecture, and business strategy and architecture is a critical success factor for modern organizations. An IT architecture that aligns with the business architecture of an organization reduces costs and provides the opportunity for new products and services. A misalignment between IT architecture and business architecture would mean higher costs and a loss of opportunities to competitors.

According to Gardner (1998) building a data warehouse is a careful alignment between IT and business. Therefore an architectural choice for building the data warehouse driven by business strategy would align the data warehouse more closely to the business strategy and goals. In the case of a data warehouse, the scope of the business vision can dictate the architectural approach (Murtaza, 1998) chosen for the data warehouse, ranging from a data mart to an enterprise-wide approach. An approach that aligns data warehousing technology with an organizations strategic objectives (Weir et al., 2003) would enhance long term success of the data warehouse.

Notwithstanding the importance of architecture alignment, practical guidelines for software architects to achieve alignment are still unavailable. Also, research in the information management area focuses almost exclusively at the strategic level. There are no practical design guidelines for the operational level. Van Eck, et al. (2004) point out that the merit of the strategic alignment model is in its recognition of an external orientation of IT strategy. However, it is difficult to apply the model in practice, as Henderson and Venkatraman (1990) do not provide an *operationalisation* of their model. Secondly, they point out that the strategic alignment model is not a constructive theory of strategic alignment, as it does not provide any guidelines on how to reach a specific goal. Given a particular alignment case study, there are no objective, concrete criteria to determine which of the alignment perspectives play a role in the case.

Van Eck et al.(2004) present a framework for architectural alignment called GRAAL (Guidelines Regarding Architecture Alignment) which tries to address this problem. They present a framework for architectural alignment that can be positioned between approaches for software architecture and strategic alignment. They show that in modern organizations,

architecture at the application level is designed and managed in a different way than at infrastructure level. IT infrastructure is designed at a time when most of its users are not known. The design of the infrastructure is therefore not motivated by user needs but by the IT strategy of the organization. Alignment at the application level is motivated both by end user needs and by features of the currently available infrastructure. Consequently, a key alignment problem is the alignment of IT infrastructure services to the application needs of business processes. As yet, there are no comprehensive guidelines that will assist the practicing architect in aligning architectures at all levels. There are no 'operationalization' of strategic alignment models.

Maes (2000) propose an alignment model which downplays the importance Henderson and Venkatraman attribute to technology itself. In their framework, the internal level of the strategic fit dimension is split into two levels – structure and operation. This is motivated by the fact that the structure of the operational processes has to be determined first before they can be executed. These two activities occur and are managed in different ways. In the functional integration dimension, the IT level is similarly split into technology and 'information and communication'. This reveals a difference with Henderson and Venkatraman's emphasis on an organization's competences with respect to information technology. Maes (1999) argues that information itself, rather than technology is the real carrier of value and the source of competitive advantage.

Beeson and Mahamid (2003) conclude that although the strategic alignment model introduce a fertile set of ideas into the IS field, it has deficiencies. It does not give managers help in choosing the right perspective (from business execution, IT potential, competitive potential and service level) for a particular circumstance. Also it assumes a more static general business environment than that which prevails today, given the existence of the internet and continued

intensification of competition. They also point out the need for theoretical development in the view of alignment as a 'process' rather than a set of perspectives. Alignment is seen by them as a process requiring continuous adaptation and coordination of plans and goals within a real and shifting framework of interactions and alliances. In their survey of managers' attitude towards strategic alignment, they find that although IT managers understand business needs, business managers do not understand IT. They suggest not only creating frequent communication channels between IT and business managers to facilitate understanding, but also that IT managers should use business language.

Burn and Szeto (2000) contends that effective alignment of IT and business strategies can be attained by means of Strategic Information Systems Planning (SISP). His study attempts to identify factors which contribute to successful alignment. He proposes that by coordinating the objectives and views of IT and business managers, companies can outperform these without such alignment. He finds that although IT and business managers have similar perceptions with regard to the drivers and need for alignment principles between business and IT strategies, there is a divergence of view concerning the different problems in implementing the alignment of business and IT strategies. He concludes that the Henderson and Venkatraman (1990) model does not identify the issues which are relevant in a practical sense, as they are perceived to be in the theoretical model. He lends support to the argument that the theoretical view is not supported by the practical implementation.

A six step approach has been designed by Luftman and Brier (1999) to make strategic alignment work in an organization. The process mirrors the traditional strategic planning process. The six step approach involves setting the organizational goals and establishing a team, understanding business-IT linkages, analyzing and prioritizing gaps, specifying actions for project management and choosing and evaluating success criteria.

It is generally accepted that strategic alignment is difficult to achieve and sustain over time. Ideally, organizations should always have a high level of strategic IS alignment. When an organization needs to change business or IS strategies, all the aspects of strategic IS alignment should also be modified. But organizations sometimes make decisions that take them out of alignment (paradoxical decision), go too far in certain respects (excessive transformation) or reverse a change and go back to the original position (uncertain turnaround). These trajectories of strategic IS alignment have been studied by Hirschheim and Sabherwal (2001). They sought to examine the factors explaining these problematic trajectories of alignment. Organizational inertia, sequential attention to goals, gaps in knowledge and split responsibilities help explain paradoxical decisions to some extent. Split responsibilities and underestimation of problems play a role in excessive transformations. Organizational inertia, sequential attention to goals and underestimation of problems seem to explain uncertain turnarounds. These problems may be addressed by taking steps for aiding strategic IS realignment efforts. Knowledge integration across business and IS domains through technical and social approaches is one such step. Shared knowledge between business and IS executives would help avoid paradoxical decisions caused by business executives' lack of IT knowledge and IS managers' inadequate business knowledge. Process integration, such as through the integration of business and IS planning processes, could reduce the adverse effects of split responsibility.

Different authors and researchers have suggested different models of alignments. Smaczny (2001) questions whether alignment between business and information technology is the appropriate paradigm to manage the IT function in today's organization. According to him a strategic approach that allows for handling a chaotic environment and offers a rapid response is required. The strategic alignment model, because of its synchronization overhead, will not be flexible and responsive enough to deliver necessary outcomes in a fast changing business

environment. Smaczny suggests that a notion of fusion should be used as the new paradigm for integrating the role of IT in an organization. IT strategy should be developed not separately from, but at the same time as business strategy. All the impacts would be evaluated at the same time and the technology forms part of a fully integrated “organic being”.

3.1.5 Enablers of Business-IT Alignment

Several frameworks have been proposed in the literature to study and explore alignment between IT and business strategy. However, there is little empirical evidence or a roadmap to carry out alignment. Researchers in this field have largely confined themselves to theoretical issues and practical generalizations. No study focused on how organizations actually achieve alignment. The crucial issues related to alignment of the data warehouse to business strategies have not been deeply investigated. There is no appropriate route to achieve coordination and cooperation between business strategy and IT strategy. However, based on the preceding discussion, alignment between business strategy and information technology may be facilitated by paying attention to the factors discussed below.

Culture: Firms that are better aligned, have cultures in which strong partnerships between business and IT are cultivated at all levels. This is reinforced when business and IT managers are jointly accountable for prioritizing, allocating resources and delivering major IT investments. Through these relationships, necessary communications can occur to ensure that both business and technological capabilities are integrated into effective solutions at each level of the business. The degree of mutual understanding and cooperation between business and IT managers can be greatly enhanced by communicating in a common language. IT organizations have for several years tended to use technical terms. By using terms business managers can understand, IT can take a more proactive role in helping to educate business

managers about current technologies. A climate of clear communication becomes a necessity for alignment to succeed.

Customer focus: Several studies discuss strategy as embarking upon an era of customer focus enabled by technology developments (Loebbecke and Wareham, 2003; Kodoma, 2002). Technology is applied to strengthen a company's customer orientation and increase customization of products. With increasing expectations from customers, companies must develop new ways to provide value added products and services to customers. Proliferation of information, reduction in geographic boundaries and acquisition of sophisticated knowledge about products and services by customers themselves, requires business strategies to produce new business models. Kodoma (2002) suggests that these new models should consciously take customer knowledge into account and build a strategic community based on a strategic partnership with a core of highly educated and experienced customers.

Organization: Clearly defined roles, responsibilities and accountabilities are key to successful collaboration between business and IT managers (Bruce, 1998). Commitment by top management and the involvement of IT in corporate strategy formulation are integral to better alignment. Technical skills have always been the preeminent requirement for IT professionals. But the skills that organizations need in their IT staff have assumed new dimensions. Skills in people management are becoming more critical. A new emphasis on negotiation, leadership, listening, innovation, teamwork, customer service and consensus building skills is required to succeed. Cooperation among the stakeholders is important in order to reduce potential conflict which may jeopardize the implementation of strategic IS plans. Key coalitions and bases of power within the organization must also be supportive of the process of strategic planning of information systems and its alignment to business strategies. The organizational learning that accompanies the planning experience should result

in improved capabilities to achieve alignment between IS and business strategies, and foster cooperation and partnership among functional managers and user groups. Segars and Grover (1998) conclude that alignment may be manifested through an understanding of organizational objectives by top IS planners, a perceived need to change IS objectives in light of changes in corporate strategy, mutual understanding between business and IS managers and a heightened view of the IS function within the organization.

Joint responsibility: Alignment between business strategy and information technology strategy requires a strong interdependent relationship between the business and IT managers. IT and business managers need to be jointly responsible for defining alignment and collaborating continuously through strong partnerships and appropriate allocation of resources. IT managers need to be knowledgeable about how new technologies can be integrated into business, and understand the strengths and weaknesses of the technology. They need to delineate to business managers the corporate wide implications of the technology in question and be privy to corporate strategies. Smaczy (2001) sees the role of the CIO moving from that of a strategic partner responsible for expectation management and technology advice to the role of a business visionary responsible for business innovation and utilization of opportunities created by the technology.

Given the complexity of the alignment process, Edwards (2000) contends that the chief executive officer is in the unique organizational position to set the stage for alignment and its subsequent implementation. The understanding, commitment and involvement of the CEO in the process can ensure the success of strategic IS alignment to business strategy. Long term success is dependent upon the ability of the CEO to act as a catalyst for strategic alignment and the organization to accept its responsibilities as a community.

Rewards: Performance and behavior is influenced by rewards and incentives, which in turn are based on performance measures. It is important that the performance measures should be aligned to corporate objectives.

In conclusion, there is no one universal mode to formulate and implement strategic alignment. It is not an easy task. Alignment is a dynamic and complex process that takes time to achieve and even more effort to sustain. The importance of alignment is well known and documented in the literature, but it is not clear how to achieve and sustain it while building and implementing data warehouses.

As long term success of the data warehouse is dependent upon the organization's ability to use the data warehouse to fulfill its strategic milestones (Weir et al., 2003), aligning the data warehouse to business objectives and strategies become essential. It involves overcoming difficulties in coordination, communication, priorities and vision on the part of the business and IS managers. Data warehousing strategy is critical in realizing competitive advantage through the effective use of information (Ma et al., 2000). Although data warehouses can provide many benefits to an organization, the direction of data warehousing can veer off-course over time and momentum can lag without continued investment of time from the business side (Watson and Haley, 1998).

Failure to align information technology (and data warehouse) to business strategy may result in an inability to gain credibility with the business and provide proactive rather than reactive services. The next section explores how strategic alignment principles can be used to align the data warehouse to business strategies and goals for a successful adoption of the data warehouse.

3.2 Research Propositions and Research Model

This section investigates the role of strategic alignment in the successful adoption of data warehouse technology. It identifies factors that contribute to strategic alignment of the data warehouse. It develops the research propositions based on the literature review. It also presents the research model and the research questions.

A survey of prior literature reveals that there have been many attempts to identify important factors that can reduce the difficulties in building and implementing a successful data warehouse (Hwang, 2004; Gorla, 2003; Sigal, 1998; Hurd, 2003; Ang and Teo, 2000; Tyagi, 2003; Johnson, 2004). This is because the adoption of data warehouse technology entails huge capital expenditure and a large development time. Companies integrate their data into data warehouses to create competitive advantages, capture new markets, improve data quality and provide better customer service. Yet, the data warehouse projects continue to have a high possibility of failure (Wen et al., 1997; Hwang et al., 2004).

Interest in strategic alignment of the data warehouse implementation to the business strategy is warranted because of the inability of organization's to realize sufficient value from their investments in data warehouses (Ballou and Tayi, 1999; Strong et al., 1997; Vatanasombut and Gray, 1999). There is a paucity of research in the area of data warehouse regarding strategic alignment factors that impact data warehouse adoption success. Therefore literature on data warehousing and strategic alignment has been synthesized to provide a set of comprehensive factors that can be used to study the alignment of data warehouses to business strategy and plans. It is postulated that alignment of the data warehouse strategy to business strategy would contribute to success of data warehouse implementations.

No study has focused on how organizations achieve alignment between business strategy and the data warehouse while developing or implementing a data warehouse project. Most researchers focus on the technological and operational aspects of data warehouse. There is very little research addressing the managerial or strategic aspects of data warehouses. Empirical evidence on how to carry out alignment in large projects like data warehouse is absent. This thesis investigates the factors that may facilitate the alignment between business strategy and data warehouse projects.

Based on the review of the literature, five factors have been identified as contributing to successful alignment of the data warehouse to business plan and strategy. The five factors are:

1. Joint responsibility between data warehouse and business managers,
2. Alignment between data warehouse plan and business plan,
3. Flexibility in data warehouse planning,
4. Technical integration of the data warehouse, and
5. Business user satisfaction.

Hereunder, the impact of strategic alignment on the successful adoption of data warehouse technology is examined and analyzed along the above five factors. Propositions are then developed to address the problem of successful adoption of data warehouses along strategic alignment principles.

3.2.1 Joint responsibility between data warehouse and business managers

Commitment by senior management and the involvement of IT in corporate strategy formulation has been found to be integral to better alignment (Bruce, 1998). Smaczy (2001) contends that alignment between business strategy and information technology strategy requires a strong interdependent relationship between the business and IT managers. He

summarizes that IT and business managers need to be jointly responsible for defining alignment and must collaborate continuously through strong partnerships and appropriate allocation of resources. IT managers need to be knowledgeable about how new technologies can be integrated into business and must understand the strengths and weaknesses of the technology.

O'Sullivan (1996) found that data warehouse projects often lacked a strong mandate from senior management. He observed that problems arose in successful adoption of data warehouses because of inadequate commitment and support from senior management. He concluded that a strong mandate from senior management was needed to impose standards, as different areas within a company may resist changing their ways.

Similarly Hwang et al. (2004) in their assessment of factors which affect the adoption of a data warehouse technology, asserted that champions and senior management support were important to data warehousing projects, as they actively promoted the project and provided information, material resources and political support. Support and commitment from the senior management was considered important to secure the required capital, human support and internal resources during the adoption and development process.

The association of senior management and its involvement with successful implementation of IS has been pointed out by researchers in information systems as well. Tallon, Kraemer and Gurbaxani (2000) asserted that the pursuit of strategic alignment was not the sole responsibility of the IS function. Involvement of business executives in IT investment decisions was important and desired since they, as the main clients of the IS function, would be the ones who would benefit the most from being able to direct IT resources to better

support the business strategy. This is especially pertinent to data warehouse projects, as they are often built as a strategic or competitive tool for business managers.

Thus it can be summarized that in the data warehouse environment, performing joint application development sessions with senior management could help in reaching an understanding of the business plan and opportunities. This would facilitate the choice of the different subject areas in a data warehouse and also identify the ones with the best potential return on investment. Participation by all stakeholders would ensure that everyone's input and perspective is taken into consideration.

Pollalis (2003) in his research found that communication of the strategic direction within the organization was necessary. Given the complexity of the alignment process, Edwards (2000) contends that the Chief Executive Officer (CEO) was in the unique organizational position to set the stage for alignment and its subsequent implementation. Therefore, it appears that the understanding, commitment and involvement of the CEO in the data warehousing process can greatly improve the prospects for strategic alignment of the data warehouse to business strategy. Long term success of the data warehouse is dependent upon the ability of the CEO to act as a catalyst for strategic alignment, and of the organization to accept its responsibilities as a community.

In a data warehouse, the data is not only integrated across different functional units of the organization, but also includes external entities such as customers and suppliers. As data warehouses evolve, myriad data quality issues emerge. The issue of data quality needs to be viewed from a business wide sense (Armstrong, 1997). A data stewardship program was suggested by Sinn (2003) as a solution to ensure good quality data. Data stewardship would require the engagement of senior management and the building of cross-functional teams

comprising of business and technical sides. By increasing the business users awareness of what data exists and where it can be found, active use of the data would be more likely. Moreover, the technical staff would gain insights that may allow them to fully align their work priorities with the company's overall business strategy.

Burn and Szeto (2000) found that though IT and business managers have similar perceptions with regard to the drivers and need for alignment principles between business and IT strategies, there was a divergence of view concerning the different problems in implementing the alignment of business and IT strategies. In data warehouse projects although IT managers may generally understand business needs, business managers may not understand IT. Creating frequent communication channels between IT and business managers could facilitate this understanding.

It is generally accepted that strategic alignment is difficult to achieve and sustain over time (Boddy et al., 2005). Organizations sometimes make decisions that take them out of alignment. These trajectories of strategic IS alignment have been studied by Hirschheim and Sabherwal (2001). They found that organizational inertia, sequential attention to goals and underestimation of problems explained some of those trajectories. They suggested that the problems could be addressed by taking steps to aid strategic IS realignment efforts. Knowledge could be integrated across business and IS domains through technical and social approaches. Shared knowledge between business and IS executives would help avoid paradoxical decisions caused by business executives' lack of IT knowledge and IS managers' inadequate business knowledge. Hirschheim and Sabherwal (2001) reported that process integration, through the integration of business and information systems' planning processes, could reduce the adverse effects of split responsibility. The above should also be true in data warehouse projects.

Therefore, the above discussion leads to the following proposition:

P1: The level of joint responsibility between business and data warehouse managers is critical to strategic alignment and successful adoption of the data warehouse.

3.2.2 Alignment between business plan and data warehouse plan

Improving alignment between IS and business plans and strategy has been the subject of several researchers. It has been argued by Henderson and Venkatraman (1990), that strategy implementation is the most common and widely understood strategic alignment perspective, corresponding to the classic hierarchical view of strategic management. It reflects the view that business strategy is the driver for both organizational design and IT infrastructure choices.

Thus developing a data warehouse strategy, in response to a business strategy, and using the corresponding choices to define the required data warehouse infrastructure and processes, should bring about closer alignment. It would seek to exploit the emerging data warehouse capabilities to impact business scope and influence key attributes of strategy. Building a data warehouse that answers the needs of the business user and provides a high return on investment would be more likely to bring it into alignment with the business.

The decision to build a data warehouse and selection of its subject areas, must be based on sound business fundamentals. The organizational vision, goals, business plan and strategic vision could provide a road map for the data warehousing team. Selecting a data warehouse project should be a careful trade-off between business and technology perspective, IT preparedness and business needs, and present technology infrastructure and future infrastructure.

Alignment of IT strategy and architecture, and business strategy and architecture is a critical success factor for modern organizations. An IT architecture that aligns with the business architecture of an organization can reduce costs and provide the opportunity for new products and services. Misalignment between IT architecture and business architecture could mean higher costs and a loss of opportunities.

In the data warehouse environment, the scope of the business vision, can dictate the architecture approach. A short term vision requires a lower budget, quick return on investment and implementation with small resource requirement, as offered by data marts. More strategic objectives of long term gain and full organizational control necessitate the enterprise data warehouse architecture (Murtaza, 1998). The most popular architecture formats from which to make choices are the enterprise warehouse model, operational data store, DSS data warehouse and the data mart.

Based upon the above discussions, it may be propositioned that

P2: The degree of alignment between business and data warehouse plans is critical to strategic alignment and successful adoption of the data warehouse.

3.2.3 Business User Satisfaction

Recent discussions on strategy describe it as embarking upon an era of customer focus enabled by technology developments (Loebbecke and Wareham, 2003; Kodoma, 2002). In the data warehouse environment, the business users are the main customers of the system. A basic requirement for a successful data warehouse is its ability to provide business users with accurate, consolidated and timely information (Triantafillakis et al., 2004). The strength of the data warehouse being its ability to organize and deliver data in support of management's decision making process, it can support business decision making by integrating data from

multiple, incompatible systems into a consolidated database. The transformation of data into meaningful information allows employees to perform substantive, accurate and consistent analyses (Meyer and Cannon, 1998).

For firms dependent upon information, processes that assimilate and use information in a superior manner have the potential for creating a sustainable advantage. Sustainable competitive advantage lies in what employees know, and how they apply that knowledge to business problems. The data warehouse is capable of rendering competitive advantage as the data it contains is firm specific.

Understanding the data that is in a data warehouse is a cornerstone to the success of a data warehouse (Strong et al., 1997). A primary cause of failure of data warehouse projects tends to be misunderstanding of the data in it. The data that is stored in the data warehouse needs to be easy to interpret by the business user. A data warehouse should not be simply a very large database. In addition to being a database, it needs to provide the information necessary to answer business questions. It needs to do this in a manner that is comfortable and intuitive to the business user. The competitive advantage of a data warehouse thus, would increasingly depend on the bulk of the organization's employees being able to quickly and easily access the data and interpret the information.

Hwang et al. (2004) reported that the end user participation has a direct impact on the adoption of data warehouse technology. They asserted the importance of selection and inclusion of appropriate users in the project team. User participation was deemed essential for better communication and coordination of the users' needs. Additionally, the end-user participation can help manage users' expectation and satisfy user requirements.

The importance of user related factors like user participation, user training and user acceptance in the success of a system is also recognized by Guimaraes, et al. (2003). In order for a data warehouse to be accepted by its end users, the system must not only be perceived as useful and easy to use, it is also important that the end-users perceive the system to be compatible with their values and past experiences, and to be a good fit with the organizational context. They recognized the importance of user training as a significant factor for user participation, and promoted user/developer communication during the system development process to reduce user conflict.

Failure to align the data warehouse to the business strategies may result in an inability to gain credibility with the business users. Building a strategic community based upon a strategic partnership with a core of highly educated and experienced business users should help align the data warehouse to the business.

Therefore, based on the above discussion it is propositioned that:

P3: The degree of business user participation and satisfaction is critical to strategic alignment and successful adoption of the data warehouse.

3.2.4 Technical integration

Researchers (Henderson et al., 1996) have identified four management methods for executing, evaluating and tracking different aspects of strategic alignment. These four alignment mechanisms are value management, governance, technological capacity and organizational capability. The following discussion uses these mechanisms to find ways of achieving technical integration in data warehouse projects. Studies in IT have been used as a starting point for the discussion as data warehouses have a significant IT component.

Value management - Value management is the organizational mechanism for ensuring that IT resources invested throughout the organization deliver anticipated or greater returns. Previous studies show (Henderson et al., 1996) that investment in IT does not in itself ensure profitability for an organization. Selecting technology for its own sake is a costly and often dangerous decision. Hence, it would seem appropriate that in a data warehouse, technology be selected based on its ability to address business and user requirements. An approach to building a data warehouse that may lead to failure would be to start with tool selection before defining business needs. This approach may fail because interactions between the business and the development team may not have resulted in comprehensive appreciation of business needs.

Responding to a call for a more inclusive and comprehensive approach to measuring IT business value, Tallon et al. (2000) found that management practices such as strategic alignment and IT investment evaluation contributed to higher perceived levels of business value. IT evaluation techniques helped firms improve strategic alignment, which in turn contributed to higher IT payoffs. In a data warehouse project, evaluating technology after the business problem has been identified, saves time and resources, and allows companies to focus on developing business solutions, and not just technology architectures.

One of the important determinants to new technology acceptance is the perceived ease of use and perceived usefulness (Gorla, 2003;Guimaraes et al., 2003; Nah et al., 2004). It has been observed (Gorla, 2003) that, despite the potential benefits of data warehousing, corporations often do not provide tools to end users that can be used easily, resulting in non-utilization of tools, millions of dollars of unused software and unrealized return on investment.

Nah et al. (2004) in their investigation on end-users' acceptance of enterprise systems (e.g. data warehouse), found that factors such as perceived compatibility, perceived ease of use and user attitude were significant determinants in the adoption of a system. They found that in order to create positive acceptance among end users, organizational interventions need to focus on the issues of compatibility and technology fit with organizational context.

If a data warehouse project selected requires too much new technology, it may fail due to the inability of the IT department to deploy a large amount of new technology. New technologies often bring new paradigms for understanding how they could fit into the business world. It appears that failure to address all aspects of the technological assimilation process is part of the reason many data warehouse projects fail, resulting in poor value management.

If a project with too little new technology is selected, it is possible that the data warehouse may be seen as being unresponsive to user needs. On the other hand, if a project is selected that will deliver large amounts of new information to the business it may collapse under its own weight. Also a data warehouse project that delivers too little new information to the business can again be seen as being unresponsive to user needs. In either case, it provides poor or no value.

Governance mechanism: The governance mechanism specifies the allocation of decision rights for IT activities to the various decision makers within the organization, as well as to outside partners. It is not concerned with the day to day operational decisions but with the distribution of decision rights that is consistent with the logic and perspective of strategic alignment. Similarly, in a data warehouse project, the pursuit of strategic alignment may not be the sole responsibility of the IS function. Involvement of business executives in data warehouse investment decisions would be important and desired. As the main clients of the

data warehouse, business executives will be the greatest beneficiaries from being able to direct resources to better support their business strategy.

Technological capability: Technological capability deals with the administrative process for creating the required IT capability for supporting and shaping the business strategy. Pollalis (2003) in his research found that strategic alignment between business and IT can have a positive business impact if an organization's IT component is a part of a well integrated organizational system. This may also be valid in the case of a data warehouse.

Organizational capability deals with the administrative processes for creating the required human skills and the capability for supporting and shaping the business strategy. Hwang et al. (2004), in their assessment of factors that affect the adoption of data warehouse technology found that the skills of the data warehousing development team had a major influence on the outcome of the project. A highly skilled project team is better equipped to manage and solve technical problems. They also found that coordination of organizational resources including money, people and time, ensured completion of the project and ultimately affected the adoption of data warehouse technology.

Based on the above discussions it may be propositioned that:

P4: The degree of technical integration is critical to strategic alignment and successful adoption of the data warehouse.

3.2.5 Flexibility

Many researchers (Loebbecke and Wareham, 2003; Prahalad and Krishnan, 2002) have addressed the issue of flexibility in strategic alignment. They describe alignment as a process requiring continuous adaptation and coordination of plans and goals within a real and shifting

framework of interactions and alliances. Managers are being continually confronted with new and ever-changing competitive pressures from deregulation, globalization and the convergence of industries and technologies. Strategy and strategic alignment therefore need to embrace greater flexibility to nurture creativity and innovation (Loebbecke and Wareham, 2003). A rigid information technology infrastructure could frustrate even the best strategic initiatives in a data warehouse, making it difficult to introduce change in cost and time efficient ways (Prahalad and Krishnan, 2002).

The gap between emerging strategic direction and information technology's ability to support it could be debilitating. The reasons for infrastructure lags may not be purely technical. Organizational issues like IT governance and senior managers approach to IT investment are equally responsible. Thus a shared understanding and a shared agenda between business managers and IT managers is required to create flexibility.

The issue of flexibility in planning is pertinent in the data warehouse environment as well. In data warehouse projects, the business strategy could change during data warehouse development. A change in business plan could lead to a shift in the business requirements of the data warehouse. Quick, iterative developments, as opposed to lengthy development projects, may address this problem to some extent.

As business needs change over time, a data warehouse needs to be flexible enough to be responsive to them, to be successful. If the data warehouse is not flexible enough to adapt to changes in the environment and provide the information users need to run the business, then the organization loses the advantage that the information provides. A warehouse needs to be built with a solid foundation that is flexible and responsive to business change. According to Armstrong (1997), this concerns three main areas: the database, the application middleware

and tool integration. In order for the data warehouse to have long term success, all these three areas must have scalability, high availability and robust manageability. Managing these changes would span all the components of a data warehouse, and would play a vital role in the development and overall success of a data warehouse. To successfully manage a data warehouse, Sen (2004) argues that two conflicting goals need to be managed: maximizing the use of the data warehouse asset, while consistently achieving user expectations by continuously monitoring the effects of business change.

Based on the above discussions it may be propositioned that:

P5: The degree of flexibility in data warehouse planning is positively associated with the degree of strategic alignment of the data warehouse.

3.2.6 Conceptual Model

Based upon the propositions drawn above, a conceptual model is proposed. The model identifies the critical factors in strategic alignment of the data warehouse to business. It is further propositioned that positively addressing these factors will result in a successful implementation of a data warehouse.

The findings from the data warehouse literature review have been aligned with concepts from strategic alignment theory to develop this conceptual model. The factors that are expected to successfully align the data warehouse to the business are shown in this model. Research questions are then developed based on the factors identified.

Figure 3.2 illustrates the conceptual model developed as part of this research. This model provides a comprehensive illustration of factors expected to influence data warehouse

strategic alignment. Factors relating to implementation of technology and to the development process of the data warehouse have been eliminated from this model.

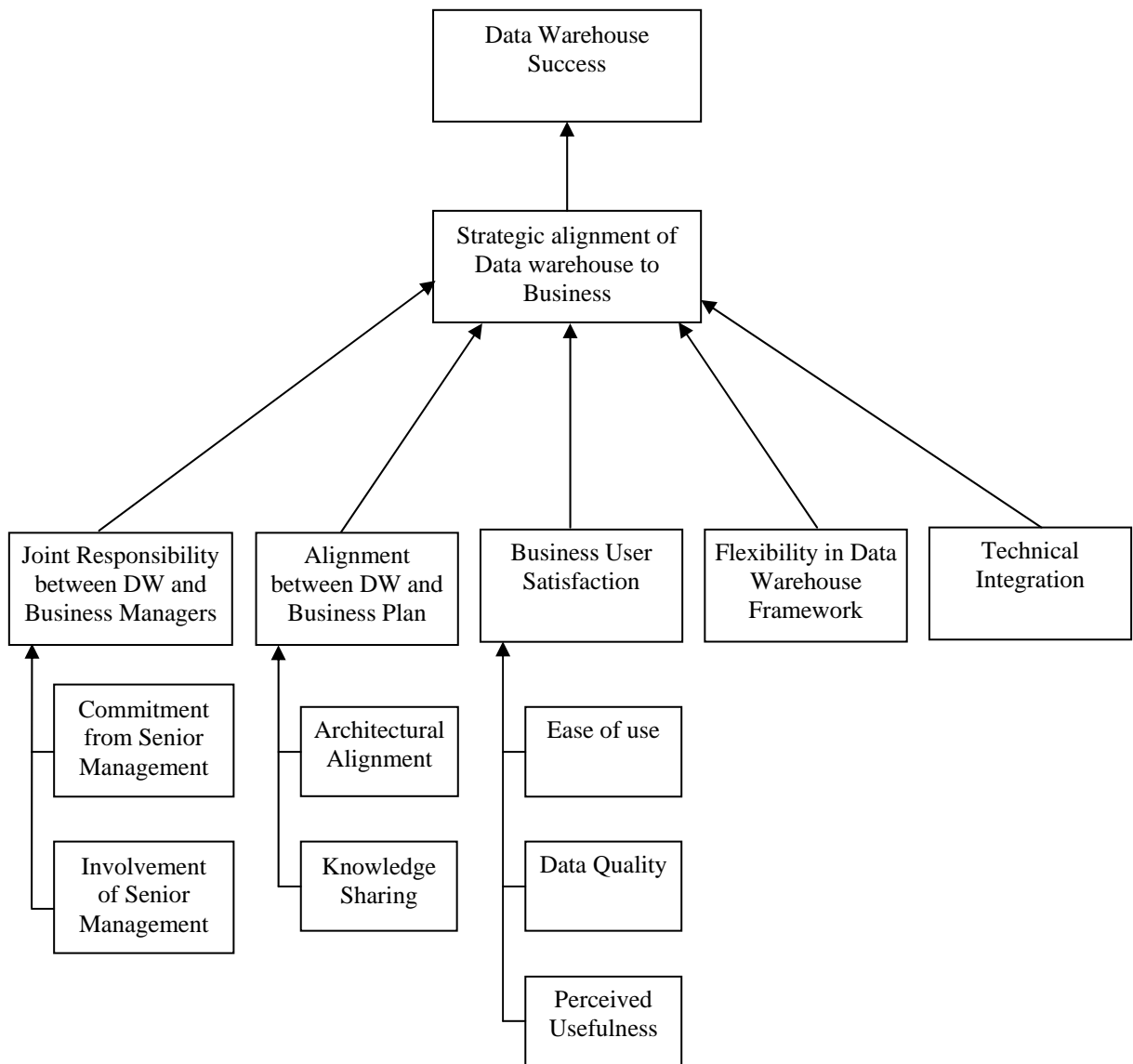


Figure 3.2 Research Model

This model proposes that data warehouse success depends on strategic alignment of the data warehouse to the business plans and strategies. Achieving this alignment enables the successful implementation and use of the data warehouse. The factors that are expected to influence strategic alignment of the data warehouse to business are (a) joint responsibility between business and data warehouse managers, (b) alignment between business plan and data warehouse plan and (c) business user satisfaction (d) flexibility in the data warehouse framework and (e) technical integration of the data warehouse.

The above factors in turn would be influenced by other attributes as shown in the model. Senior management's commitment and senior management's involvement are expected to play an important role in establishing joint responsibility between data warehouse and business managers. Architectural alignment, knowledge sharing and good communication between business and data warehouse managers, should improve the alignment between data warehouse and business plans. Ease of use, data quality and perceived usefulness should enhance business user satisfaction.

The proposed model postulates that strategic alignment between business and data warehouse can be achieved by ensuring that the underlying critical factors are addressed. As stated above the model identifies *(a) joint responsibility between business and data warehouse managers, (b) alignment between business plan and data warehouse plan (c) flexibility in the data warehouse framework and (d) business user satisfaction and (e) technical integration* of the data warehouse as the critical factors in influencing the successful adoption of a data warehouse.

3.3 Summary

This chapter presented a review of literature on strategic alignment. It establishes that a need for strategic alignment between IT and business exists as strategic IS alignment has shown to enhance not only IS success but organizational success as well. Strategic planning has evolved over the last three decades. The strategic alignment model discussed combines the traditional notion of functional integration with the concept of strategic fit. This model identifies four alignment mechanisms as value management, governance, technological capacity and organizational capability. The strategic alignment model provides a framework to understand the substantive knowledge required to align business and technology strategies. But it does not reflect the dynamic aspect of alignment.

This chapter also discusses developments in strategic alignment research. These include instruments to measure IS strategy and IS strategic alignment, consideration of business strategies in conjunction with IT investments, process level measures, knowledge sharing in the alignment process, the issue of flexibility in strategic planning, strategic co-alignment model and the organizational factors and mechanisms for success in strategic planning.

This chapter discusses the drawbacks of the strategic alignment model and alternatives to the strategic alignment model. Alternatives presented include a framework for architectural alignment called GRAAL, Strategic Information Systems Planning, a six step approach designed by Luftman and Brier and the study of trajectories of strategic IS alignment. Cultural factors, customer focus, organizational factors, joint responsibility and rewards have been identified as enablers of alignment between business strategy and information technology.

Factors that contribute to strategic alignment of the data warehouse have been identified as joint responsibility between data warehouse and business managers, alignment between data warehouse plan and business plan, flexibility in data warehouse planning, technical integration of the data warehouse, and business user satisfaction.

Propositions addressing the problem of successful adoption of the data warehouse along strategic alignment principles were also developed and presented in this chapter. A research model based upon the propositions was also presented. These research propositions have been evaluated by the conduct of two case studies in the industry. The research methodology and research design to evaluate these propositions are discussed in the next chapter.

4 RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the research method. It is divided into eight sections. The first section reviews the existing research approaches used in information systems. The second section justifies the choice of case study as an appropriate research method for the current research. The third section discusses the multiple case study approach. The fourth section describes the criteria for case selections. The fifth section describes the conduct of the case study. The sixth section discusses data collection through interview instruments and questionnaire and the conduct of the interviews. The seventh section discusses the design of the interview instruments and questionnaires. The eighth section is the summary.

4.2 An Overview of Research Approaches

Research approaches have been broadly categorized into two categories: quantitative research and qualitative research. Quantitative research is used to answer questions about relationships among measured variables with the purpose of explaining, predicting, and controlling phenomenon (Leedy and Ormrod, 2001). This approach is also called the experimental or traditional approach. Qualitative research on the other hand is typically used to answer questions about the complex nature of phenomenon, often with the purpose of describing and understanding the phenomenon from the participants' point of view.

A range of research approaches have been used in the field of Information Systems (Galliers, 1991). The case study approach used for this research is one among these approaches. Other approaches include observation, analysis of archival information (Yin, 2003), surveys, evaluation research (Patton, 1990; Cook and Reichardt, 1979), experiments and simulation. According to Yin (2003) each approach has its advantages and disadvantages, depending on

(a) the type of research question, (b) the control the investigator has over the events, and (c) the focus on contemporary as opposed to historical phenomenon.

This section briefly reviews the approaches that have been advocated as being suitable for research in the field of information systems. It discusses the advantages and limitations of these accepted approaches. The next section discusses the case study approach adopted for this research.

4.2.1 Observation

Observation is the principal technique incident to all empirical research. The purpose of observation is to witness factual situations and perceive reality without intervention (Buckley, Buckley and Chiang, 1976). A good observer is a highly skilled individual who has the ability to separate the relevant from the irrelevant, to see casual relationships, and to derive theories which are capable of further testing. There are two modes of observation, participant (Spradley,1980) and non-participant.

Participant observation involves the development of intimate familiarity with a specific setting, the systematic recording of observations and the gathering of auxiliary information. In non-participant observation, the researcher stays relatively uninvolved in the social interactions he/she observes (Giacomini and Cook, 2000). Observation gives a meaningful, coherent picture of a setting. Participant observation is not appropriate for use with large populations, events of great duration, infrequent events and activities inaccessible to observers. It is also not appropriate when you have something to prove (Jones, 1985).

4.2.2 Archival Research and Content Analysis

Archival research is a research approach concerned with the examination of recorded facts. Archival research (Myers and Avison, 2002) and content analysis involves the re-examining of existing materials. Archival research utilizes the vast store of records generated in a society, for example – financial data, unemployment data, production data – to examine systematically questions and hypotheses of current interest (Jones, 1985). Content analysis is a formal technique for evaluating written or oral communications and analyses texts in the contexts of their uses (Krippendorff, 2003). In its most precise form it consists of assigning quantitative values to words and phrases in order to assess the intensity and significance of a communication (Buckley, Buckley and Chiang, 1976). Content analysis utilizes texts of all sorts – books, magazines, diaries and speeches. Archival research and content analysis are less reactive and unobtrusive (Krippendorff, 2003) than other research methods as they make use of data generated as a by-product of other endeavors. Analysis of archival records and surveys are advantageous when the research goal is to describe the incidence or prevalence of a phenomenon or when it is to be predictive about certain outcomes (Yin, 2003).

4.2.3 Survey Research

Survey refers to the gathering of data or information from a sample or specific population, usually by questionnaire, interview or telephone survey (Fowler, 2002). Survey methodology involves measuring variables by asking people questions and then examining relationships among the variables (Babbie, 1990). Survey research is the appropriate mode of inquiry for making inferences about a large group of people from data drawn on a relatively small number of individuals from that group (Marshall and Rossman, 1989). The researcher does not manipulate independent variables or apply control conditions to the subjects under study (Adam and Schvaneveldt, 1991). The emphasis in a survey is not usually on individuals in a sample but rather on generalized profiles or statistics derived from all the individual cases.

Most survey studies involve cross sectional measurements made at a single point in time, or longitudinal measurements taken at several different times (Marshall and Rossman, 1989).

4.2.4 Evaluation Research

Evaluation research is a form of applied research with the purpose of informing action and improving decision making about the policies and programs designed to bring about change (Clarke, 1999, 35). Evaluation research is an assortment of techniques, procedures and methods for systematic data based assessment of the need, implementation, and impact of social programs to improve social conditions and community life (Rossi, Freeman and Wright, 1979). Evaluation research involves surrendering some freedom in selecting the problems to be pursued (Jones, 1992, 277). It often involves working on research problems that have been defined by those who have established policy or set programs in motion.

4.2.5 Experimental Research

The goal of an experimental study is to examine cause and effect relationships (Leedy and Ormrod, 1985). In experiment research one variable is manipulated to see its effect on another variable. The variable that is manipulated is the independent variable and the one observed or measured is the dependent variable. Experimental studies begin with very specific research hypotheses and subsequent statistical analyses are conducted to test these hypotheses.

4.2.6 Simulation

Simulation and models are imitations of scaled down versions of social or behavioral systems. The purpose of a simulation is to help understand how the system being modeled operates (Jones, 1985). Simulations are most useful when they lead to unanticipated consequences. They are most likely to do that when the system being simulated is a complex one, involving a variety of competing forces.

4.3 Justification for adopting the case study methodology

The case study research method was adopted for this study. Darke, Shanks and Broadbent (1998) point out that case study research is the most widely used qualitative research method in information systems research, and is well suited to understanding the interactions between information technology-related innovations and organizational contexts. This section discusses the justification of case study approach to show how case study method contributes to the achievement of the research objective.

The case study approach is suitable to this research for several reasons. Benbasat, Goldstein and Mead (1987) showed that the goal of the researcher and the nature of the research topic influence the selection of a research method. According to Yin (2003) case study strategy has a distinct advantage when a “how” or “why” question is being asked about a contemporary set of events, over which the investigator has little or no control and when the boundaries between phenomenon and context are not clearly evident. This research delves in-depth into the complexities of a data warehouse and its alignment to business strategies. It seeks to explore *how* data warehouses are aligned to business strategies and plans in the real world. These goals, and the need to study a complex topic within its institutional context, led to adopting a case study strategy. The case study approach recognizes the complexity of the research question undertaken and assesses the data warehouses in its natural, unaltered setting. It explores in depth into complexities and processes of a data warehouse and its alignment to business strategies and goals.

A case approach is also appropriate for this research as it is a way to research an area in which few previous studies have been carried out (Benbasat, Goldstein and Mead, 1987). The case study strategy is particularly well suited to this research as the data warehousing technology is

relatively new, and more so where interest has shifted to strategic issues from technical issues. The case studies provide the organizational context for the study of the relationship between data warehouse technology and business strategy and allows for valuable insights.

Case study is also appropriate for this research objective as it meets all eleven characteristics of case studies noted by Benbasat, Goldstein and Mead (1987). These eleven characteristics are:

1. Phenomenon is examined in a natural setting.
2. Data are collected by multiple means.
3. One or few entities (person, group, or organization) are examined.
4. The complexity of the unit is studied intensively.
5. Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process.
6. No experimental controls or manipulation are involved.
7. The investigator may not specify the set of independent and dependent variables in advance.
8. The results derived depend heavily on the integrative powers of the investigator.
9. Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.
10. Case research is useful in the study of “why” and “how” questions.
11. The focus is on contemporary events.

To judge the appropriateness of the case strategy as a useful approach Benbasat, Goldstein and Mead (1987) suggested exploring the following issues be discussed.

1. Can the phenomenon of interest be studied outside its natural setting?
2. Must the study focus on contemporary events?
3. Is control or manipulation of subjects or events necessary?
4. Does the phenomenon of interest enjoy an established theoretical base?

Thus this case study was appropriate for this research for the following four reasons. *Firstly*, the researcher could study the data warehouse in its natural setting by conducting a case study in the organizational setting. *Secondly*, the case method allows the researcher to understand the nature and complexity of the processes taking place in the data warehousing environment and answer the “how” and “why” questions in a contemporary setting. Also as answering ‘how?’ and ‘why?’ questions are the preferred strategy in case studies (Yin, 1989), the research questions being examined were appropriate for this research approach.

Thirdly, the subjects or events are not controlled or manipulated during the course of the research. The case approach is used to study and explain the events in the data warehousing process, leading to proposition generation and proposition testing.

Fourthly, the research being undertaken enjoys an established theoretical base. The concepts from strategy and strategic alignment have been used to create a theoretical framework which takes account of previous knowledge and creates a sensible theoretical basis to inform the topic of data warehousing.

The research being undertaken in this thesis is largely a qualitative study. Case study can be seen to satisfy the three tenets of the qualitative method: describing, understanding, and explaining (Tellis, 1997). The qualitative research undertaken explores, describes and explains in depth the complexities and processes of a data warehouse and its alignment to

business strategies, and attempts to identify ways in which better alignment between the data warehouse plans and business strategies can be achieved, leading to a successful data warehouse adoption. The case studies undertaken in this research provide insight into the issue of strategic alignment of the data warehouse to business and serves to test the propositions that were made in this study.

4.4 The Multiple Case Study Research Approach

This section discusses the two-case case study research method adopted in this thesis.

A frequent criticism of case study methodology is that its dependence on a single case renders it incapable of providing a generalizing conclusion (Tellis, 1997). Case studies can be single or multiple-case designs. According to Eisenhardt (1991) multiple cases are a powerful means to create theory because they permit replication and extension among individual cases. Yin (2003) points out similarly that multiple design must follow a replication rather than sampling logic. Replication allows individual cases to be used independently for corroboration of specific propositions. Extension refers to the use of multiple cases to develop more elaborate theory by piecing together the individual patterns and drawing a more complete theoretical picture (Eisenhardt, 1991).

As the strength of empirical research lies in its contact with reality, multiple case studies provide a rich context in which this research could take place. This approach tests the applicability of the research model to diverse situations, making it general and not industry specific. Yin (2003) points out that generalization of results, from either single or multiple designs, is made to theoretical propositions and not to populations.

A two-case case study approach was adopted for the current research. Two cases strengthen the results by replicating the pattern-matching and eliminate chance associations (Eisenhardt, 1991), thus increasing confidence in the robustness of the theory (Tellis, 1997; Herriott and Firestone, 1983). A two-case study also increases the external validity and reliability of the research compared to a single-case study (Yin, 2003). The two case studies also expand the generalizability of the findings compared to a single case alone.

This study focused on two case studies to provide a comprehensive understanding between the strategic alignment factors and the success of the data warehouse. Based on the perspectives and research model presented in the previous chapters, studies were carried out at Nielsen Media Research and Raymond James Financial. The case studies undertaken thoroughly assess the cluster of factors leading to strategic alignment of the data warehouse to business plans. As the case study was confined to two subjects, the focus was broad in the type and quantities of variables that were being studied. The approach taken in these case studies was in-depth and comprehensive. The case studies describe and help understand this strategic alignment from the participants' point of view. The case studies provides tentative answers to the research question based on what was observed and also serves to validate the research model.

The case study methods involve systematically gathering enough information about a person, social setting or event, to permit the researcher to effectively understand how it operates or functions (Berg, 2001). Case study approach employs a number of data collection technologies such as documents, oral histories, in-depth interviews and participant observation (Yin, 2003).

The two case studies undertaken in this research were based on a mix of qualitative and quantitative evidence. Data gleaned from literature survey and secondary sources were combined with in-depth interviews to gain insight into the processes behind the problem under study. Interviews were conducted using semi-structured questions in the interview instruments to ensure completeness and replicability. Typically, questions were posed in an open manner of the participant and the responses were recorded. The same question was then asked in a closed manner through questionnaires, requesting quantitative responses using scores.

Interviews were supplemented with questionnaires to the participants to gain a reasonably accurate description of real world situations from their viewpoints. They were used to capture the degree of agreement or disagreement with the research element and the degree of satisfaction or dissatisfaction of the interview participants.

4.5 Research Design and Strategy

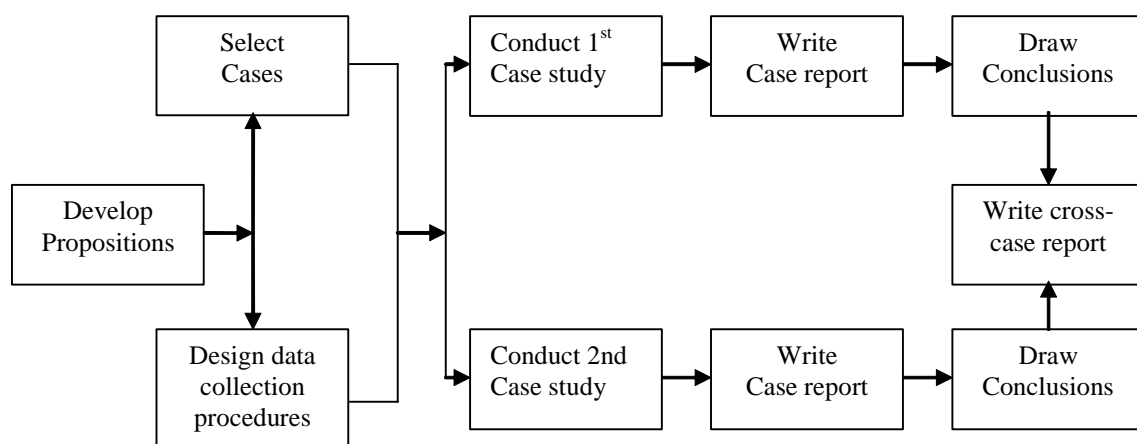


Figure 4.1 Case Study Method

The research design followed in this study involved the following components (as shown in Figure 4.1):

1. Research question
2. Theoretical propositions and research model
3. Case selection
4. Data collection through interview instruments and questionnaire
5. Individual case reports linking the data to the propositions and
6. Cross-case analysis and conclusions.

These satisfy Yin's (2003) requirement of five components of a research design important for case studies: a study question, its propositions, its unit of analysis, the logic linking the data to the propositions and the criteria for interpreting the findings.

The research question is an important factor of the research process. The research question focuses the research and also guides selection of the research approach. The research question is presented in Section 1.1 of Chapter 1. Chapter 1 discusses the research question, clarifies the need to address the research question and presents the challenges involved in aligning the data warehouse to business strategy.

The research question also helps focus the literature research, spotting trends and gaps in the research. Related literature on data warehouse and strategic alignment is reviewed (and presented in chapters 2 and 3 respectively) to set up a theoretical framework for the research and to understand the key concepts and issues related to the research question. In keeping with Yin (2003), the research approach undertaken involves the review of related literature,

the development of theoretical propositions to guide data collection and analysis of data to test the propositions, leading to analytic generalization (as opposed to statistical generalization found in surveys). The theoretical propositions and research model are presented in Chapter 3 (section 3.2).

The complex and exploratory nature of the research question leads to the selection of a multiple case study approach (discussed in chapter 4, section 4.3) to achieve the research objective. The strength of the case study approach enables the capture of 'reality' in considerable detail by collecting rich, deep, real and valid data. Chapter 4, Section 4.7 discusses case selection. The research question also helps determine the appropriate unit of analysis in the sites chosen for the case studies. The conduct of the case study is presented in section 4.8 of this chapter.

The research design linked the data to be collected to the research question. Data was primarily collected through interview instruments and questionnaire during the case studies (presented in section 4.9 of this chapter). Data collection led to the attainment of a rich set of data surrounding the research issue, as well as capturing the contextual complexity. The data was examined and analyzed to answer the research question. The design of the interview instruments and questionnaire is presented in section 4.6 of this chapter. The method of analysis of the data collected from the case studies is discussed in section 4.5.1 of this chapter.

The next step of the research design is the presentation of individual case reports linking the data to the propositions. These are presented in Chapter 5 and Chapter 6. Chapter 5 presents the case study at Nielsen Media Research and Chapter 6 presents the case study at Raymond James Financial. These two chapters present the overview of the organizations, the

background of the data warehouses and the findings from the case study, linking the data to the propositions and the analysis of results.

The last component of the research design is cross case analysis and conclusions (presented in Chapter 7). Cross case analysis is presented in the discussion and summary of findings for each of the factors that facilitates successful alignment of the data warehouse to business plan and strategy. The contrast between the two case studies show a significant outcome where data warehouse strategy needed to align with organizational strategy irrespective of whether the data warehouse is the core application for the organization or a supporting application.

4.5.1 Data Analysis

The major difficulty in multiple case studies is the large amount of data. Analysis was accomplished through direct interpretation of the individual instance and through aggregation of instances to find patterns, seek significance and arrive at generalizations. The design of the research instruments facilitated the analysis of the data collected during the research study. The design of the research instruments is discussed in detail in the next section. The main research question was studied by breaking it into five sub-questions (as presented in section 4.6 of this chapter). Data collected during the case studies was grouped according to the sub-question they addressed and organized to analyze and examine each arm on the conceptual model which also corresponds to each of the research propositions. Data was also regrouped under each group of stakeholders in the data warehousing process: the senior business managers, the data warehouse managers/team and the business users, to facilitate analysis. The data collected from the questionnaires was tabulated into tables categorized under each group of stakeholders in the data warehousing process (tables 5.1, 5.2, 5.3, 6.1, 6.2, 6.3) for

each of the case studies, to facilitate the examination of the theoretical propositions and research questions made in this study.

4.6 Design of the Interview Instruments

The design of the research instruments used in this qualitative research is discussed in this section. The case studies were conducted using semi-structured interviews and questionnaires. Appendix 1 describes at what level on the conceptual model the interview questions were based, and how the questionnaires were designed. The following five questions pursued in this research to address the main research question, provided the background to the design of the interview questions.

RQ-1: In practice, how is joint responsibility established between business and data warehouse managers ?

RQ-2: How are the data warehouse plans aligned to business strategy and business plans?

RQ-3: What is the impact of flexibility in the data warehouse framework on its success?

RQ-4: How does business user involvement and satisfaction affect data warehouse success?

RQ-5: What is the impact of degree of technical integration of the data warehouse on its success?

Each of the research questions are linked directly to each arm on the conceptual model. They also correspond to each of the research propositions made in Chapter 3. The questions in the interview instruments explore each of these research questions, providing a pathway to study the conceptual model and explore the theoretical propositions.

The interview questions were divided into 3 groups to address each group of stakeholders in the data warehousing process: the senior business managers, the data warehouse managers/team and the business users respectively as shown in Appendix 1. Interview questions for the senior business managers, the data warehouse managers and the business users are also described *regrouped* according to the research question (and research propositions) they address to facilitate analysis of the data gathered during the case studies (also shown in Appendix 1). In addition to these open-ended questions, each participant filled out a five point graded questionnaire to each of these questions as shown in Table A1, A2 and A3 in Appendix 1. This served to capture the degree of agreement or disagreement with the research element and the degree of satisfaction or dissatisfaction of the interview participants.

Construct validity has been known to be especially problematic in case study research. It has been a source of criticism because of potential investigator subjectivity (Tellis, 1997). Yin (2003) proposed three remedies to counteract this: using multiple sources of evidence, establishing a chain of evidence, and having a draft case study report reviewed by key informants.

These three remedies have been addressed in this research. The data was collected from documents, interviews and questionnaires in the case study and was carefully analyzed. Case reports were prepared for each site. The case report for Nielsen Media Research is included in Chapter 5 and for Raymond James Financial in Chapter 6 respectively. The two case reports follow similar steps. It presents the overview of the organization and the background and description of the data warehouse implementation. The data from the questionnaires are presented in tabular forms to support the findings from the interviews and questionnaires. The findings from the interviews and questionnaires are discussed and analyzed in depth and are

presented to address the theoretical propositions made earlier in the study and to validate the research model developed in Chapter 3. The individual case study report for each site has been reviewed by two participants in each company for completeness and accuracy. Analytic conclusions arising independently from both the cases are presented in Chapter 7 and support the theoretical propositions.

The next few paragraphs sketch the criteria used for the choice of the case and data collection methods used. Appendix 1 presents the design of the research instruments in detail.

4.7 Criteria for Case Selection

The choice of the case study sites is explained in the following paragraphs. The goal was to focus on cases that (a) could serve as examples for a wide range of organizations, and (b) where the data warehouse seemed likely to grow in its impact on the participating organizations' business. A site was chosen for study that was high in the overall Fortune 1000 ratings of businesses or a pioneer in its industry, and one that would have a high impact and use of the data warehouse. Several additional selection criteria were applied to choosing these organizations.

Firstly, to focus on alignment to business strategies, a *for-profit* organization was favored; one whose purpose for the data warehouse was for business strategy or competitive advantage, over ones that existed simply to provide data to others. Secondly, a case where an *infrastructure* of some kind was being built to enable the study of how the data warehouse plans were aligned to business plans systematically was favored. Thirdly, data warehouses that were *integrated* into the organizations overall information technology systems, rather than stand-alone data marts, were chosen. Fourthly, organization where the business community and the *users were involved* with the data warehouse was chosen over those where an elite user group accessed the data warehouse.

To find a suitable case for study, initial contacts were obtained from around the country through colleagues. These people in turn referred the researcher to their colleagues and acquaintances who knew of data warehousing efforts in the corporate world. After a few contact cycles, the researcher learned of several data warehousing efforts, that met the criteria developed. The researcher then spoke to the CEOs, CIOs and other senior executives of these potential corporate sites, discussing the possibility of conducting a case study in their organizations.

Two issues quickly became clear from this preliminary inquiry. First, in order to have *any* cases to study, a confidentiality agreement needed to be addressed, as the study required an understanding of strategic use of data warehouse or competitive advantage to the organization. Secondly, even after addressing this issue several of these organizations were unwilling to participate in any academic studies due to concerns of potential loss of competitive advantage. Finally from the companies that were willing, Nielsen Media Research and Raymond James Financial were chosen as case study sites. These sites were chosen as they met all the selection criteria. Prior to embarking on the case study, the researcher familiarized herself with the company background and business as much as possible before meeting with them.

4.8 Conduct of the Case Study

This section is focused on the conduct of the case study. Two sets of issues are discussed here: the choice of the role of the researcher and the interviewing techniques.

Role of the researcher: Two different roles have been identified in IS research for interpretive researchers: namely that of outside observer and that of an involved researcher through participant observation or action research (Walsham, 1995). The role of the outside observer has been chosen for this research because this role preserves greater distance from the

personnel in the case study organizations. The merit of this approach is that the researcher does not have a personal stake in various interpretations and outcomes, and thus the personnel will often be relatively frank in expressing their views. The main disadvantage of this role was that the researcher would not get a direct sense of the organization from the inside and may have been denied access to/ debarred from certain data and issues which may have been considered confidential or sensitive to be shared with “outsiders”.

Conduct of interviews: Interviews were the primary data source for the case studies. According to Stake (1995) two principal uses of case study are to obtain descriptions and interpretations of others. He adds that interview is the main road to discovering and portraying the multiple realities of the case. In the present research, it is through interviews that the researcher accessed the interpretations that participants had regarding the actions and events which had or were taking place, and the views and aspirations of themselves and other participants. Evidence for the case studies also came from documents and records made available to the researcher at the organizations studied.

With respect to the interviewing style, a balance was adopted between excessive passivity and over-direction. Interviewees were allowed to express their own views. The interviewees were prompted with questions that follow the direction of the research but the interview was not directed too closely. To capture the interview’s in an effective way, extensive notes were taken during the interviews.

4.9 Data Collection through Interview Instruments and Questionnaire

Eisenhardt (1991) stresses the importance of methodological rigor while conducting case studies and advocated the need to identify research questions and develop well-designed instruments such as interview schedules and questionnaires. Interview was an essential step in

the research design. Interview was chosen as a research method because these activities involve few (but key) personnel and the data required related to individual experiences. Information was obtained largely through interviews with senior management, data warehouse management and user representatives. This enabled a full understanding of the nature of the data warehouse project, its principle objectives and the rationale behind its design and implementation approach. The interviews were open ended to allow the interviewee to give definition of the situation, thereby facilitating a greater understanding of the subject's point of view. Interviews allowed an exploration in some depth of the opinions, expectations and actions of the individuals. Some quantitative observations were also made in the form of questionnaire data.

A five part interview protocol was drawn to (a) gather the business background of the organization; (b) gather information about the overall data warehouse implementation (c) gather information on strategic alignment factors from the data warehouse managers perspective; (d) gather information on strategic alignment factors from the business managers perspective and lastly (e) gather information on strategic alignment factors from the data warehouse users perspective.

4.9.1 Field Study Details

To identify interview participants, a document outlining the research objectives and background, level of involvement and confidentiality terms was sent to the CIO in the company. Discussions with CIO/his designates led to the identification of data warehouse managers, business functional managers and business users who should be interviewed. These participants were determined to be knowledgeable about or affiliated with the data warehouse

implementation in their organization. They were then requested to participate. All participants identified, agreed.

Relevant information about the company history and data warehouse implementation process was provided by the primary contact. Upon identification of possible participants, the researcher familiarized herself regarding their role, and contacted them to schedule for an interview.

The interviews were held in person, on-site and lasted between 45 minutes to 90 minutes. Interviews at Raymond James Financial were held over a three month period, from 3rd October 2005 to December 7th 2005. Interviews at Nielsen Media Research were held over a two week period between February 28th 2006 and March 13th 2006. Relevant documents consisting of company background were also collected at this time. These in-depth interviews helped gain insight regarding the processes behind the data warehouse under study. Portions of the interview were used to investigate the use and role of the data warehouse in each organization, the apparent factors in its success or stagnation, and the role of alignment factors to business strategy in the growth and successful adoption of the data warehouses.

Three different interview instruments were developed, one each for the data warehouse managers, the senior business functional managers and the data warehouse users. Appendix 1 discusses the development of these three interview instruments. Each interview was supplemented with a short questionnaire to each of the participants, to gain a reasonably accurate description of their views. Raw data from the questionnaires answered at Nielsen Media Research is placed in Appendix 4 and from questionnaires answered at Raymond James Financial is placed in Appendix 5.

Note taking was used to record the interviews. The interview notes of all the participants at the two case study sites (Nielsen Media Research and Raymond James Financial) are included in Appendix 2 and Appendix 3. Response to the questionnaires by senior business managers, data warehouse managers and business users are included in tabulated form in the individual case report for each of the case studies in Tables 5.1, 5.2, 5.3 for Nielsen Media Research and Tables 6.1, 6.2 and 6.3 for Raymond James Financial respectively.

4.9.2 Description of Case Study Participants

In each case study at least 10 participants were interviewed at each site. The participants in the case study were experienced members of the organization who were influential stakeholders in the data warehouse project. They represented different groups: senior business managers, data warehouse managers and users. In reality these 22 participants were the decision makers who had significant impact on the outcomes of the project. The focus of their interview was on strategic alignment between data warehouse and business plans.

In the case study at Nielsen Media Research, the participants who represented senior management were the CIO, Senior Vice President (Monitor Plus), Senior Vice President (Local Products) and Senior Product Manager (Foundation Strategy). The IT Director, Data warehouse Project Manager and Data Warehouse Architect represented the data warehouse managers. The user group was represented by Senior Product Manager, (Viewer Insight); Product Manager (Currency Overnights) and Product Manager, (Strategy and Research).

In the case study at Raymond James Financial, the participants who represented senior management were the Vice President (Software Development), Regional Administrative Manager (RJA Private Client Group) and Product Manager. The Product Manager (Data warehouse), Data Warehouse Manager and Data warehouse Supervisor represented the data

warehouse managers. The user group was represented by Assistant to Chairman of RJFS, Asst. Vice President (Sales Management), Regional Administrative Manager (RJA Private Client Group), Assistant Vice President (Branch Administration), Learning Specialist and Database Administrator (RJFS Group).

4.10 Summary

The case study research method was adopted in this research. The case study approach was found to be particularly suited to address the research question as the case studies provided the organizational context for the study of the relationship between data warehouse technology and business strategy. A two-case case study was conducted versus a single case study to strengthen the robustness, reliability and external validity of the findings. Cases that were selected could serve as examples for a wide range of organizations, and were where the data warehouse seemed likely to grow in its impact on the participating organizations' business. Evidence for the case studies was collected from documents, interviews, questionnaires and observation. The interview instruments and the questionnaire were designed keeping the research question and research propositions in mind. Data analysis consisted of examining, categorizing, tabulating and recombining both qualitative and quantitative evidence to address the theoretical propositions made in this study. The individual case study report for each site was reviewed by two participants in each case for completeness and accuracy. The individual case reports and analysis for the two case studies undertaken are presented in the following chapters.

5 CASE STUDY - NIELSEN MEDIA RESEARCH

5.1 Introduction

This chapter presents the findings from a case study conducted at Nielsen Media Research and the data collected through the interviews with and questionnaires to various participants. A description of the participants of this case study is presented in chapter 4. It also analyses the research findings, based on the research propositions. The case study findings are presented in three sections. The first section presents the overview and background of the organization where the case study was carried out. The second section describes the data warehouse implementation at the organization. The third section of this chapter presents the findings from the interviews of the participants in the case study as well as their responses to the questionnaire. This section also provides an analysis of the information gathered from the case study based on the research propositions, and evaluates the research model.

5.2 Overview of the Company

Nielsen Media Research is the leading provider of television audience measurement and advertising information services worldwide. It is headquartered in New York, with offices throughout the United States. Nielsen Media Research International has offices around the world and provides television and radio audience measurement, print readership and customized media research services measurement data in more than 40 countries. The company is owned by VNU, a publicly-traded international publishing and information leader based in Haarlem, The Netherlands. Nielsen Media Research is part of VNU's Media Measurement & Information Group (MMI), a global leader in information services for the media and entertainment industries. Nielsen Media Research employs around 5000 people and has a gross turnover of US \$1 billion.

The ratings from Nielsen Media Research provide an objective estimate of television ratings and media research. They act as a barometer of peoples' viewing habits. In the United States, Nielsen's National People Meter service provides audience estimates for all national program sources, including broadcast networks, cable networks, Spanish language networks, and national syndicates. Local ratings estimates are produced for television stations, regional cable networks, cable interconnects, and Spanish language stations in each of the 210 television markets in the U.S.

In addition to providing television audience estimates, Nielsen Media Research provides competitive advertising intelligence services, as well as information on interactive television and Internet usage. Nielsen Monitor-Plus, a service of Nielsen Media Research, is the leader of innovative advertising information services in the United States, providing advertising activity for 18 media including television tracking. Nielsen Outdoor harnesses Global Positioning System (GPS) technology to measure consumer exposure to billboards and other forms of outdoor advertising.

Business Objective

Nielsen Media Research provides high quality estimates of audiences through a fair and open system that objectively reports viewership. Their customers use Nielsen Media Research's television audience estimates to buy and sell television time. This information is the currency in all the transactions between buyers and sellers, which adds up to approximately \$45 million in national and local advertising spending each year.

Nielsen Media Research provides an independent, completely neutral, third party measurement system embracing the highest standards of accuracy and integrity in the television marketplace. Assuring the quality of the ratings and the value of this currency is the number one priority for Nielsen Media Research.

5.3 Background of the Data warehouse

The task of audience measurement is a complex one. To capture viewership ratings, Nielsen Media Research has divided the USA into 210 clusters. In different markets, different measurement devices are used. In small markets, diary measurement is used to collect viewing information from sample homes. Paper diaries are mailed out to the households and each household member in a diary sample is asked to write down what channels and programs they watch.

In the larger markets, *People Meter*, an electronic metering system is placed in randomly selected households to measure what channel or station is being tuned into and who is watching it. The *People Meter* is used to produce household and persons audience estimates for broadcast and cable networks and nationally distributed barter-syndicated programs. In medium sized market homes, a similar electronic metering system is used to provide set-tuning information on a daily basis and it is supplemented with diaries.

Household tuning and persons viewing data from both the national and local samples for each day are stored in the in-home metering system until they are downloaded to Nielsen media's computers each night. This information is processed each night for release to the television industry the very next day. Nielsen Media Research collects information from more than 25,000 metered households starting about 3 AM, and processes approximately 10 million viewing minutes for delivery to customers every day.

This data is critical to broadcasters and advertisers alike, who rely on it to make and fine-tune programming decisions and advertising placements. As demand grew for more timely and detailed information, Nielsen Media Research decided to build an online data warehouse that would allow each client to access its vast data store on an ad hoc basis and query that data

rapidly. The data warehouse enables the clients to sort through enormous volumes of data to get the intelligence they need to make effective and profitable business decisions.

5.4 The Data warehouse Development

Project Initiation

At Nielsen Media Research, unlike traditional data warehouses which have a support function, the data warehouse is the revenue earning arm of the business. To address business needs, the data warehouse project was initiated by the CIO and senior management. The data warehouse is very tightly aligned to business and was developed by a select team called a Platform team. The team was carefully selected and comprised of 25 members. This team brought together people from information technology and product management groups representing the business. The team used an iterative XP methodology to develop the data warehouse, and the data warehouse was available to products as it was being developed. The development of the first data warehouse was started in 1997, and two more data warehouses were built subsequently. The third data warehouse is the subject of this case study.

Data warehouse architecture selection

The data warehouse architecture was selected after considering high level strategies and detailed level sources of data. It is a reconciliation of a top-down as well as a bottom-up approach to architecture. The broad vision of the data warehouse had the concepts of data marts in it. It emphasized building the base repository first and then servicing the products through the data marts.

The data warehouse was built after careful evaluation consisting of both technical criteria and business metrics. The data warehouse architecture was selected after an in-house architect researched and explored different options. Different data warehouse data base management

systems (DBMS) were considered and vendor evaluations were completed by November of 2002. Each of the vendors was quizzed on technical and business metrics and weighted values were given to each criterion. Input was also received from Gartner Group and proof of concept was completed for the products evaluated. Sybase IQ was finally selected over NCR Teradata and IBM DB2.

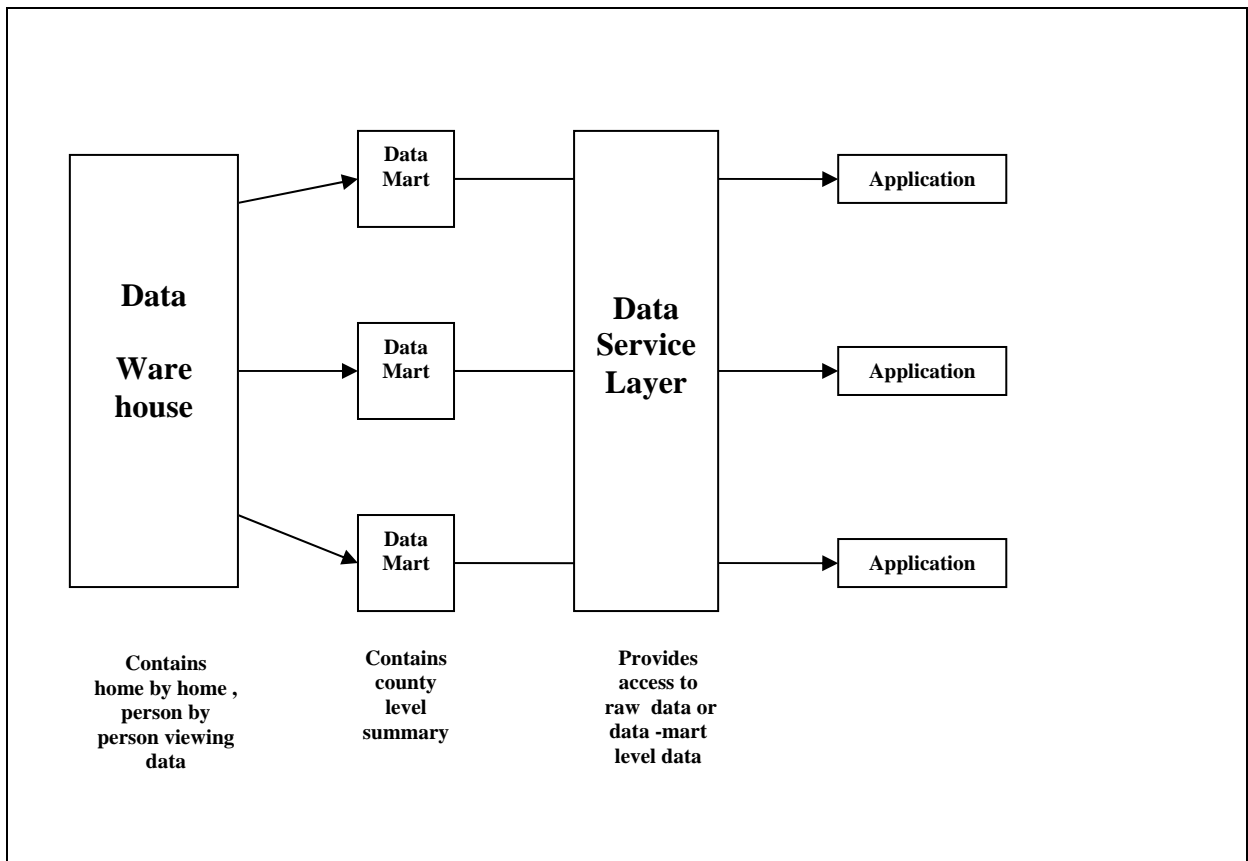
There were several reasons for selecting Sybase IQ. As Sybase databases already existed in-house for OLTP type systems, there was a shorter learning period involved. The CIO had a good relationship with SYBASE and it had his support since it was an existing vendor. Sybase IQ also offered a very large, analytical database that could provide query response that was fast as well as a solution that was efficient and cost effective. The data warehouse is accessed using customized software applications as well as by business intelligence tools MicroStrategy and ProClarity.

Physical Implementation

The current data warehouse which is the subject of this case study is the third generation data warehouse at Nielsen Media Research. The first data warehouse was built in 1997 and ran a single application, off a 2 terabyte database. Later around 2002, a second larger data warehouse of 20 terabytes size was built, supporting multiple applications. A much larger third generation data warehouse was then built using Sybase IQ. The design of this data warehouse was not completely driven by the applications as in the earlier data warehouse. The data warehouse's architecture allows Nielsen to add new products and applications that can access the audience data warehouse in order to satisfy ever-evolving client demands. This eliminated the need to create duplicate databases for each new application. The data warehouse is currently accessed by over 2000 users and is available 24 hours, 7 days a week.

The data warehouse architecture creates base level structure for the data warehouse by integrating data from all sources that have been identified including legacy files, mainframe data, ancillary data and reference hubs through an ETL (extract, transform and load) process using Synopsis, into the data warehouse. The data is then summarized and is rolled up to separate data marts like Stellar data mart and Overnight data mart, to support different products and applications.

Figure 5.1 Nielsen Media Research Third Data warehouse Architecture



A separate data service layer insulates the data from the products. It manages the delivery of the data to the applications through web service, FTP or subscription service. It also optimizes the data to the product, for example 24/7 availability or very fast performance. The current data warehouse derives greater value and long term leverage by repurposing the data and by using better technology and programming architecture. The flexibility in the architecture of

the data warehouse allows new products, applications or data structures to be added to the data warehouse without affecting its performance.

Business intelligence applications run off this data warehouse enabling syndicators, advertising agencies, and national broadcast and cable networks to understand television viewing habits, resulting in more targeted advertisement placement and optimized revenues. Business intelligence applications use MicroStrategy and ProClarity to access the data warehouse that contains virtually the entire breadth of Nielsen's data. Clients and research analysts from the TV industry, broadcasting industry, and advertising agencies also use customized and proprietary analytical software to run various analyses on the data warehouse.

5.5 Presentation of Findings from the Case Study and Analysis of Results

This case study was undertaken to study the impact of strategic alignment of the data warehouse to business strategies and plans, on its successful adoption and to investigate the research questions derived from the research model.

The research model proposed in Figure 3.2 identifies that strategic alignment between business and data warehouse can be achieved by ensuring that the underlying critical factors are addressed. The model identifies *(a) joint responsibility between business and data warehouse managers, (b) alignment between business plan and data warehouse plan (c) flexibility in the data warehouse framework (d) business user satisfaction and (e) technical integration* of the data warehouse as the critical factors in influencing alignment and the successful adoption of a data warehouse. The model along with the five propositions (described in Chapter 3) is examined in this research.

At Nielsen Media Research, the participants who represented senior management were the CIO, Senior Vice President (Monitor Plus), Senior Vice President (Local Products) and Senior Product Manager (Foundation Strategy). The IT Director, Data warehouse Project Manager and Data Warehouse Architect represented the data warehouse managers. The user group was represented by Senior Product Manager, (Viewer Insight); Product Manager (Currency Overnights) and Product Manager, (Strategy and Research).

The questions and rated responses of the participants are summarized in the tables below. The rated responses of questions relevant to the propositions, accompanies its analysis to facilitate better understanding.

Table 5.1 Result from questionnaire completed by senior managers

No	Question	SrBusn	SrBusn	SrBusn	SrBusn	Average
		Mangr1	Mangr2	Mangr3	Mangr4	Rating
1.	The data warehouse strongly supports the business plans	5	5	5	5	5
2.	The data warehouse drives business decision	3	5	3	3	3.5
3.	Senior management has a high level of commitment to the data warehouse project.	5	4	5	5	4.7
4.	Business managers are highly involved in the data warehouse investment decisions..	5	4	5	5	4.7
7.	Data warehouse managers are highly involved in corporate strategy	2	3	5	5	3.7
8.	Cross-functional teams are highly active in the data warehouse project	5	5	4	5	4.7
9.	There are established communication channels to facilitate better understanding	4	4	5	4	4.2
10.	The data warehouse team is aware of the business plans and strategies	5	4	5	4	4.5
11.	The data warehouse is responsive to a change in business needs.	5	5	5	4	4.7
13.	The data warehouse is successfull .	5	5	5	5	5

(Ratings of 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

Table 5.2 Result from questionnaires completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
1.	Data warehouse managers are aware of the corporate strategies.	5	5	5	5
2.	Data warehouse managers are highly involved in corporate strategy	4	3	5	4
3.	Data warehouse plans support the business plans and strategies.	5	4	5	4.6
4.	Business decisions are the driver for the data warehouse design.	5	4	4	4.3
5.	Business and data warehouse planning processes are integrated.	4	5	5	4.6
6.	Business visions are the drivers for data warehouse architecture.	5	5	4	4.6
7.	Data is integrated from different systems across the organization.	5	5	5	5
8.	The data warehouse architecture is integrated into existing IT systems' architecture.	4	3	5	4
9.	The data warehouse technology was evaluated after the decision to build it.	4	1	5	3.3
10.	The data warehouse is highly responsive to a change in business needs.	4	4	5	4.3
11.	The database, application middleware and front-end tools have scalability.	4	4	5	4.3
12.	The database, application middleware and front-end tools have high availability.	5	4	4	4.3
14.	The data warehouse is successful	5	5	5	5

(Rating of: 5-Strongly Agree, 4-Agree, 3-Neither Agree nor Disagree, 2-Disagree, 1-Strongly Disagree).

Table 5.3 Result from questionnaire completed by business users

No.	Question	User1	User2	User3	Average Rating
1.	User's participation in the data warehouse project.	4	5	4	4.3
2.	Communication of users needs to the data warehouse team.	4	5	4	4.3
3.	Communication by the data warehouse team to the users	4	4	5	4.3
4.	Data warehouse response to change in business needs.	4	3	5	4
5.	Accuracy of data warehouse information.	4	5	4	4.3
6.	Consistency and reliability of the data warehouse information.	4	5	4	4.3
7.	Timeliness of data warehouse information.	4	5	5	4.6
8.	Ease of use of the data warehouse.	4	2	4	3.3
9.	Relevance of the data warehouse information to day-to-day-decisions.	3	5	5	4.3
10.	Users' understanding of the data warehouse functions and features.	3	4	4	3.6
11.	Adequacy of user training.	NA	5	4	4.5
12.	The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	5	5	5
13.	Level of satisfaction with the data warehouse success.	4	4	5	4.3

(Ratings of 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

The findings from this case study for each of the propositions is presented below.

5.5.1 Assessing joint responsibility between business and data warehouse managers

To identify the level of joint responsibility that exists between the business and data warehouse managers, questions were asked of senior business managers and data warehouse managers to get a comprehensive view. The four senior managers of the company selected as participants for the case study were asked the following questions:

- How involved are you in the data warehouse investment decisions?
- In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?
- How often do data warehouse managers participate in your strategy meetings?

Commitment and involvement of senior management in data warehouse project.

Table 5.4 Results from questionnaire completed by senior business managers.

No	Question	SrBusn Mangr1	SrBusn Mangr2	SrBusn Mangr3	SrBusn Mangr4	Average Rating
3.	Senior management has a high level of commitment to the data warehouse project.	5	4	5	5	4.7
4.	Business managers are highly involved in the data warehouse investment decisions.	5	4	5	5	4.7

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question on how involved the senior business managers were in data warehouse investment decision, all four senior managers answered that they were very involved. The questionnaire results as shown in Table 5.4 also reveal the same response. The CIO was very involved in data warehouse investment decisions. For example,

were now involved at the very top level only. The CIO reinforced the general technical policy and saw to it that it fit the product strategy and business values. The data warehouse design and data decisions involved cross functional teams. As the data warehouse team was given the business plans, all adjustments decisions were made at the data warehouse manager's level.

Analysis

The results from the analysis of data from the questionnaire completed by the senior business managers provide compelling evidence of the high level of commitment by the senior management to the data warehouse project, and their high involvement, as shown in Table 5.4. On a scaled rating from 1 to 5, where 5 represents strongly agree and 1 represents strongly disagree, three out of four senior managers responded with a rating of 5, that is they strongly agreed that they have a high level of commitment to the data warehouse project and are highly involved. One senior business manager responded with a rating of 4, which is agreed.

At Nielsen Media Research, the CIO, the Senior Vice Presidents of business divisions along with the product manager were very involved in data warehouse investment decisions. The CIO responded to requests from senior management and initiated the data warehouse project. The project Platform team was headed by a senior vice president. The association of senior management and its involvement with the successful implementation of the data warehouse confirms the research model and proposition 1, that strong support at the senior levels of management is important to data warehousing projects.

This support and commitment by senior management results in active promotion of the project and ensures availability of capital, human support and internal resources during the development and implementation process. The involvement by business managers and

product manager in the data warehouse is desired and important, as they being the users of the data warehouse are able to better support their business strategies. This is especially pertinent at Nielsen Media Research, where unlike traditional data warehouses which have a support function, the data warehouse is the revenue earning arm of the business. Joint meetings between the data warehouse and product manager at Nielsen Media Research help in reaching an understanding of the business plans and opportunities. It facilitates the identification of areas for development in the data warehouse with the best return on investments. For example,

CIO and Senior Vice President, Monitor Plus	The data warehouse manager participates in strategy meetings with the business..... They are sometimes involved in business strategy planning. ... It is to make sure other people know the data warehouse architecture and how they can leverage it, and also so that she can see other ways the data warehouse can be used.
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Involvement of data warehouse managers in corporate strategy

To identify the level of involvement of data warehouse managers in corporate strategy, the data warehouse managers were asked the following questions:

- How involved are you in corporate strategy decisions?
- Over the last 5 years what are the major changes that have taken place in your organization’s business plan?

Table 5.5 Results from questionnaire completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
1.	Data warehouse managers are aware of the corporate strategies.	5	5	5	5
2.	Data warehouse managers are highly involved in corporate strategy	4	3	5	4

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

It was found that all levels of data warehouse management were highly aware of the corporate strategies (as also shown in questionnaire results in Table 5.5 above). The product manager ensured that the data warehouse team was aware of all business plans and strategies. The data warehouse managers were aware of the changes in the media industry over the past five years. They are aware of technology driving this change in the traditional broadcasting mode. The broadcasters were re-inventing themselves to adjust to these changes in technology (for example, iPods, digital video recording and video on demand) and so was Nielsen Media Research, to stay relevant in this changing industry landscape. For instance,

Data warehouse Project Manager	At a high level, business plans have to come up with alternative methods to collect information to get client viewing data and data to support out of home viewing. Business plans have to see that designs are in place to support viewing collection methods for DVR (digital video recording) and VOD (video on demand). Business plans are trying to keep up with new technologies.
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IT Director	New challenges are faced in collecting data from new devices and gadgets such as iPods and cross media type gadgets. Advertisers are interested in the total picture, on what the consumers are doing as a whole. Nielsen Media is working towards a single meter strategy in the future. They are also looking into lower cost diary solutions
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Data warehouse Architect	Changes have occurred in technology in the television industry. New devices and measurement technology came out to handle these changes. Changes have occurred in the engineering aspects of encoding to the stations to collect the data.
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Nielsen Media Research employs different measurement devices in its different measurement markets to capture viewership ratings, from People Meters to paper diaries. New challenges

were faced in collecting data from new devices and gadgets such as iPods and cross-media type gadgets. As advertisers were interested in the total picture of what the consumers were viewing as a whole, Nielsen Media is working towards a single meter strategy in the future. The data warehouse managers were well aware of the biggest challenge for Nielsen Media Research - the ability to service these needs for more flexible and timely reporting as well as providing a wider breadth of data. The data warehouse managers were also aware of business plans to support viewing collection methods for DVR (digital video recording) and VOD (video on demand).

The data warehouse managers were also involved in corporate strategy. The Director of IT Operations, (data warehouse projects leader reported to her) has been the IT representative on the local product strategy team. She interacts closely with senior management and is also closely tied to the data warehouse project and to the business side. For instance,

IT Director

The Director, IT Operations is involved in corporate strategic decisions. She has been the IT representative on local product strategy team. She interacts closely with senior management and is very tied into what happens on the business side. For example, she is involved in decisions regarding where revenue will come in and how products will be rolled out.

The data warehouse project manager is also involved in strategy decisions as well. She was involved more than other managers because of the good relations she had with the product manager.

Analysis

The results from the questionnaire filled out by the business managers and data warehouse managers, as shown in Table 5.6 below, reflect on the level of involvement of data warehouse managers in corporate strategy.

Table 5.6 Results from questionnaire completed by senior business managers

No	Question	SrBusn Mangr1	SrBusn Mangr2	SrBusn Mangr3	SrBusn Mangr4	Average Rating
7.	Data warehouse managers are highly involved in corporate strategy	2	3	5	5	3.7

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to a question on whether the data warehouse managers were highly involved in corporate strategy, senior managers responded with an average rating of 3.7 (Table 5.6 above), which means that the data warehouse managers were perceived as being involved in corporate strategy decisions.

A slight difference in response was found in the level of *awareness* of corporate strategy by data warehouse managers and their *involvement* in corporate strategy decisions. The level of awareness of corporate strategies by data warehouse managers interviewed received a rating of 5 (in Table 5.5). However, the level of involvement of the data warehouse managers in corporate strategy making was slightly lower, (average rating of 3.7 and 4 by senior managers and data warehouse managers respectively). This difference can be explained by the strong and interdependent relationship between the product manager and the data warehouse managers. For instance,

CIO &

Yes, the data warehouse managers have a good dialogue with the business

Senior Vice President,
Monitor Plus

managers. Everyone at Nielsen Media is interested in technology. The product managers work along with the IT people in regard to the data warehouse. The product manager belongs to the product management group but represents the data warehouse if someone comes with a new product. The product manager manages the strategic value of the data warehouse, ahead of the curve.

Senior Product Manager,
Foundation Strategy

The data warehouse managers do help us understand the advantages and limitations of the data warehouse. The product manager, due to past experience, understands the business as well as the technology side. She advises the business on what the data warehouse can and can not do. The product manager educates the business on data warehouse possibilities.

Data warehouse
Project Manager

(Data warehouse project manager) is involved more than other managers (in strategy decisions) because of the good relations with the product manager. The product manager makes the data warehouse team aware of all business plans and strategies.

Though the data warehouse manager participates in corporate strategy meetings as needed, the product manager works with the business managers on all data warehouse issues. She informs the data warehouse manager and project leader of higher level decisions in the company, the business plans and opportunities and the needs of the business from the data warehouse.

The above status is consistent with the research model as the research model requires joint involvement of data warehouse managers and senior managers to ensure strategic alignment of the data warehouse to business plans. The understanding, commitment and involvement of

the product manager in the data warehousing process ensure strategic alignment of the data warehouse to business strategy.

Assessment of joint responsibility between business and data warehouse managers

The above results from the interviews and questionnaire provide compelling evidence that alignment between business strategy and data warehouse strategy requires a strong interdependent relationship between the business and data warehouse managers. As seen in the previous paragraphs, the product manager, data warehouse managers and business managers are jointly responsible for aligning the data warehouse to the business by collaborating continuously through strong partnerships and appropriate allocation of resources.

Thus the findings suggest that a high level of involvement and commitment of senior business managers to the data warehouse is important. They confirm proposition 1 that high level of involvement and commitment of senior managers and data warehouse managers is critical to successful alignment and adoption of data warehouse.

5.5.2 Assessing alignment between business and data warehouse plans

A number of factors contribute to, and facilitate, alignment between business and data warehouse plans. Hence, to gain a comprehensive understanding of the degree of strategic alignment, the study was broken into four sub-sections: (a) architectural alignment of the data warehouse; (b) knowledge sharing; (c) integration of business and data warehouse planning, and (d) communication between business and data warehouse managers.

To identify the level of alignment that exists between the business and data warehouse plans, questions were asked of business managers, data warehouse managers and user

representatives of the data warehouse to get a comprehensive view. The senior managers familiar with the business of the company were asked the following questions:

- How well does the data warehouse support (a) your business plans and (b) the organization's plans?
- Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?
- Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?
- What are the formal communication channels between you and data warehouse managers?

The data warehouse managers were asked the following questions:

- How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?
- Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?
- How is the integration of the business and data warehouse planning processes achieved?

To identify the level of alignment that exists between the business user needs and the data warehouse plans, the business users were asked the following questions:

- How are your needs communicated to the data warehouse team and vice versa?
- What are the formal communication channels between you and data warehouse team?

Architectural alignment of the data warehouse

The research model suggests that alignment of the data warehouse strategy and architecture to business strategy and architecture, ensures its successful adoption. A data warehouse architecture that aligns with the business architecture of an organization reduces costs and provides opportunities for new services. The findings on the architectural alignment of the data warehouse are presented hereunder.

Table 5.7 Results from questionnaires completed by senior business managers.

No	Question	SrBusn Mangr1	SrBusn Mangr2	SrBusn Mangr3	SrBusn Mangr4	Average Rating
1.	The data warehouse strongly supports the business plans	5	5	5	5	5

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question on how well the data warehouse supports business plans, all four senior managers interviewed responded with a rating of 5 (strongly agreed). This is also reflected in the questionnaire responses in Table 5.7 above. This demonstrates that they strongly felt that the data warehouse supports the business plans. The data warehouse was designed to increase revenues, and it has succeeded in doing that. The data warehouse has also been extended to match business plans and supports existing business plans and business needs very well.

Table 5.8 Results from questionnaire completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
3.	Data warehouse plans support the business plans and strategies.	5	4	5	4.6
4.	Business decisions are the driver for the data warehouse design.	5	4	4	4.3
6.	Business visions are the drivers for data warehouse architecture.	5	5	4	4.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

Findings from responses by data warehouse managers to the question on how the data warehouse architecture was selected, show that the data warehouse was built in response to business plans and strategies. There was a need at Nielsen Media Research to meet the challenges posed by the changing technologies in the media industry over the last five years. Media broadcasters were re-inventing themselves to adjust to these changes in technology. To stay relevant in this changing industry landscape, the objective of building the data warehouse at Nielsen Media Research was to be able to service these needs for greater flexible and timely reporting as well as for providing a wider breadth of data. For example,

Data Warehouse Project Manager	There is a new measurement for viewing called PeopleMeter. The data warehouse was able to react to change more quickly and put data that was more usable to the mainframe type system and feed it back to the mainframe. The data warehouse could adapt to new technology in industry more quickly than the old systems and was our justification.
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Data Warehouse Architect	The content is tightly coupled with business direction and so we are able to rotate on changing need in a Agile way. There was a need for overnight data, and it was brought into the data warehouse. We are adding commercial data this year. The changes are very driven by business.
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The data warehouse architecture was selected after considering high level strategies and detailed level sources of data. It is a reconciliation of a top-down as well as a bottom-up approach to architecture. The broad vision of the data warehouse embraced the concepts of first building a base repository and then servicing products through data marts rolled up from the base repository. The data warehouse allows each client to access its vast data store on an ad hoc basis and to query data rapidly. The data warehouse enables the clients to sort through

There have been changes in the data warehouse plans over the past five years as well. As the content of the data warehouse is closely coupled with the business direction, the changes have been driven by business needs. The data warehouse has adapted to new technology in the industry more quickly than older systems. It has incorporated data from the new measurement device for viewing data, called PeopleMeter. It has also incorporated overnights data into an overnights data mart. This year, commercial data will be added to the data warehouse. Changes have also been made to the integration, collection and presentation layers of the data warehouse.

Analysis

All senior managers interviewed agreed that the data warehouse strongly supported the business plans and the organizations plans as shown in Table 5.7 above. All gave a rating of 5. Of the data warehouse managers interviewed, all agreed that the data warehouse plans support the business plans and strategies (average ratings of 4.6 in Table 5.8). The research model (Figure 3.2) proposes that a data warehouse that strongly supports business plans is in greater alignment to the business and is important for a successful adoption of the data warehouse. The responses from the questionnaire and the findings from the interviews, confirm that the data warehouse supports the business plans and strategies.

All data warehouse managers interviewed, responded in the questionnaire (average rating of 4.3 in Table 5.8) that business decisions were the drivers for the data warehouse design. When asked if the business visions are the drivers for the data warehouse architecture, two data warehouse managers strongly agreed (rating of 5) and one agreed (rating of 4) as shown in Table 5.8. This is consistent with the research model.

At Nielsen Media Research, the decision to build a data warehouse and the selection of its subject areas were closely coupled with business needs and business strategies. The scope of the business vision dictated the architectural approach. The organizational strategic plans and objectives provided a roadmap for the data warehousing effort. The research model suggests that the alignment between the data warehouse strategy and architecture and the business strategy and architecture is a success factor in an organization implementing a data warehouse. Thus the findings lend support to the research model and the importance of the alignment of the data warehouse architecture to business strategy and architecture is to some extent suggested.

Knowledge sharing

In the research model, knowledge sharing between the business and data warehouse managers is one of the factors improving alignment between data warehouse and business plans. The research suggests that shared knowledge between business and IS managers helps in avoiding paradoxical decisions caused by business executives' lack of IT knowledge and IS managers' inadequate business knowledge (Hirschheim and Sabherwal, 2001). This suggests that knowledge sharing avoids making decisions that are out of alignment and can help in integrating business and data warehouse planning process.

Table 5.9 Results from questionnaires completed by senior business managers

No	Question	SrBusn Mangr1	SrBusn Mangr2	SrBusn Mangr3	SrBusn Mangr4	Average Rating
10.	The data warehouse team is aware of the business plans and strategies	5	4	5	4	4.5

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question if data warehouse managers helped the business managers understand the advantages and limitations of the data warehouse, all senior business managers answered in the affirmative. The data warehouse managers had a good dialogue with the business managers. The product manager worked along with the data warehouse manager in regard to the data warehouse. The product manager managed the strategic value of the data warehouse and represented the data warehouse to the business. The product manager educated the business on data warehouse possibilities and capabilities. For example,

Senior Product Manager,
Foundation Strategy

The data warehouse managers do help us understand the advantages and limitations of the data warehouse. The product manager, due to past experience, understands the business as well as the technology side. She advises the business on what the data warehouse can and can not do. The product manager educates the business on data warehouse possibilities.

CIO &
Senior Vice President,
Monitor Plus

Yes, the data warehouse managers have a good dialogue with the business managers.

Analysis

In response to whether the data warehouse team were aware of the business plans and strategies, two of the four senior managers strongly agreed (rating of 5) and two agreed (rating of 4) as shown in Table 5.9 above. It is evident from the interview responses discussed above and the questionnaire response, that the data warehouse managers at Nielsen Media Research along with the product manager have helped the business managers understand the advantages and limitations of the data warehouse technology and are in turn aware of the business plans and strategies. These findings lend support to the research model which

highlights the necessity of sharing the knowledge of business plans and data warehouse strengths and capabilities, between the business and data warehouse managers.

Integration of business and data warehouse planning

The following section presents the findings on how the business and data warehouse plans are integrated at Nielsen Media Research.

In response to the question, if the senior business managers were aware of a team that was integrating business needs and strategy with the data warehouse, all senior managers replied in the affirmative. They explained the role of the product management group and its effectiveness in ensuring that the business vision drove the design of the data warehouse. The product manager represented both the IT and the business sides. This cross-functional team comprised of 25 people consisting of product managers, quality assurance personnel, application and data warehouse developers, data architects and business analysts. Moreover, a business analyst and a data warehouse person had been assigned for every product being developed, to ensure that the data service could be reused. The product manager for the data warehouse worked with other product managers and senior management to determine their data needs and to balance and prioritize projects. For instance,

CIO & Senior Vice President, Monitor Plus	The product manager represents both sides of the business. It represents IT and product management. There are 25 people in this cross-functional team.
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In response to the question on how integration of business and data warehouse planning was achieved, the data warehouse managers replied that integration was achieved through working closely with the product manager, who was involved on both sides.

The integration of business and data warehouse planning process was also achieved through portfolio reviews with senior management four times a year. These portfolio reviews drove the IT projects and defined the projects that would be initiated. Product managers looked at high level strategies and translated them into IT projects and products. The integration of business and data warehouse planning is thus a structured method, stemming from the portfolio reviews. It involves business strategy, prioritization of projects and planning of resources. For example,

IT Director	The integration of business and data warehouse planning process is achieved through portfolio reviews with senior management 4 times a year. These portfolio reviews drive the IT projects and defines the projects that will be set off.
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Data warehouse Architect	The integration of business and data warehouse planning process is achieved through working closely with the product manager and director. They are the voices to upper management to say how the data warehouse can be best used to achieve business initiatives.
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Integration between business and data warehouse planning is also achieved through a process of completing “contract books”. The contract book contains the details of the plan, risks, justification, finance etc, for each major project, when it is undertaken. A contract book was signed for the data warehouse. The contract book in effect is a reflection that all stake holders understand what are the goals, what are the deliverables, what the project involves, how long it will take and what are the expected outcomes. ,

Table 5.10 Results from questionnaire completed by senior business managers

No	Question	SrBusn Mangr1	SrBusn Mangr2	SrBusn Mangr3	SrBusn Mangr4	Average Rating
8.	Cross-functional teams are highly active in the data warehouse project	5	5	4	5	4.7
10.	The data warehouse team is aware of the business plans and strategies	5	4	5	4	4.5

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

Table 5.11 Results from questionnaire completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
5.	Business and data warehouse planning processes are integrated.	4	5	5	4.6
6.	Business visions are the drivers for data warehouse architecture.	5	5	4	4.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

Analysis

The above tables, Table 5.10 and Table 5.11 present the results from the questionnaire to help validate the proposition that integration between business and data warehouse plans is critical to strategic alignment and successful adoption of the data warehouse. In response to the question if the data warehouse planning process was integrated with the business planning process, two of three data warehouse managers interviewed strongly agreed (ratings of 5) and one data warehouse manager agreed (rating of 4) as shown in Table 5.11. Asked if business visions were the drivers for the data warehouse architecture, again two of the three data warehouse managers strongly agreed (ratings of 5), and one agreed (rating of 4).

These findings from the interview and the questionnaire responses suggest that at Nielsen Media Research the data warehouse planning process is well aligned with the business visions and plans. The data warehouse was built in response to business needs. The data warehouse

strategy was a response to business strategy and used corresponding choices to define the data warehouse infrastructure and capabilities.

When the senior business managers were asked if cross functional teams were highly active in the data warehousing project, three out of four senior managers strongly agreed (ratings of 5) and one agreed (rating of 4) as shown in Table 5.10. On being asked if data warehouse managers were aware of business plans and strategies, two of the four senior business managers again, strongly agreed (ratings of 5) and two agreed (ratings of 4 in Table 5.10). This suggests that the role of the product manager is very effective in bringing about better coordination between the business and the data warehouse. The data warehouse managers are well informed of business plans and strategies and the data warehouse plans seek to exploit data warehouse capabilities to meet business needs and strategies.

The above findings suggest the idea that integration of data warehouse plans with business plans is critical to strategic alignment and successful adoption of the data warehouse. The above analysis therefore provides compelling evidence of the importance of integration of business and data warehouse planning and supports the research model.

Communication between the business and data warehouse managers

Communication between all stakeholders of the data warehouse is essential for its alignment to business strategy and adoption by the business users. Along with knowledge sharing and communication of the strategic direction to the data warehouse managers by the senior management, creating frequent communication channels between data warehouse managers and users is necessary to facilitate better understanding of the data warehouse and its ultimate successful adoption.

Senior Product Manager,
Foundation Strategy

The communication is very informal. We meet whenever it is needed. Plans are published to the business and made available to senior management and all other managers. We use a tool IT Governance to communicate, where schedules and project priorities are entered. Another communication channel is the product portfolio reviews held 3-4 times a year. Priorities are communicated in this venue and decisions are made if there are any questions.

IT Governance, a tool where all IT managers and project managers entered all projects, IT staffing, schedules and priorities, also served as a medium of communication. The product reviews held three to four times a year served as a communication channel as well. At these reviews, priorities were communicated and decisions were made. Also, there were frequent informal communications between the data warehouse manager and product and business managers. Meetings were held between them, whenever it was needed.

In response to the questions, if there were any formal communication channels between the users and data warehouse team, and how the user needs were communicated to the data warehouse team and vice versa, it was found that there were formal and informal communication channels between them. All the users interviewed, responded that they communicated with the data warehouse team both formally and informally.

Informally, they communicated directly with the data warehouse project leader through conversations over the phone or in person. The XP Methodology adopted for the development of the data warehouse facilitated communication across business and data warehouse units. Formally, if a project needed information from the data warehouse, the project leader would initiate the communication and meet with the data warehouse project leader. For example,

Senior Product Manager, Viewer Insight Open communication and XP Methodology. It allows an open workspace. Weekly planning meetings are held to plan weekly iterations. In XP Methodology requirement and analysis phase is combined. The development and QA phase is also combined. Business is always involved and weekly tasks are identified. Instead of six month development cycles, there were 13 week development cycles. There were check points for every week and every day.

Communications to the data warehouse team were also made through the product manager for the data warehouse. If a project were to impact the data warehouse or if a deliverable was required from the data warehouse or if any modifications were to be made, it was conveyed to the data warehouse team by the product manager. The weekly meetings held for every project and the daily stand-up meetings, also served as channels for communication between the users and the data warehouse team. For example,

Senior Product Manager, Viewer Insight From formal project perspective, if a product needs information, it initiates the communication and meets with the data warehouse team leader. They hold meetings and brainstorm. We work together informally as well. We pick up the phone and call as needed. We also have weekly meetings, project by project and daily stand-up meetings for 10-15 minutes everyday to check status.

Product Manager, Strategy & Research We have contact persons in the data warehouse in the product manager and the IT Director who manages the data warehouse. We communicate if there is a project that would impact the data warehouse or if a deliverable is required out of the data warehouse or if there is a modification to be made. We work very closely with them and based on the issue we have conversations as well as formal meetings. We keep the project community up-to-date on where they are progressing.

Analysis

In answer to the question if there were established communication channels to facilitate better understanding with the data warehouse managers, three out of four senior business managers agreed (ratings of 4) and one business manager strongly agreed as shown in Table 5.12. At Nielsen Media Research the communication between the business managers and the data warehouse managers flowed directly and also with the facilitation of the product manager.

Of the three users interviewed as shown in Table 5.13, one user was highly satisfied (rating of 5) and two users were satisfied (rating of 4) with the communication of user needs to the data warehouse team. The users interviewed were also satisfied with the communication vice versa, by the data warehouse team to the users. Two of the users were satisfied (ratings of 4) with the level of communication between the data warehouse managers and the users and one user was highly satisfied (rating of 5).

The above responses show that there is a good two-way communication between the data warehouse managers and its users. The user needs are communicated either directly or through the product manager to the data warehouse managers and a reciprocal feedback to the users is also satisfactory. These findings reflect the importance of good communication.

Assessment of alignment between business and data warehouse plans

Proposition 2 states that the degree of alignment between business and data warehouse plans is critical to the strategic alignment and successful adoption of the data warehouse. As discussed above, the data warehouse plans were developed in response to business plans. The business needs and business strategy were the drivers of the data warehouse architecture and processes and led to its strategic alignment and successful adoption. It is also seen that integration between business and data warehouse planning, knowledge sharing and the strong

and effective communication between the business managers and user on one hand, and the data warehouse manager on the other, brought about closer alignment between the business and data warehouse plans.

5.5.3 Assessing the degree of business user participation and satisfaction

The study of this proposition was broken into four sub-sections, as the model identifies a number of factors that contribute to the degree of participation and satisfaction of the data warehouse user. To gain a comprehensive understanding of the degree of user participation and satisfaction, the study was broken into the following four sub-sections: (a) user participation (b) perceived usefulness (c) ease of use and (d) data quality.

To study the degree of user participation in the data warehouse and the degree of satisfaction with it, the following questions were asked of the user representatives.

- Were you involved in the data warehouse project and how did you participate?
- How well does the data warehouse support your needs?
- Is the data warehouse easy to use?
- Does the data warehouse enable day-to-day-decisions?
- Are the data warehouse functions and technical features easy to understand?
- Was the user training adequate to help you carry out your functions?

To find out how satisfied the senior management was with the data warehouse, they were asked the following questions:

- Does the data warehouse provide you with information you need and has that resulted in changing business direction?
- How good is the response of the data warehouse team to your needs?

To find out the data warehouse managers perception of user satisfaction and needs, they were asked the following questions:

- Do the database, application middleware and front-end tools have high availability?
- Do users have to comply with the tools and outputs you provide or do the user choose tools to get the output that users want?
- What in your opinion are your users' key requirements now?

Participation

Table 5.14 Result from questionnaire completed by business users of the company

No.	Question	User1	User2	User3	Average Rating
1.	User's participation in the data warehouse project.	4	5	4	4.3

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

Findings from the case study show that all users interviewed were involved in the development of the data warehouse. One user interviewed was involved with the data warehouse from its initial implementation. She identified the low level details and variables of data to be captured into the data warehouse during the requirements gathering stage of the data warehouse. She identified data to be captured into the data warehouse for the Stellar project. She continues to interact with the data warehouse manager to make sure that the required data pieces are included into the data warehouse as it matures. She also ensures that the data warehouse was aligned to the three to five year strategies in the business plan. For instance,

Product Manager,
Viewer Insights

Yes, was informed about the data warehouse project. 4-5 projects were identified that needed to use low level detail of data from the data warehouse. Stellar was one of these projects. Low level variables that I needed were captured by the data warehouse team when gathering requirements..... I also make sure that the 3-5 year strategies in business plan are aligned into the data warehouse. We negotiate timelines.

A second user (Product Manager, Currency Overnights) interviewed was involved in defining specifications for the data warehouse pertaining to overnight data, ratings data and program names data. He was also involved in handling instances that did not occur on a daily basis. For example, events like daylight saving time changes, launch of a new network or changes in network affiliation.

Product Manager,
Currency Overnights

I was involved the data warehouse pertaining to ratings data, program names data and overnight data. I was involved in the scenarios that occur infrequently. For example, what happens when a new network launches or a network changes its affiliation, what happens when daylight saving time changes, what happens in the different time zones across the country and how are the feeds to the applications going to be handled.

The third user was involved with the data warehouse project in defining user requirements, user needs and in validating the output from the data warehouse. She was also involved in the local hub feeds into the data warehouse and in the Stellar project, where the multi-dimensional cube was loaded from the data warehouse to cater to business intelligence tools. She was also involved in loading local reference data into the data warehouse. She is now involved with the business intelligence tool MicroStrategy, looking for viewing patterns on the minute level views of data in the data warehouse. For instance,

Product Manager,
Strategy & Research

I was involved in defining user requirements, user needs and helping validate the output of the data warehouse.

I was involved in the local hub feeds into the data warehouse and in the Stellar project where the cube was loaded from the data warehouse. I was involved in loading of tables specific to local reference data as well. Now I am involved with the BI tool Microstrategy, looking for viewing patterns on the minute level views of data.

Analysis

Results from the questionnaire completed by the users presented in Table 5.14 above, show that all of the users interviewed are satisfied with their participation in the data warehouse project. Two users were satisfied with their participation (rating of 4) and one highly satisfied (rating of 5).

The research model (Figure 3.2 in Chapter 3) suggests that participation by the users in the data warehouse project is important. End user participation has a direct impact on the adoption of the data warehouse. The selection and inclusion of users in the project team is essential. Findings from the case study provide evidence that the users were satisfied with their level of participation in the development of the data warehouse. This finding supports the research model. User participation is essential for better communication and coordination of user needs. End user participation is helpful in managing user expectations and satisfying user requirements.

Perceived Usefulness

Findings on how well the data warehouse supports user needs show the users perceive the data warehouse as useful and find that it supports their needs very well. For example,

Senior Product Manager, The data warehouse supports my needs very well.

Viewer Insights

Product Manager, The data warehouse has been wonderful.

Strategy & Research

The data warehouse supports the products and has incorporated improvements asked for by the clients. It also offers a tremendous amount of flexibility. It allows leverage with future product development as well. As all the data resides in the data warehouse repositories, the

data warehouse architecture allows a new application to be added easily. The data warehouse has helped to get the products into the market faster and the clients have experienced performance gains. Enhancements have been included in the data warehouse and the user interface for overnights data has become more events driven. This has reduced the client's support interface with Nielsen Media Research. For instance,

Product Manager, Currency Overnights The data warehouse very much supports my needs. For instance, a lot of improvements that client's have asked for, have been incorporated in the Overnight's data warehouse.... It will allow leverage with future product development.

Table 5.15 Results from questionnaire completed by business users of the company.

No.	Question	User1	User2	User3	Average Rating
9.	Relevance of the data warehouse information to day-to-day-decisions.	3	5	5	4.3

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

Analysis

The above table 5.15 shows that the users were satisfied (average rating of 4.3) with the relevance of the data warehouse to their day-to-day decisions. Findings from the interviews show that the data warehouse adequately supported the user's needs. The research model suggests that for the data warehouse to be accepted and be successfully adopted by the users, it should be perceived as useful by its users.

The response of senior managers to the usefulness of the data warehouse was similar to the business users' perceptions. They have found the data warehouse useful in their ability to respond to changes in business direction. For example,

Senior Vice President,
Local Products

It (the data warehouse) has responded to help our ability to respond to changes in business direction.

CIO &
Senior Vice President,

The data warehouse supports the business plans very well. It was designed to increase revenue, and it has exceeded in doing that.

Monitor Plus

The Toolbox application is for internal use to answer to the client base and for custom analysis. We use it to look at data and give guidance to our clients.

The customers of Nielsen Media Research have been provided with information from the data warehouse and have used it to make better business decisions. The Toolbox application available internally within the company has helped in answering to the client base and in giving guidance to the clients. It has been used for customized analysis as well.

The product manager finds that the data warehouse does provide information for the products it supports. For example,

Senior Product Manager,
Foundation Strategy

The data warehouse supports the business plans very well.

The data warehouse supports business by integrating data from multiple, incompatible systems into a consolidated data base. As there are still many legacy systems being used within the organization, work is underway to develop an over arching product strategy to

rework the customer analysis system so that at a future date it would use the data warehouse exclusively.

Previous research (Triantafillakis et al., 2004; Meyer and Cannon, 1998) suggests that a basic requirement for a successful data warehouse is its ability to provide business users with accurate, consolidated and timely information. The findings from this case study show that senior management and users perceive the data warehouse as useful.

Ease of use

Table 5.16 Result from questionnaire completed by business users of the company.

No.	Question	User1	User2	User3	Average Rating
8.	Ease of use of the data warehouse.	4	2	4	3.3
10.	Users' understanding of the data warehouse functions and features.	3	4	4	3.6
11.	Adequacy of user training.	NA	5	4	4.5

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

Findings from this case study show that generally the users found the data warehouse easy to use. One user observed that the clients were happy with the data warehouse and there had not received any complaints.

Senior Product Manager, Yes, the clients are happy and there are no complaints.

Viewer Insight

Another user observed that the data warehouse was easy and transparent to the end-user, for end-user experience. The user understood the table structure and the data within the data

warehouse. Even though the data in the data warehouse was complicated, internal users found it easy to use due to support from the data warehouse team. For example,

Product Manager, Strategy & Research	It's easy and transparent to the end-user for the end-user experience. The data warehouse data is complicated but the internal users with the data warehouse teams support find it easy to use.
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The third user also agreed that the data warehouse was easy to use. But he added that some applications running on the data warehouse were intuitive and some were not. For the same client, sometimes different applications looked different, even though they used the same data source. This was because the products were developed using different tools by different groups that did not communicate well before. With the data warehouse, there is better communication and cross fertilization of ideas across groups. Efforts were underway to improve and have a common look and feel across products.

Analysis

Previous research (Meyer and Cannon, 1998; Strong et al., 1997) suggests that a basic requirement for a successful data warehouse is its ability to provide its users with consolidated information in an intuitive and comfortable manner. The research model also suggests that understanding the data that is in a data warehouse is a cornerstone to the success of a data warehouse.

Table 5.16 above shows that two of the three users interviewed was satisfied with the ease of use of the data warehouse (rating of 4). One user was dissatisfied (rating of 2) with the ease of

use of the data warehouse, but was aware of efforts being undertaken to improve upon the consistent look of applications across the products, to make them more user friendly.

With respect to the understanding of the data warehouse functions and features, two users were satisfied (rating of 4 in Table 5.16 above) with it. One user was moderately satisfied (rating of 3) but felt that understanding the data warehouse functions and features was getting easier as a lot of changes were being incorporated into the design and architecture of the overnight data mart. In his opinion, the performance of the data warehouse had also improved since these changes.

Previous research (Guimaraes, Staples and McKeen, 2003; Ang and Teo, 2000) recognizes the importance of user training as a significant factor for user participation. It also promotes communication between the users and developers of the data warehouse during the development process to reduce user conflict. The users interviewed during this case study, were satisfied with the amount of training they had received on the data warehouse. One user was highly satisfied with the training received (rating of 5 in Table 5.16), another was satisfied (rating of 4) and one user interviewed felt that user training was not applicable to her. It was found that the training provided to the users was informal and on an 'as needed' basis. The users found it to be sufficient to carry out their functions. The users found the data warehouse team very accommodating and received help from them whenever needed. The training was found to be adequate for the clients of the company to carry out their functions as well, because the clients were engaged very early on in the process of building the data warehouse.

These findings suggests that the data warehouse is simply not a very large database. The data warehouse is able to provide information necessary to answer business questions. It enables day-to-day decisions for the clients of the company, and the users are able to understand the functions and features of the data warehouse and interpret its data adequately.

Data Quality

To gain a comprehensive understanding, data quality has been studied in relation to three factors – accuracy of data, consistency and reliability of information and timeliness of data, in the data warehouse.

Table 5.17 Result from questionnaire completed by business users of the company.

No.	Question	User1	User2	User3	Average Rating
5.	Accuracy of data warehouse information.	4	5	4	4.3
6.	Consistency and reliability of the data warehouse information.	4	5	4	4.3
7.	Timeliness of data warehouse information.	4	5	5	4.6

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

In response to the question, if the data warehouse provided accurate information, it was found that all users were satisfied with the accuracy of the data provided in the data warehouse. It was found that the data provided by the data warehouse was the ‘currency’ for the business and was therefore held to a higher standard.

In response to the question if the data warehouse provided consistent and reliable information, it was found that all users interviewed found the data to be very consistent and reliable. There was an input of data from 25,000 homes between 3am and 4am everyday. This data after processing was loaded into the data warehouse and was released to the clients consistently,

starting at 7am. Numerous checks and balances were incorporated into the quality assurance process to ensure the accuracy and reliability of the data. The data warehouse project leader and the data base administrator made every effort to ensure the data's consistency and reliability. For instance,

Product Manager,
Currency Overnights

The data warehouse is very consistent. There is input from over 25,000 homes between 3 to 4 am everyday and the data gets passed along the mainframe and different systems and fed into the data warehouse. Then the data is released from the data warehouse as published data starting at 7 am and goes out to the clients at 7 am, 7.20 am, 7.40 am and so on.

Product Manager,
Strategy and Research

Yes. There are a lot of checks and balances within the QA role. Also the people like project leader for DW and data base administrator make sure the data warehouse is consistent.

Findings in response to the question if the data warehouse provided timely information showed that for all users the data warehouse provided information in a very timely fashion and has always met the service level agreements. For example,

Senior Product Manager,
Viewer Insight

The data warehouse provides timely data. If there is a delay up-stream, it is not the data warehouse's fault. The data warehouse meets the SLA (Service level agreement).

The data warehouse is available 24 hours, 7 days a week to its users. It is available even during back up as the features in Sybase IQ allows reader nodes to access the data base even while the writer node updates the data base. Sybase IQ switches between the nodes automatically.

Analysis

In response to whether the users were satisfied with the accuracy of the data warehouse information, two users were satisfied (ratings of 4), and one user was highly satisfied (ratings of 5) as shown in questionnaire results presented in Table 5.17 above. These ratings are consistent with their interview responses. In response to the question if the user was satisfied with the consistency and reliability of the data warehouse information, two users replied that they were satisfied (rating of 4) and one user was highly satisfied (rating of 5) shown in Table 5.17. In response to the question if the users were satisfied with the timeliness of data warehouse information, two users replied that they were highly satisfied (rating of 5) and one user was satisfied (rating of 4).

Previous research (Rahm and Do, 2000; Inmon, 1996; Schubart and Einbinder, 2000; Chaudhuri and Dayal, 1997; Moody and Kortink, 2000) suggests that a basic requirement for a successful data warehouse is its ability to provide business users with accurate, consolidated and timely information. The above findings from the interview questions and the questionnaire suggest this as well. This case study provides evidence to support the argument that data quality is essential for user satisfaction and for the successful adoption and alignment of the data warehouse to business.

Assessment of business user participation and satisfaction

Previous research suggests that the degree of business user participation and satisfaction is critical to strategic alignment and successful adoption of the data warehouse. Interview responses in this case study show that the users were satisfied with the ease of use and the data quality of the data warehouse. Satisfaction also existed among the users with their level of participation in the development of the data warehouse. Previous research suggests that all

these factors- user participation, perceived usefulness, ease of use and data quality are important to achieve user satisfaction. User satisfaction is important to achieve successful adoption of the data warehouse and its alignment to business strategies.

5.5.4 Assessing the degree of technical integration

A number of factors contribute to and facilitate technical integration of the data warehouse. To gain a comprehensive understanding of the degree of technical integration, the alignment mechanisms of (a) value management, (b) technological capacity and (c) organizational capability were used to study the means of achieving technical integration in data warehouse projects.

To find the level of technical integration of the data warehouse, questions were asked of data warehouse managers, users and senior business managers in the company. The following questions were asked of the data warehouse managers:

- How is the data integrated from different systems across the organization?
- How is the data warehouse architecture integrated into existing IT systems architecture?
- How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

To understand the impact of the degree of technical integration of the data warehouse on its success, from the users' standpoint, the following questions were asked of them:

- Is the data warehouse project team sufficiently well skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

To gain a comprehensive understanding of the impact of the degree of technical integration of the data warehouse on its success, the senior managers were asked the following question:

- Given a choice, what expertise would you like to add to the data warehouse team?

Value management

Value management is the organizational mechanism for ensuring that data warehouse resources invested throughout the organization deliver anticipated or greater returns (Henderson et al., 1996). The research model suggests that in a data warehouse, technology should be selected based on its ability to address business and user requirement. Generally, making investments in technology does not in itself ensure profitability (Henderson et al., 1996).

Table 5.18 Result from questionnaires completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
9.	The data warehouse technology was evaluated after the decision to build it.	4	1	5	3.3

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

In data warehouse projects, evaluating technology after the business problem that it can help solve has been identified, saves time and resources and allows organizations to focus on developing business solutions, and not just technology architectures. In response to the question if the data warehouse technology was evaluated after the decision to build the data warehouse at Nielsen Media Research, two data warehouse manager replied in the affirmative (ratings of 5 and 4 as shown in Table 5.18), and one strongly disagreed (rating of 1).

According to the data warehouse manager who disagreed, the data warehouse technology was evaluated not after, but before the decision to build it.

At Nielsen Media Research the data warehouse was built after careful technical evaluation consisting of both technical criteria and business metrics. The data warehouse architecture was selected after an in-house architect researched and explored the different options. Different data warehouse DBMSs were considered and vendor evaluations were completed. Each of the vendors was quizzed on technical and business metrics and weighted values were given to each criterion. Input was also received from Gartner Group and proof of concept was done for the products evaluated. Sybase IQ was finally selected over NCR Teradata and IBM DB2.

At Nielsen Media Research, the technology for the data warehouse was selected after comprehensive appreciation of business needs. As discussed above, the technology was selected after careful evaluation of technical and business criteria. The technology selected was appropriate to address business and user requirements. It had acceptance at the user interface, due ease of use and perceived usefulness. It was also found that the users were satisfied with the training provided to them. According to the CIO, the technology invested had delivered more than anticipated returns, as the data warehouse had exceeded its expectation with respect to return on revenue.

CIO

The data warehouse supports the business plans very well. It was designed to increase revenue, and it has exceeded in doing that. We are focusing on the third generation of the data warehouse and it has demonstrated that it supports business plans. The third generation data warehouse has extended to match the business plans and has done well.

Integration of data warehouse architecture into existing IT architecture

In response to the question on how the data warehouse architecture was integrated into existing IT systems architecture, all the data warehouse managers interviewed responded that it was well integrated as seen in Table 5.20 below (average rating of 4).

Table 5.20 Results from questionnaires completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
8.	The data warehouse architecture is integrated into existing IT systems architecture.	4	3	5	4

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

It was found from the interview responses that the data warehouse architecture was closely tied into existing IT infrastructure and was fairly transparent to source systems. For instance,

IT Director

The data warehouse architecture is integrated into the existing IT infrastructure and is fairly transparent to source systems. The data warehouse intercepts the data from the source systems and cleans them. It integrates the data back into existing legacy systems that are not yet part of the data warehouse. The data warehouse bridges back into the legacy world without it having to change. Nielsen Media is in the process of stream lining the products and repurposing the product due to aging technology.

Data Warehouse
Project Manager

The data warehouse architecture is integrated into the existing IT infrastructure. We try and conform to the naming standards. Data is received into the data warehouse and from existing IT systems and data is also passed from the data warehouse to these IT systems.

It was found that data was received into the data warehouse from existing IT systems and data was passed from the data warehouse to these IT systems. The data warehouse intercepted the data from source systems and cleansed it. It integrated this data back into the legacy systems that were not yet a part of the data warehouse. As there are different variations of the product, Nielsen Media Research is in the process of stream lining these products and repurposing the products due to ageing technology. The data warehouse is the precursor to the efforts to service the products in a new way.

Organizational capability

In response to the question if the data warehouse project team was highly skilled to manage and solve technical problems and how good the response of the data warehouse team was to user needs, it was found that the users were highly satisfied with the data warehouse team.

Table 5.21 Result from questionnaire completed by business users of the company.

No.	Question	User1	User2	User3	Average Rating
12.	The data warehouse project team’s skill to manage and solve technical problems, response of the data warehouse team	5	5	5	5

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

The users found the data warehouse team to be very skilled and highly motivated and talented as revealed by questionnaire results in Table 5.21 as well. The users found the data warehouse team to be very responsive to their needs as well.

Findings from responses to the question to senior managers on what expertise they would like to see added to the data warehouse team, show that the senior managers are highly satisfied

with the present data warehouse team. They find the present team knowledgeable in business and technology, and feel that they have the right people with the right skill set. For instance,

Senior Product Manager, Foundation Strategy	We have all the right people. Maybe add more of the same people. Present team is sufficient.
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One senior manager observed that she would like to offload the production and operational type of work from the data warehouse team to an operational department. This move was on the business plan as it was deemed expensive to use the data warehouse resources for operational process. For example,

Senior Vice President Local Products	I would like to offload some of the production and operational type of work from the data warehouse team to an operational department. For example, loading of the data warehouse, fixing errors and monitoring load. It's still being done by the data warehouse group because the data warehouse is new. It's expensive for IT resources to do it. It's on the business plan.
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Assessment of degree of technical integration

Previous research (Pollalis, 2003) suggests that strategic alignment between business strategies and the data warehouse strategies can have a positive impact on its adoption, if the data warehouse is a part of a well integrated organizational IT system. The above findings from the case study show that data from other systems within the organization have been well integrated into the data warehouse and also the data warehouse architecture is well integrated into existing IT architecture. Selection of the data warehouse technology based on business requirements and plans, and evaluation of the data warehouse technology investment, has contributed to higher than anticipated returns and business value. These findings from the case study therefore support a view that the degree of technical integration is critical to strategic alignment and successful adoption of the data warehouse.

Previous research (Hwang et al., 2004) also suggests that the skills of the data warehousing development team have a major influence on the outcome of the project and affect the adoption of data warehouse technology. A highly skilled team is better equipped to manage and solve technical problems. Findings from the interviews reveal that the business users, data warehouse managers and senior managers are satisfied with and recognize the importance of a highly skilled and well equipped development team.

5.5.5 Assessment of flexibility in data warehouse planning

To study the impact of flexibility in the data warehouse framework and in data warehouse planning on its success, questions were asked of the senior business managers, data warehouse managers and the users of the data warehouse to get a complete perspective. The senior managers were asked the following questions:

- Over the last 5 years what are the major changes that have taken place in your business plans?
- How has the data warehouse responded to your changing needs?

The data warehouse managers were asked the following questions to study the degree of flexibility in the data warehouse architecture and planning:

- Over the last 5 years has the data warehouse architecture changed and how?
- In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?
- Do the database, application middleware and front-end tools have high scalability?

To understand the business users' perception on the flexibility of the data warehouse, they were asked to answer the following question:

- How does the data warehouse respond to a change in business need?

In response to the question to senior managers on what major changes had taken place in the last 5 years in their business plans, it was found that there had been a dramatic increase in complexity in the industry. For example,

CIO and Senior Vice President, Monitor Plus	Business plans have remained the same over the past 5 years. The same business model has existed for a long term. The only change has been a dramatic increase in complexity in the industry.
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Even though the same business model had existed for a long time, and the overall business plans had remained the same, technological advances had introduced new methodologies for measuring television audiences. A major shift in business plans had been the addition of the Local People Meter to collect household information and person by person data every day instead of on a quarterly basis. Another change was the introduction of new television technology in the form of DVR (digital video recorder) and VOD (view on demand) services in the market and corresponding business plans to measure audience viewings on them. For instance,

Senior Vice President, Local Products	In the last 5 years, the major change has been the addition of the Local People Meter. It's a new methodology for measuring TV audiences.
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Senior Product Manager, Foundation Strategy	In the last 5 years, Local People Meter was implemented. It collects household information and person by person data. This is a major shift, to get person data everyday instead of quarterly. Another change is the introduction of new TV technology in the form of DVR (digital video recorder) and VOD (view on demand) services in the market.
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Table 5.22 Results from questionnaire completed by senior managers

No	Question	SrBusn Mangr1	SrBusn Mangr2	SrBusn Mangr3	SrBusn Mangr4	Average Rating
11.	The data warehouse is responsive to a change in business needs.	5	5	5	4	4.7

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

In response to the question on how the data warehouse had responded to changing needs, the senior business managers felt that the response of the data warehouse has been very good (also supported by questionnaire results shown in Table 5.22 above). Moving from diaries to capture demographics of the market, to Local People Meter had caused changes in the Nielsen Media Research environment. The data warehouse had been developed as a result of this. The senior managers found the data warehouse response to be flexible to frequent reprioritization of business needs, as client needs changed. The data warehouse also allowed the products to develop faster. Strategically, the data warehouse is being leveraged to cater to modernization and cost effective programs, though it was originally built to generate greater revenue. For instance,

Senior Product Manager,
Foundation Strategy

The data warehouse response has been amazingly flexible. We reprioritize frequently. As client needs change, the business and data warehouse changes with them

CIO and
Senior Vice President,
Monitor Plus

The data warehouse allows the products to be developed faster. Strategically, the data warehouse is being leveraged to do modernization and cost effective programs, though it was originally put up as a revenue generating thing.

Table 5.23 Result from questionnaires completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
10.	The data warehouse is highly responsive to a change in business needs.	4	4	5	4.3
11.	The database, application middleware and front-end tools have scalability.	4	4	5	4.3

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

From data warehouse managers’ responses to the question on how flexible the data warehouse is to accommodate new business needs and changes, all agreed that the existing architecture of the data warehouse was extremely flexible (shown in Table 5.23 above). The data warehouse had been built keeping flexibility in mind. The data warehouse has embraced re-factoring and continuous delivery as much as addition of new data types such as time-shifting data. The data warehouse allows data structures to be extended efficiently to handle changes. Changes have been made to the base structure of the data warehouse, with the changes having rippled through to products with minimum down time and effect. If the data warehouse were not flexible to react quickly to changing conditions, its usefulness would decline. According to the data warehouse managers, new events are a priority for the data warehouse. For instance,

Data Warehouse
Project Manager

The data warehouse is extremely flexible. It’s been built keeping flexibility in mind. The data warehouse is new and extremely useful. If the data warehouse is not flexible to react quickly to changing conditions, its usefulness will decline. New events become a priority for the data warehouse.

Data Warehouse
Architect

The data warehouse is extremely flexible. We have embraced re-factoring and continuous delivery as much as we have added new types of data.

All the data warehouse managers agreed that the database, application middleware and front end-tools had high scalability as seen in Table 5.23 also. In one application, Stellar, the front-end faced some issues with scalability due to growth in its user base.

Table 5.24 Result from questionnaire completed by business users

No.	Question	User1	User2	User3	Average Rating
4.	Data warehouse response to change in business needs.	4	3	5	4

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

In response to the question to the users, on how the data warehouse responds to a change in business need, it was found that in most cases the data warehouse responded quickly and thoroughly (as shown also in questionnaire results in Table 5.24). This was attributed to the experience of the data warehouse team members. They were experienced in both data knowledge and the technology involved. Business managers met regularly with the data warehouse managers at strategy group meetings and business needs were conveyed to the data warehouse manager. Since the data warehouse team usually had a lot of business requests, they had to prioritize these requests. Depending on the severity of the request, some request were met sooner and some later.

Analysis

Alignment is seen as a process requiring continuous adaptation and coordination of plans and goals. A flexible data warehouse infrastructure makes it easier to introduce change in cost and time efficient ways. The senior management at Nielsen Media Research views the data warehouse as being responsive to changing business needs (average rating of 4.7 in Table 5.22). The data warehouse managers also view the data warehouse as being responsive to changes in business needs (average rating of 4.3 in Table 5.23). It also appears that the

database, application middleware and front-end tools have high scalability (average rating of 4.3). The users also showed satisfaction (average rating of 4 in Table 5.24) with the data warehouse's responsiveness to changing business needs and viewed the data warehouse as being flexible.

From the above responses (to the interview questions and questionnaire) it appears that everyone interviewed in this study at Nielsen Media Research views the data warehouse as being flexible to accommodate changing business needs. There does not seem to be a wide gap between emerging strategic direction, and the data warehouse's ability to support it. Quick, iterative developments of the data warehouse have addressed the shifting of business requirements in a satisfactory manner.

Assessment of degree of flexibility in data warehouse planning

The satisfaction of the senior management and users with the response of the data warehouse to changes in their business need corroborates with the research model and proposition 5. In the research model, the issue of flexibility in planning is pertinent to the data warehouse environment. Previous research (Armstrong, 1997; Moody and Kortink, 2000) suggests that as business needs change over time, a successful data warehouse needs to be flexible enough to be responsive to it. The flexibility of the data warehouse at Nielsen Media research has allowed the organization to react to changes in its environment (new technology in audience viewing) and maintain the advantage its information provides.

5.6 Conclusion

This chapter presented the findings of the case study conducted at Nielsen Media Research. It also provided an analysis of the case study to determine whether an alignment of the data warehouse to business strategy and plans, had an impact on its successful adoption. The

research findings indicate that the factors that facilitate strategic alignment of the data warehouse also influence the successful adoption of the data warehouse. It was found that strong management support, joint responsibility between business and data warehouse managers, alignment between business plan and data warehouse plan, flexibility in the data warehouse framework, business user satisfaction and technical integration of the data warehouse, have a positive influence on the successful adoption of the data warehouse at Nielsen Media Research.

6 CASE STUDY RAYMOND JAMES FINANCIAL

6.1 Introduction

This chapter presents the findings from a case study conducted at Raymond James Financial and the data collected through the interviews with questionnaires to various participants (as discussed in chapter 4). It also analyses of the research findings, based on the research propositions. The case study findings are presented in three sections. The first section presents the overview and background of the company where the case study was carried out. The second section describes the data warehouse implementation. The third section of this chapter presents the findings from the interviews of the participants in the case study as well as their responses to the questionnaire. This section also provides an analysis of the information gathered from the case study based on propositions and evaluates the research model.

6.2 Overview of the Company

Raymond James Financial was established in 1962 and has been a public company since 1983. It is now one of the largest financial services firms in the United States, with 2,100 locations worldwide. Their stock is traded on the New York Stock Exchange (RJF) and its shares are currently owned by more than 13,000 individual and institutional investors. Raymond James Financial was selected by Forbes (Jan 10, 2005) magazine as one of the 100 best-managed companies in the United States.

Raymond James Financial is a diversified financial services holding company. Its subsidiaries engage primarily in investment and financial planning, including securities and insurance brokerage, investment banking, asset management, banking and cash management, and trust services. Through its four investment firms, Raymond James & Associates, Raymond James Financial Services, Raymond James Ltd. and Raymond James Investment Services, the firm

has more than 5,100 financial advisors in 2,200 locations throughout the United States, Canada and abroad, providing service to over one million individual and institutional accounts. In addition, total client assets are currently over \$136 billion, of which more than \$25 billion are managed by the firms' asset management subsidiaries.

Company Subsidiaries

- Raymond James Financial Services is a subsidiary company and consists of 3,809 independent contractor financial advisors in 1,565 offices in all 50 states.
- Raymond James & Associates is a wholly owned subsidiary and consists of 861 employee financial advisors in 76 offices concentrated in the South, Mid-Atlantic and Midwest.
- Raymond James Ltd. consists of 259 financial advisors in 46 offices, all located in Canada.
- Raymond James Investment Services consists of 53 independent contractor financial advisors in 25 offices. The Company owns 75% of this joint venture in the United Kingdom.

6.2.1 Business Objectives

Raymond James Financial provides individual investors, corporations and municipalities with investment, financial planning, investment banking, asset management, banking and trust services throughout the United States, Canada and internationally. Raymond James Financial has over five thousand Financial Advisors (FA), both employees (RJA) and brokers (RJFS) that work directly with the investor client's.

Raymond James Financial in their mission statement announces, as its first precept, that clients always come first. As a client oriented company, it therefore aims to provide the

highest level of service and have clear and frequent communications with its clients. It aims to maintain superior quality in its service and cooperate with and provide assistance and support to its Associates. Its mission is to also provide continuing education and excel beyond its peers.

Corporate structure

Raymond James Financial has a traditional (hierarchical) corporate structure. Its subsidiaries operate independently but compete collectively, focusing on a diverse range of businesses. It is headed by the President who is also the CEO (Chief Executive Officer). The COO (Chief Operating Officer) and the Presidents of all its subsidiaries, report directly to him. The CIO (Chief Information Officer) is a corporate officer at the vice presidential level, and reports directly to the CEO. With only one level separating him from the top of the organizational hierarchy, the CIO wields great decision making authority and control over a large IT organization. The information technology division comprises of four major functions: Software development and production management, operations, database administration and project management which helps integrate all areas. The data warehouse falls under the software development and production management function. The chief data warehouse development officer reports directly to the CIO.

6.3 Background of the Data warehouse

Raymond James Financial operates in a vast, complex and competitive financial market. In an industry that has generally consolidated into a relatively few large conglomerates, Raymond James has continued to remain independent and grow. To sustain this growth it becomes imperative for them to help build loyalty between clients and the Raymond James advisors.

The long term operating plan of Raymond James Financial focuses on improving their Return On Equity (ROE) through an effective deployment of excess capital and a re-engineering of the processes utilized in Operations and Information Technology. The objective is to improve their effectiveness and efficiency, as well as their service to clients and financial advisors, by elevating the quality and productivity of their sales force.

The data warehouse provides an opportunity to improve their efficiency and serve the needs of the financial advisors better. The idea of building a data warehouse emerged in 2002. It grew out of the recognition that the financial advisors (FAs) had to look in many different places for information and reports. The large inventory of information sources (over 20) and different interfaces placed an additional burden on the FA to first become aware of all of these sources and then to access multiple user interfaces, i.e. applications, reports and web sites to retrieve information. Moreover in providing information these sources many times overlapped with each other.

In addition, having similar information stored in multiple databases provided a greater probability that the information often differed across these databases. For example, many times the Retail division as well as other divisions within Raymond James created their own local databases to provide information not currently provided by existing data sources and their user interfaces. Loading and maintaining all of these databases significantly increased the cost of doing business.

A need was also felt for more detailed and relevant reports. Certain reports core to the Raymond James business had been in place for a significant period of time and had not kept up with the changing business environment and technological advances. Some paper based reports only provided a static view of key information, which did not answer all the key

business questions. Again, some other reports were distributed on a weekly or monthly basis and provided summary information and not the underlying detail. A need was felt for more immediate on-line access to information as well as the ability to provide different views and reports of this information based upon the specific needs of the FA or management.

6.3.1 Data warehouse Objective

The objective of the data warehouse was to provide the financial advisors, financial advisor's management and other Raymond James Financial individuals and divisions, with one data warehouse which provides current, dynamic access to consistent and accurate information on key performance indicators for the business. This data warehouse provides the ability to not only report information but also the ability to leverage this information to increase profitability, both by reducing costs and expenses as well as increasing production.

6.4 Data warehouse Development

Conceptual model

The first step in building the data warehouse was to provide a strong foundation of common information. An enterprise foundation was created on which subject areas were then built. This foundation comprised of information on Organization, Products, Account Types, Time, General Ledger Buckets, Asset Ranges, Transaction Types, Production Types, Financial Advisor Types, and Demographics. This common information provided all users with a single point of reference when accessing subject specific data, such as Account Assets or a Financial Advisors' Production numbers.

Subject areas for Assets, Production, and Account Statistics were then created on top of this foundation. These subject areas provided a flexible, dynamic on-line view, which replaced

and enhanced the information currently provided. These subject areas are available not only to the financial advisors community but also other Raymond James employees and divisions.

Physical Implementation

The data warehouse was built on an HP Superdome platform with 12 processors, 48 gigabytes memory and a 64 bit MS Sequel server, Enterprise Edition. It sourced data from 20 different databases into a staging relational database of 10 terabytes size. Data was cleansed, integrated, transformed and then loaded into the three data marts. It used Online Analytical Processing from Microsoft (MS OLAP) to build the subject areas for reporting and analysis. OLAP is a database software that provides an interface, so users can transform raw data quickly and interactively examine the results in various dimensions of the data. The MS OLAP rolled the three data mart views up to an enterprise view of the data warehouse. The data warehouse contains mainly historical data up to two years old and it is current up to the previous close of day. The front end of the warehouse comprised of a custom application MDX (a Microsoft term for Multi-Dimensional Expressions), a visualizing component, which directly accessed MS OLAP. It consisted of mainly preformatted reports. Data was accessed for analysis through Proclarity, a third party analysis tool, chosen from a limited number of access tools that can service MS OLAP.

Project Initiation

The data warehouse project was initiated by the CIO, who was instrumental in presenting and selling the project to the business and CEO. It was one of the top 5 projects in the company at that time and enjoyed high visibility at the upper management level. The data warehouse is a joint effort between the business and IT division. The IT division, having heard the requests over the years worked closely with business managers and financial advisors to determine the data warehouse project's impact on business and its priorities. The data warehouse was built

to an initial cost of 3 million dollars, which the business divisions invested into the data warehouse as a shared business expense. The CIO was involved in all higher level decisions and major expense decisions, for example, the purchase of major hardware, large software expenses or new human resource expenses.

Current Data warehouse

The data warehouse project has been in existence for over 2 years. A successful prototype was built in the first 8 months as proof of concept. The prototype was then enlarged over the next 1 ½ years into the current data warehouse. An iterative development methodology was adopted to build the data warehouse. This enabled the demonstration of the progress of the data warehouse to the financial advisors every 3-4 months at regular conferences. These conferences allowed the articulation of requests and information needs from the management and financial advisors and their inclusion into the data warehouse development process.

The data warehouse is available for use by up to six to seven thousand individuals. Every financial advisor has the ability to use some form of data from the data warehouse. Different levels of users have been assigned different levels of access to the data warehouse depending upon the security required. Users have been trained using online sessions and Web based training for the data warehouse. Data warehouse classes are held for financial advisors, who then receive a certificate at the completion of their training. Around 500 financial advisors and managers use it everyday for reporting and analysis. The activity level on the data warehouse changes over time. Activity level is at its highest during Mondays and near month ends.

6.5 Presentation of Findings from the Case Study and Analysis of Results

This case study was undertaken to investigate the research questions derived from the research model, to study the impact of strategic alignment of the data warehouse to business strategies and plans, on its successful adoption.

The research model proposed in Figure 3.2 posits that strategic alignment between the business and data warehouse can be achieved by ensuring that the underlying critical factors are addressed. The model identifies *(a) joint responsibility between business and data warehouse managers, (b) alignment between business plan and data warehouse plan (c) flexibility in the data warehouse framework (d) business user satisfaction and (e) technical integration* of the data warehouse as the critical factors in influencing alignment and the successful adoption of a data warehouse. The model along with the five propositions (described in Chapter 3) is examined in this research.

In the case study at Raymond James Financial, the participants who represented senior management were the Vice President (Software Development), Regional Administrative Manager (RJA Private Client Group) and Product Manager. The Product Manager (Data warehouse), Data Warehouse Manager and Data warehouse Supervisor represented the data warehouse managers. The user group was represented by Assistant to Chairman of RJFS, Asst. Vice President (Sales Management), Regional Administrative Manager (RJA Private Client Group), Assistant Vice President (Branch Administration), Learning Specialist and Database Administrator (RJFS Group).

The questions and subsequently rated responses of the participants are summarized in the tables below. The rated responses of questions relevant to the propositions accompanies its analysis to facilitate better understanding.

Table 6.1 Results from questionnaire completed by senior managers

No	Question	Busn	Busn	Busn	Average
		Mangr1	Mangr2	Mangr3	Rating
1.	The data warehouse strongly supports the business plans	4	4	4	4
2.	The data warehouse drives business decision	2	2	5	3
3.	Senior management has a high level of commitment to the data warehouse project.	4	4	4	4
4.	Business managers are highly involved in the data warehouse investment decisions..	4	4	1	3
7.	Data warehouse managers are highly involved in corporate strategy	2	4	2	2.6
8.	Cross-functional teams are highly active in the data warehouse project	4	4	3	3.6
9.	There are established communication channels to facilitate better understanding	4	4	3	3.6
10.	The data warehouse team is aware of the business plans and strategies	4	4	3	3.6
11.	The data warehouse is responsive to a change in business needs.	3	5	4	4
13.	The data warehouse is successful.	4	4	4	4

(Ratings of 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree)

Table 6.2 Result from questionnaires completed by data warehouse managers

No	Question	DW	DW	DW	Average Rating
		Mangr1	Mangr2	Mangr3	
1.	Data warehouse managers are aware of the corporate strategies.	4	4	4	4
2.	Data warehouse managers are highly involved in corporate strategy	3	2	2	2.3
3.	Data warehouse plans support the business plans and strategies.	4	4	3	3.6
4.	Business decisions are the driver for the data warehouse design.	4	4	4	4
5.	Business and data warehouse planning processes are integrated.	4	1	1	2
6.	Business visions are the drivers for data warehouse architecture.	4	2	2	2.6
7.	Data is integrated from different systems across the organization.	4	5	5	4.6
8.	The data warehouse architecture is integrated into existing IT systems' architecture.	4	5	5	4.6
9.	The data warehouse technology was evaluated after the decision to build it.	3	5	5	4.3
10.	The data warehouse is highly responsive to a change in business needs.	3	4	4	3.6
11.	The database, application middleware and front-end tools have scalability.	4	5	5	4.6
12.	The database, application middleware and front-end tools have high availability.	4	5	5	4.6
14.	The data warehouse is successful	4	4	4	4

(Rating of: 5-Strongly Agree, 4-Agree, 3-Neither Agree nor Disagree, 2-Disagree, 1-Strongly Disagree).

Table 6.3 Result from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
1.	User's participation in the data warehouse project.	4	3	3	3	3	2	3
2.	Communication of users needs to the data warehouse team.	5	3	3	3	3	4	3.5
3.	Communication by the data warehouse team to the users	3	3	3	2	3	2	2.6
4.	Data warehouse response to change in business needs.	4	2	2	4	3	1	2.6
5.	Accuracy of data warehouse information.	3	2	4	3	4	3	3.1
6.	Consistency and reliability of the data warehouse information.	3	2	3	3	4	3	3
7.	Timeliness of data warehouse information.	4	2	3	2	4	2	2.8
8.	Ease of use of the data warehouse.	1	3	1	1	1	1	1.3
9.	Relevance of the data warehouse information to day-to-day- decisions.	5	2	3	4	3	2	3.1
10.	Users' understanding of the data warehouse functions and features.	4	4	2	2	3	2	2.8
11.	Adequacy of user training.	4	4	2	1	3	2	2.6
12.	The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	3	3	3	3	3	3.3
13.	Level of satisfaction with the data warehouse success.	4	3	1	3	2	3	2.6

(Ratings of 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

The findings from the case study for each of the proposition is presented below.

6.5.1 Assessing joint responsibility between business and data warehouse managers

To identify the level of joint responsibility that exists between the business and data warehouse managers, questions were asked of business managers and data warehouse managers. The three senior managers familiar with the business of the company were asked the following questions:

- How involved are you in the data warehouse investment decisions?
- In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?
- How often do data warehouse managers participate in your strategy meetings?

Commitment and involvement of senior management in data warehouse project.

Table 6.4 Results from questionnaire completed by senior business managers.

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
3.	Senior management has a high level of commitment to the data warehouse project.	4	4	4	4
4.	Business managers are highly involved in the data warehouse investment decisions..	4	4	1	3

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question on how involved the business managers were in data warehouse investment decisions, two senior managers answered that they were involved and one senior manager answered that he was not involved and was struggling to get his point of view across.

For instance,

Vice President,
Software Management

Extremely involved. The VP of software development reports to the CIO who reports to the CEO. The head of software development oversees 330 people and works closely with the heads of product management and project management. The product management group, along with the product manager for the data warehouse make decisions about moving people to the data warehouse and other teams, sizing the teams and allocating resources. Decisions about moving forward in a project and funding resources is made along with IT operations and IT engineering groups.

Senior Product Manager

The product manager was involved in building a long term roadmap for the data warehouse. He participated in defining the deliverables of the system as well as its display layouts. He was also responsible in getting the resources from the operating committee of the company and the business units together who have the ownership.

Regional Administrative
Manager, RJA Private Client
Group

Not involvement in data warehouse investments. Only involved in defining user needs.

It was found that the senior managers were involved in the data warehouse investment decisions, and were responsible for funding the data warehouse and getting resources from the operating committee of the company and the business units, who have ownership of the data warehouse. The senior managers participated in defining the deliverables of the system as well as its display layouts. They were also involved in sizing the data warehouse team and allocating its resources.

In response to the question on how involved the senior managers, including the CEO, were in data warehouse decisions, it was found that the CIO was the champion of the data warehouse project and the CEO participated in investment decisions involving over 1 million dollars. The CIO was instrumental in selling the data warehouse project to upper management and making it visible among senior management and finding support for it.

Data Warehouse Manager	The data warehouse decision was made at the CIO and VP levels. The CIO was involved in initiating and selling the data warehouse to the business. The senior product manager works with the business manager and involves the CIO at higher level decisions
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Vice President, Software Management	The VP of software development is involved in data warehouse decisions. The CEO was involved in the fact that building it was a good idea and in seeing the demo of the data warehouse. He is involved in all decisions involving over a million dollars.
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The product management group was involved in data warehouse investment decisions and met with the CEO and COO for presentations and funding.

Analysis

The results of the data analysis from the questionnaire completed by the senior business managers provide evidence of the high level of commitment by the senior management to the data warehouse project. On a scaled rating from 1 to 5, where 5 represents strongly agree and 1 represents strongly disagree, all three senior managers responded with a rating of 4, that is agree as shown in Table 6.4. In response to the question, if business managers were highly involved in the data warehouse investment decisions, two out of three managers responded with a rating of 4 and one strongly disagreed

At Raymond James Financial, the CEO and the Vice President of software development along with the senior business managers and product managers are very involved in data warehouse investment decisions. The CIO acted as the champion of the data warehouse project and was responsible for initiating and selling the data warehouse to the business. This confirms the research model and proposition 1, that strong support at the senior levels of management is important to data warehousing projects. This support and commitment by senior management has resulted in active promotion of the project (the DW project was identified as one of the five most important projects in the organization) and ensured availability of capital, human support and internal resources during the development and implementation process.

Involvement of data warehouse managers in corporate strategy

To find out the level of involvement of data warehouse managers in corporate strategy, the data warehouse managers were asked the following questions:

- How involved are you in corporate strategy decisions?
- Over the last 5 years what are the major changes that have taken place in your organization’s business plan?

Table 6.5 Results from questionnaire completed by data warehouse managers

No	Question	DW	DW	DW	Average
		Mangr1	Mangr2	Mangr3	Rating
1.	Data warehouse managers are aware of the corporate strategies.	4	4	4	4
2.	Data warehouse managers are highly involved in corporate strategy	3	2	2	2.3

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

It was found that not all data warehouse managers were uniformly involved in corporate strategy (as also shown in questionnaire results in Table 6.5 above). One data warehouse manager was moderately involved in corporate strategic decisions. The upper management involved them in task forces dealing with new initiatives to improve current processes and to improve financial advisor relationships. For example,

Product Manager The data warehouse product manager is moderately involved in corporate strategic decisions. The upper management involves them in task forces dealing with new initiatives to improve current processes and to improve advisor relationships.

Data Warehouse
Supervisor There has been a shift in the corporate strategy decisions. The corporate goal now is to acquire Financial Advisor and the assets under their management. There is a focus on technology as being a differing factor for recruiting Financial Advisors aboard. The data warehouse is being used as a strategic as well as a competitive tool

The second data warehouse manager was more involved in corporate strategy decisions and stated that there had been a shift in corporate strategy decisions. The corporate goal had shifted to acquire financial advisors and the assets from under their management, into the company. There had also been a focus on the use of technology as being a differentiating factor for recruiting more financial advisors. *The data warehouse is thus being used as a strategic and competitive tool.* The change in focus had led to the changes in the organization's IT plans. Efforts were underway to improve processes, and new software development methods were being rolled out. Also, within the company there was an ensuing discussion and analysis of the buy versus build option, and focus was moving to buy third party products.

The third data ware house manager felt that he was not very involved and corporate strategy decisions were made at the CIO and VP levels of the company. He was aware of major organizations business plans linked to the data warehouse applications in marketing and compliance, in performance reporting and contact management.

Analysis

The results from the questionnaire filled out by the business managers and data warehouse managers, as shown in Table 6.6 below, reflect on the level of involvement of data warehouse managers in corporate strategy.

Table 6.6 Results from questionnaire completed by senior business managers.

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
7.	Data warehouse managers are highly involved in corporate strategy	2	4	2	2.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to a question on whether the data warehouse managers were highly involved in corporate strategy, senior managers responded with an average rating of 2.6 (Table 6.6 above), which means that the data warehouse managers were not perceived as being highly involved in corporate strategy decisions by senior managers. For instance,

Regional Admonistrative
Manager, RJA Private Client
Group

The involvement of the data warehouse managers in business strategy meetings depends on the attitude of the managers. Some do not want to have anything to do with IT. The data warehouse team also is happy because it can continue to do its own thing.

On asking data warehouse managers if they were highly involved in corporate strategy, the average rating was 2.3, which means they did not perceive themselves as being highly involved in corporate strategy making. When asked if the data warehouse managers were aware of the corporate strategy, all the data warehouse managers responded with a rating of 4 (agree) on a scale of 1 to 5, where 5 denotes strongly agree. This means that the data warehouse managers were well aware of corporate strategies.

Thus, a difference in response was found in the level of awareness of corporate strategy by data warehouse managers (average rating of 4 in Table 6.5) and their involvement in corporate strategy decisions (average rating of 2.3). The level of awareness of corporate strategies by data warehouse managers interviewed received a rating of 4, by all data warehouse managers interviewed. But the level of involvement of the data warehouse managers in corporate strategy making was low (average rating of 2.6 and 2.3 by senior managers and data warehouse managers respectively).

This status is inconsistent with the research model. The model requires joint involvement of data warehouse managers and senior managers to ensure strategic alignment of the data warehouse to business plans.

At Raymond James Financial, this problem is being addressed. A recent organizational change in the management structure of the company underlines the importance of the understanding and joint responsibility between data warehouse managers and business managers. Until now, the data warehouse managers had been participating in meetings with the business users and business managers. Now, a new layer in the form of product manager has been added to the data warehouse management. The product manager has over five years extensive business experience at the company and has been given the task and role of managing the data warehouse. For example,

Senior Product Manager

The data warehouse managers do participate in strategy meetings with the business. But with the recent organizational change, the product manager is increasingly taking up this role, and the involvement of the data warehouse managers will progressively reduce. The data warehouse team is being shielded from participating directly so they can concentrate on development

efforts. Also the product manager speaks the language of business better than the DW team who use a lot of technical terms.

The product manager is now responsible for building a long term roadmap for the data warehouse. He participates in defining the deliverables of the system as well as being responsible for getting resources for the data warehouse, from the operating committee of the company and the business units who have the ownership of the data warehouse. The product manager works with the business managers on all data warehouse issues and involves the CIO at higher level decisions on the data warehouse.

The product manager is thus in the unique organizational position to set the stage for alignment of the data warehouse in its subsequent implementations. The understanding, commitment and involvement of the product manager in the data warehousing process could have an effect on improving the strategic alignment of the data warehouse to business strategy in the future.

Assessment of joint responsibility between business and data warehouse managers

The above results from the interviews and questionnaire provide compelling evidence that alignment between business strategy and data warehouse strategy requires a strong interdependent relationship between the business and data warehouse managers. The product managers, data warehouse managers and business managers are jointly trying to align the data warehouse, addressing deficiencies that have been observed.

Thus the findings suggest that a high level of involvement and commitment of senior business managers to the data warehouse is important. It confirms proposition 1 that high level of involvement and commitment of senior managers and data warehouse managers is critical to successful alignment and adoption of data warehouse.

6.5.2 Assessing alignment between business and data warehouse plans

A number of factors contribute to, and facilitate, alignment between business and data warehouse plans. Hence, to gain a comprehensive understanding of the degree of strategic alignment, the study was broken into four sub-sections: (a) architectural alignment of the data warehouse; (b) knowledge sharing; (c) integration of business and data warehouse planning, and (d) communication between business and data warehouse managers.

To identify the level of alignment that exists between the business and data warehouse plans, questions were asked of business managers, data warehouse managers and users of the data warehouse to get a comprehensive view. The senior managers familiar with the business of the company were asked the following questions:

- How well does the data warehouse support (a) your business plans and (b) organizations plans?
- Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?
- Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?
- What are the formal communication channels between you and data warehouse managers?

The data warehouse managers were asked the following questions:

- How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?
- Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?

- How is the integration of business and data warehouse planning process achieved?

To identify the level of alignment that exists between business user needs and the data warehouse plans, the business users were asked the following questions:

- How are your needs communicated to the data warehouse team and vice versa?
- What are the formal communication channels between you and data warehouse team?

Architectural alignment of the data warehouse

The research model suggests that alignment of the data warehouse strategy and architecture to business strategy and architecture, ensures its successful adoption. A data warehouse architecture that aligns with the business architecture of an organization reduces costs and provides opportunities for new services. The findings on the architectural alignment of the data warehouse are presented hereunder.

Table 6.7 Results from questionnaires completed by senior business managers.

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
1.	The data warehouse strongly supports the business plans	4	4	4	4

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question on how well the data warehouse supports business plans, two senior managers agreed that it supported their business plans while one responded that the data warehouse did not support his business plans very well. Of the two who felt that the data warehouse supported their and the organizations business plans, one senior manager admitted that initially there had been growing pains and the amount of data in the data warehouse seemed overwhelming. He further stated that as they became familiar with the data warehouse

and were able to use the data, the financial advisors found the data warehouse to be of immense help in analyzing and planning their business. Before the data warehouse was developed, the financial advisors did not have access to integrated data and information was mainly extracted from scattered reports. For example,

Senior Product Manager

The data warehouse has supported the business plans of the company. Initially there were growing pains and the data seemed overwhelming. But it has helped the financial advisors plan their business. It has given the financial advisors tools to analyze from top-down. Before the warehouse, they had to depend on scattered reports.

The data warehouse has been available to the Financial advisors for 1-1/2 years. During this time span some changes have been facilitated by the data warehouse. Departments have made policy changes, and enforced these policies based on data from the data warehouse.

Vice President,
Software Development

It supports recruiting. It's also being used to support business plans. For example, to decide the impact of a rise in a particular fee being imposed. How many accounts will it impact? How can the fee be instituted? But the very complexity that makes the data warehouse powerful is making it hard to use. More expertise is required to use the data warehouse fully. A cell of power users is required to run queries against the data warehouse

The second senior manager concurred that the data warehouse supported his and the organization's business plans. The access to the data warehouse had been one of the key competitive advantages that the company had been able to offer in recruitment of financial advisors. Additionally, the data warehouse was also seen to support the analytical functions in the business. For example, the data warehouse had been helpful in analyzing the impact of the

imposition of, or raise in a particular fee on the accounts held, and how the fee could be instituted. However, he added, that the very complexity that made the data warehouse powerful, was making it hard to use. He suggested that a team of users with greater expertise was required to fully exploit and use the data warehouse.

The senior manager who found that the data warehouse did not support his business plans well, observed that it was attributable to the fact that different functional groups within the company functioned differently. There was a need to share appropriate data within the functional groups and this was not reflected by the data warehouse. He felt that there were ownership issues with data within the functional groups. He was of the opinion that the data warehouse could help in diminishing these boundaries and facilitate sharing of information. In his view, the data warehouse could help in the de-segregation of data by integrating it. The manager felt that although the data warehouse did not meet his personal business plans, it probably met the organization's business plans. For example,

Regional Administrative
Manager, RJA Private Client
Group

The data warehouse does not support the business plans very well. The different functional groups function differently. There is a need to share appropriate data. The data warehouse does not reflect this. There has been ownership issues with data. But to realize the vision of the company, the data warehouse could help in taking down the boundaries and sharing the information. It could help in the de-segregation of data by combining the efforts and presenting a united front.

analyze institutional data through the data warehouse. There had been requests from business users to expand the data warehouse beyond the three core subject areas to other areas such as expenses and bank data. However, the data warehouse plans had been scaled back due to resource constraints and institutional priorities, and there is less focus on its use across the organization by adding additional subject areas. Even though the data warehouse could not satisfy all current user requests due to resource constraints, the data warehouse managers realized the need for more subject areas. For example,

Data warehouse Supervisor

The Data warehouse project initiated 2 years ago and went live a year ago. Since its gone live, the plans have been scaled back. There is also less focus on its use across the firm by adding additional subject areas. There was more focus on the initial roll out of one piece – the business analyzer.....Since then several users have requested the VP to analyse institutional data.

Analysis

All senior managers interviewed agreed that the data warehouse strongly supported the business plans as shown in Table 6.7 above. All gave a rating of 4. Of the data warehouse managers interviewed, majority agreed that the data warehouse plans support the business plans and strategies. One neither agreed nor disagreed, responding with a rating of 3 as shown in Table 6.8. The research model (Figure 3.2) proposes that a data warehouse that strongly supports business plans is in greater alignment to the business and is important for a successful adoption of the data warehouse. The responses from the questionnaire and the findings from the interviews, support the contention that the data warehouse supports the business plans.

All the data warehouse managers interviewed responded in the questionnaire (rating of 4 in Table 6.8) that business decisions were the drivers for the data warehouse design. When asked if business visions were the drivers for the data warehouse architecture, one data warehouse manager agreed (rating of 4) but two disagreed (rating of 2) as shown in Table 6.8. This seems contrary to the model.

In the case studied the decision to build a data warehouse and the selection of its subject areas seem to be based on business needs. Initially, the scope of the business vision dictated the architectural approach. For example,

Data warehouse Manager

There were business requests from the financial advisors and from retail for data on assets and revenue, historical and statistical data. There was no place to analyse all this data together. So an enterprise wide data warehouse was selected to allow financial advisors to see all aspects of the business.....The data warehouse project goal was to structure in one system, all the information for the financial advisors and the management. It has three major subject areas – assets, revenue and account statistics. The project scope was a joint effort between the business users and IT.

But currently, the organizational vision and strategic plans do not provide a roadmap for the data warehousing effort. In the research model, a strategic objective of long term gain and full organizational control is necessary for an enterprise data warehouse architecture. The data warehouse managers and senior management are aware of this and steps are being taken to address this disconnect between strategic vision and data warehouse plans. The reality that efforts are underway to address this deficiency, suggests to some extent that alignment of the data warehouse architecture to business strategy and architecture is important and lends support to the research model.

Knowledge sharing

In the research model, knowledge sharing between the business and data warehouse managers is one of the factors improving alignment between data warehouse and business plans. The research suggests that shared knowledge between business and IS managers helps in avoiding paradoxical decisions caused by business executives’ lack of IT knowledge and IS managers’ inadequate business knowledge (Hirschheim and Sabherwal, 2001). This suggests that knowledge sharing avoids making decisions that are out of alignment and can help in integrating business and data warehouse planning process.

Table 6.9 Results from questionnaires completed by senior business managers.

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
10.	The data warehouse team is aware of the business plans and strategies	4	4	3	3.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question if data warehouse managers helped the business managers understand the advantages and limitations of the data warehouse, one senior manager replied that the data warehouse managers were receptive to their needs and vision. The data warehouse managers had explained to them what the data warehouse was capable of doing for them. He felt that the data warehouse was not flexible enough to adapt to all their current needs and they were struggling with it. For example,

Regional Administrative Manager, RJA Private Client Group	The data warehouse managers are receptive to their (user) needs and vision. But some areas in the data warehouse are not flexible enough to adapt to their needs and they are struggling with it.
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Both the other senior managers stated that the data warehouse managers helped the business managers understand the advantages and limitations of the warehouse well. The data warehouse managers had also informed them of the need for more resources and funds, required for the incremental releases of the data warehouse. The senior managers understood the necessity for these resources but were finding it hard to justify these resources, financially.

For instance,

Senior Product Manager	Data warehouse managers help the business managers understand the advantages and limitations of the warehouse well.
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Vice President Software Development	It is very hard to justify financially. More resources are required for the data warehouse and funds are required for the incremental releases.
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Analysis

In response to the question whether the data warehouse team was aware of the business plans and strategies, two of the three senior managers agreed (rating of 4) and one neither agreed nor disagreed (rating of 3) in Table 6.9 above. Overall, it appears from the interview responses and the questionnaire responses that the data warehouse managers at Raymond James Financial have helped the business managers understand the advantages and limitations of the data warehouse technology and are in turn aware of the business plans and strategies. These findings lend support to the research model which highlights the necessity of sharing the knowledge of business plans and data warehouse strengths and capabilities, between the business and data warehouse managers.

Integration of business and data warehouse planning

Table 6.10 Results from questionnaires completed by senior business managers.

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
8.	Cross-functional teams are highly active in the data warehouse project	4	4	3	3.6
10.	The data warehouse team is aware of the business plans and strategies	4	4	3	3.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

Table 6.11 Results from questionnaire completed by data warehouse managers

No	Question	DW Mangr2	DW Mangr2	DW Mangr3	Average Rating
5.	Business and data warehouse planning processes are integrated.	4	1	1	2
6.	Business visions are the drivers for data warehouse architecture.	4	2	2	2.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

In response to the question whether there was a team that was integrating business needs and strategy with the data warehouse, two of the three senior managers replied in the affirmative. They explained that the product manager was responsible for integrating the data warehouse with business needs and business strategy. The product manager understood the business side of the company and had over five years of experience in it. The position of the product manager was added to the management structure of the data warehouse, to enhance the cooperation and coordination between the data warehouse and the business. These senior managers felt that this change in the management structure had shown signs of being effective and they had received good feedback from the business. Since the needs of the different groups within the business were different, the product manager prioritized the user needs and determined costs and ways to drive future releases of the data warehouse. The third senior

manager interviewed, did not interact with the product manager but dealt directly with the data warehouse manager for his business needs. For instance,

Senior Product Manager The product manager is a new position responsible to integrate business needs and strategy with the data warehouse. The product manager has spent the last 5 years in the business side of the company and understands it well. This position is created to enhance the cooperation and coordination between business and the data warehouse. It has shown signs of being effective and has had good feedback from the business.

Vice President
Software Development Yes, the product manager's cooperation is quite good. The needs of the private client group and the needs of the capital groups are quite different. The product manager surveys the landscape and uses that to drive future releases of the data warehouse. He prioritizes the needs across the different user groups. He determines the costs and the way to go ahead.

In response to the question on how integration of business and data warehouse planning process was achieved, the data warehouse managers explained that to address this issue, the product manager had been added to the management structure of the data warehouse, to better facilitate the integration of business and data warehouse planning. For example,

Data warehouse Supervisor The integration of business and data warehouse planning is a slow process. At present the data warehouse is not tied strategically to the business plans. The filtering down of business plans through the management layers is slow. To address this issue, product manager group was created to better integrate business and IT planning.

Initially, in the first two years, the data warehouse was aligned to business strategies. But following changes to the business strategies and business demands, the data warehouse's speed of change, to meet these changes in strategic direction and demands, was slow. The

filtering down of business plans through the management layers was also slow. The data warehouse team had also met with resource constraints. To address these problems, integration of business and data warehouse planning was now being facilitated by the product manager, who was involved on both sides.

Analysis

The above tables Table 6.10 and Table 6.11 present the results from the questionnaire to test the proposition that integration between business and data warehouse plans is critical to strategic alignment and successful adoption of the data warehouse. In response to the question if the data warehouse planning process was integrated with business planning process, two of three data warehouse managers strongly disagreed (ratings of 1 out of 5) and one data warehouse manager agreed (rating of 4) as shown in Table 6.11. Asked if business visions were the drivers for the data warehouse architecture, again two of the three data warehouse managers disagreed (ratings of 2), and one agreed (rating of 4). These findings suggest that at Raymond James Financial the data warehouse planning process is currently not well aligned with the business visions and plans. The model predicts that the above scenario would lead to poor alignment.

The senior management and the data warehouse managers at Raymond James Financial are aware of this problem and they recognize the importance and necessity of integrating business and data warehousing plans. The introduction of the product manager is a step in this direction to enhance the cooperation and coordination between the business and data warehouse plans. These corrective actions validate the model.

When the senior business managers were asked if cross functional team was highly active in the data warehousing project, two out of three replied in the affirmative (ratings of 4)

referring to the product manager, and one neither agreed nor disagreed (rating of 3) as shown in Table 6.10. On being asked if data warehouse managers were aware of business plans and strategies, two of the three senior managers again agreed (ratings of 4) and one neither agreed nor disagreed (rating of 3 in Table 6.10). This suggests that the role of the product manager is being effective in bringing about better coordination between the business and the data warehouse managers and there is positive action on their part to integrate data warehouse plans with business needs and plans.

These findings suggests that integration of data warehouse plans with business plans is critical to its strategic alignment and successful adoption of the data warehouse. The above analysis therefore provides compelling evidence of the importance of integration of business and data warehouse planning and supports the research model.

Communication between the business and data warehouse managers

Communication between all stakeholders of the data warehouse is essential for its alignment to business strategy and adoption by the business users. Along with knowledge sharing and communication of the strategic direction to the data warehouse managers by the senior management, creating frequent communication channels between data warehouse managers and users is necessary to facilitate better understanding of the data warehouse and its ultimate successful adoption.

Table 6.12 Results from questionnaires completed by senior business managers.

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
9.	There are established communication channels to facilitate better understanding	4	4	3	3.6

(Rating of 5-strongly agree, 4-agree, 3-neither agree nor disagree, 2-disagree, 1-strongly disagree)

Table 6.13 Results from questionnaires completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
2.	Communication of users needs to the data warehouse team.	5	3	3	3	3	4	3.5
3.	Communication by the data warehouse team to the users	3	3	3	2	3	2	2.6

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

From the replies to the question what formal channels for communication existed between the business and data warehouse managers, it was found that both formal and informal communication channels existed within the organization. One of the formal channels of communication between the business and data warehouse manager flowed through the product manager. The product manager was a fundamental and open line between the two sides and allowed free and open communication. The product manager validated the various requests coming through the different business divisions and conveyed it to the data warehouse managers. For instance,

Senior Product Manager

Communication between the business and the data warehouse managers flows through the product manager. It's a fundamental and open line between the two sides and allows open and free communication. The product manager validates the different requests coming through the different divisions before conveying it to the data warehouse managers. If changes are required, the data warehouse goes through a change management process.

Regional Administrative
Manager, RJA Private Client
Group

There is a formal IT order form that serves as a channel of communication. But as it is formal and hard to fill out, the business managers talk directly to the data warehouse managers.

The change management process used within the IT division was another formal medium of communication. But as the change management process consisted of completing several IT forms which were difficult to fill out, it was occasionally circumvented and the business managers talked directly to the data warehouse managers. Another communication channel was the weekly staff meetings held by the vice president of software development of the company in which the product manager and data warehouse managers sometimes participated.

In response to the question, if there were any formal communication channels between the users and data warehouse team, and how the user needs were communicated to the data warehouse team and vice versa, it was found that there were formal and informal communication channels between them. Four of the six users interviewed, responded that there were no formal or established communication channels between them and the data warehouse team. The communication between the user and the data warehouse managers and team was informal. Generally the user communicated to the warehouse team via emails or over phone calls. Sometimes ad hoc meetings were held. For instance,

Assistant Vice President, Branch Administrative	There are no formal communication channels. The data warehouse team communicates to us by email and vice versa. At times there are ad hoc meetings. When necessary, we talk to the data warehouse team members over phone.
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Assistant to Chairman of TJFS	The communication with the data warehouse team is informal.
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The other two users communicated their needs through the learning specialist to the data warehouse managers. One user replied that earlier, when they were preparing for the first implementation of the data warehouse, they communicated directly with the data warehouse team. They had committees initially, and communicated through email groups and intranet

test sites. Now the users communicated to the data warehouse managers via the training team and the learning specialist. For example,

Learning Specialist We meet face to face with the data warehouse developers for an hour every Tuesday. That is the main way to communicate with them. The users communicate through the training team to the development team. In this forum, the user issues are communicated to the data warehouse team, but there is no resolution. It is a compounding list that is communicated.

The learning specialist met with the data warehouse developers and managers for an hour every Tuesday, in a face to face meeting. In this forum, the user issues were communicated to the data warehouse team, but usually there was no resolution to these issues. The outcome usually was a compounding list of user needs communicated to the warehouse team. The users were also supposed to communicate directly to the product managers. These users stated that the decision of the product manager or data warehouse manager was not communicated back to them. There users received little or no feedback from the data warehouse managers or product manager.

Analysis

In answer to the question if there were established communication channels to facilitate better understanding with the data warehouse managers, two out of three business managers agreed (ratings of 4) and one business manager neither agreed nor disagreed as shown in Table 6.12 above. Overall, the communication between the business managers and the data warehouse managers seems to flow, either directly or with the facilitation of the product manager. For example,

Senior Product Manager Communication between the business and the data warehouse managers flows through the product manager.

Of the six users interviewed, only one user was highly satisfied (rating of 5 in Table 6.13) with the communication of user needs to the data warehouse team. One user was satisfied (rating of 4) and the remaining users were only moderately satisfied (ratings of 3) with the communication of user needs to the data warehouse team.

No user interviewed was highly satisfied or satisfied with the communication in the opposite direction, by the data warehouse team to the users. Two of the users were dissatisfied (ratings of 2) with the level of communication between the data warehouse managers and the users and the remaining four users were only moderately satisfied (ratings of 3 as shown in Table 6.13).

This shows that there is a lack of good two way communication between the data warehouse managers and its users. Although the user needs are communicated either directly or through the learning specialist to the data warehouse managers, a reciprocal feedback from data warehouse managers to the user was not satisfactory. This is an area of communication which needs to be improved for better adoption and use of the data warehouse. The observation by a user of the need for more effective communication and knowledge sharing among the various IT divisions and the data warehouse team, to keep information in the data warehouse consistent, further lends support to the research model and proposition 2.

For instance,

Assistant Vice President,
Sales Management

The data warehouse team also needs to communicate with other IT divisions that affect the data warehouse, for consistency. The user feels there is a need for more effective communication and knowledge sharing among the various IT divisions, so that when a new piece of information is introduced in one system, it gets incorporated in the rest.

These findings reflect the importance of good communication. The fact that lack of communication has led to user dissatisfaction is evidence of importance of good communication for better alignment of the data warehouse.

Assessment of alignment between business and data warehouse plans

Proposition 2 states that degree of alignment between business and data warehouse plans is critical to strategic alignment and successful adoption of the data warehouse. As discussed above, the data warehouse plans were developed in response to business plans. The business needs and business strategy were used to define the data warehouse architecture and processes and led to its strategic alignment and successful launch. It is also seen that the divergence between the data warehouse plans, business needs and business plans led to sub-optimal outcomes. That a change in management structure had been effected to address this divergence, lends support to the fact that integration between business and data warehouse planning, knowledge sharing and the strong and effective communication between the business managers and user on one hand, and the data warehouse manager on the other, brings about closer alignment between the business and data warehouse plans.

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6.5.3 Assessing the degree of business user participation and satisfaction

The study of this proposition was broken into four sub-sections, as the model identifies a number of factors that contribute to the degree of participation and satisfaction of the data warehouse user. Hence, to gain a comprehensive understanding of the degree of user participation and satisfaction, the study was broken into the following four sub-sections: (a) user participation (b) perceived usefulness (c) ease of use and (d) data quality.

To study the degree of user participation in the data warehouse and the degree of satisfaction with it, the following questions were asked of the users.

- Were you involved in the data warehouse project and how did you participate?
- How well does the data warehouse support your needs?
- Is the data warehouse easy to use?
- Does the data warehouse enable day-to-day-decisions?
- Are the data warehouse functions and technical features easy to understand?
- Was the user training adequate to help you carry out your functions?

To find out how satisfied the senior management was with the data warehouse, they were asked the following questions:

- Does the data warehouse provide you with information you need and has that resulted in changing business direction?
- How good is the response of the data warehouse team to your needs?

To find out the data warehouse managers perception of user satisfaction and needs, they were asked the following questions:

- Do the database, application middleware and front-end tools have high availability?
- Do users have to comply with the tools and outputs you give or do the user choose tools to get the output that users want?
- What in your opinion are your users key requirements now?

Participation

Table 6.14 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
1.	User's participation in the data warehouse project.	4	3	3	3	3	2	3

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

Findings from the case study show that not all users interviewed were involved in the development of the data warehouse. For example,

Assistant Vice President ...*(I)* was not involved in any way in the development of the data
Sales Management warehouse.

Regional Administrative Manager The user was involved in the data warehouse project in defining the
user specification.

Assistant Vice President No. But have been involved in testing reports that come out of the data
Branch administration warehouse. To see if the outcome of the report looks alright, does the data
seem what it should be. Have participated as a user for over 18 months.

Only one user interviewed was involved in defining the user specification. Another user was involved in testing reports that came out of the data warehouse after implementation to validate output. He was not involved in defining the report. The third user interviewed was asked to contribute his suggestions on how to train the users. The rest of the participants in the study were involved as users of the data warehouse only.

Analysis

Results from the questionnaire completed by the users presented in Table 6.14 above, show that most of the users are only moderately satisfied with their participation in the data warehouse project, with only one being satisfied with his participation (rating of 4) and one highly dissatisfied (rating of 1). Findings from the interviews show that the users wanted greater involvement and participation in defining user requirements, report specifications and design of the queries. For example,

Database Administrator, ...*But they did not involve the people who use the data to design*

RJFS Group

the data warehouse. The data warehouse is to provide competitive advantage. The users need the data in it. They are thrilled to know that the data is there, but they cannot use it readily.....We were not told about how the data warehouse was designed and how data was stored in it

The research model (Figure 3.2) suggests that participation by the users in the data warehouse project is important. End user participation has a direct impact on the adoption of the data warehouse. The selection and inclusion of appropriate users in the project team is essential. Findings from the case study provide evidence that the users are not satisfied with their level of participation in the development of the data warehouse. This finding supports the research model. User participation is essential for better communication and coordination of user needs. End user participation is helpful in managing user expectations and satisfying user requirements.

Perceived Usefulness

Findings on how well the data warehouse supports user need, show that not all users perceive the data warehouse as useful to their needs. The data warehouse was used by the users on a weekly or monthly basis for analytical purposes and business planning.

Regional Administrative
Manager

The data warehouse enables weekly or monthly decisions. It's not used on a day to day basis.

Assistant to Chairman of RJFS

We use it for weekly and monthly reports. We use it for querying and for looking at historical data.

It was primarily used for querying, reporting and looking up historical data. Some users wanted to use it more frequently and felt that it could be used for day-to-day decisions. But they were unable to use it adequately because of the difficulty encountered in finding the desired information in the data warehouse, the non-intuitive design of the user interface, the data warehouse 'locking up' while running reports and drawbacks in preparing reports. Occasionally, users resort to other information systems that exist within the company, to satisfy these information needs. For example,

Assistant Vice President,
Branch Administration

If one can get the information, it can be used for day-to-day decisions. But I can't use it as much as I would like to, and I have to get the information from other systems. Since in a particular report there are 3,400 financial advisor records, it gets locked up when running the report.

The users observed that although the platform of data warehouse had all the information they sought, the way the data warehouse was designed made it difficult to extract the necessary data. For example, a financial advisor could view his individual assets, but could not view assets at the corporate level. The users found it difficult to merge data from the data warehouse with other files or external data, as the data warehouse information lacked unique identifiers. For instance,

Database Administrator for
RJFS Group

One can find the data. But the way they house the data, in the data warehouse, it is not easy. Information needs to be integrated with external files, spreadsheets etc. The data warehouse needs to merge information together..... As the data warehouse information has no unique identifier, it can't take two files and merge them easily.

Of the users that found the data warehouse supported their needs, it was the availability of integrated data in the data warehouse that they found the most useful. Before the data warehouse, they had limited ability to collect, integrate and analyze data. They also found the available canned reports useful.

Table 6.15 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
9.	Relevance of the data warehouse information to day-to-day- decisions.	5	2	3	4	3	2	3.1

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

Analysis

The above table 6.15 shows that the business users were only moderately satisfied (average rating of 3.1) with the relevance of the data warehouse to their day-to-day decisions. Findings from the interviews show that the data warehouse does not adequately support the user’s needs. The users felt that the data warehouse could be better used and had greater potential. The latter suggests a positive outlook. The research model suggests that for the data warehouse to be accepted and be successfully adopted by the users, it should be perceived as useful by its users.

The response of senior managers to the usefulness of the data warehouse varied from its business user’s perception. Two out of three senior managers interviewed stated that the data warehouse did provide them with the information they needed. The third manager observed that even though the data warehouse did not provide him with the information he sought, the data warehouse was designed for the financial advisors and they had found it useful. For

example, the data warehouse provided information on the viability of a particular fee, and applying this fee made a direct impact on profitability of the company. One senior manager observed that the data warehouse had also resulted in new business strategy. The data warehouse had been used by management to monitor the progress of its new model for recruitment of financial advisers. Senior management found the access to organized and centralized information in the data warehouse useful. For instance,

Vice President Software Developmentit (data warehouse) is being used to easily see the correlation between the account side and revenue. Its being used to drive behavior from sales management.....
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Senior Product Manager	The data warehouse has been available to the Financial advisors for 1-1/2 years. During this time span some changes have been facilitated by the data warehouse. Departments have made policy changes, and enforced these policies based on data from the data warehouse.
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Regional Administrative Manager,RJA Private Client Group	The data warehouse is useful in studying the after effect of this new model for recruitment and in monitoring its progress. Also, because of the integrated data available on the data warehouse, an individual does not have to make several points of contact to find information. It has made access to information more organized and centralized.
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Previous research (Triantafillakis et al., 2004; Meyer and Cannon, 1998) suggests that the strength of the data warehouse lies in its ability to organize and deliver data in support of management's decision making process. The above findings show that the senior management perceives the data warehouse as useful, supporting the research model.

Ease of use

Table 6.16 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
8.	Ease of use of the data warehouse.	1	3	1	1	1	1	1.3
10.	Users' understanding of the data warehouse functions and features.	4	4	2	2	3	2	2.8
11.	Adequacy of user training.	4	4	2	1	3	2	2.6

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Dissatisfied, 1-Strongly Dissatisfied).

Findings from this case study show that the users did not find the data warehouse easy to use. It was observed that the data warehouse was not intuitive to use and lack of user manuals made it even harder to use. The financial advisors found the data warehouse difficult to navigate and time consuming. This difficulty in using it had prevented users from exploring all the options provided in the data warehouse and was therefore resulting in its infrequent use. Some users felt that greater technical expertise was required to fully utilize the data warehouse. For instance,

Assistant Vice President The data warehouse is not easy to use. There are many options available, Sales Management that the user has not yet touched upon. The user finds it very highly technical. One has to know how and what to do, to use it. There are no user manuals to refer to. There is also no intuitive way to do it.....Besides speed, the other difficulty faced by the users is knowing which cube the information they are looking for lies in and how to extract it. They find the data warehouse to be complex and lacking a user's guide. The user interface needs improvement.

Assistant Vice President No. It is not intuitive to build reports that you need. Financial Advisors in Branch Administration the fields may have different perspectives. We can build queries easily on

other systems, but not the data warehouse. I would use it more often, if not so difficult to use.

Learning Specialist

No, it is not easy to use. For the sales men, the financial advisors, finding data is time consuming. It is not easy to use by any means

The users observed that querying for information on the data warehouse was not “straight forward”. For example, data could be sliced by region, but not a combination of regions. The user would like to see additional ways to slice the data in the data warehouse. Other users found that it difficult to understand the logic of sorting data in the data warehouse. The data warehouse would often “hang” the computer while running a query it could not accommodate. Overall the users found the data warehouse functions and technical features difficult to understand. They felt that a background in a database tool seemed necessary to fully understand and use the data warehouse.

Analysis

In the data warehousing environment, the business users are the main customers of the system. Previous research (Meyer and Cannon, 1998; Strong et al., 1997) suggests that a basic requirement for a successful data warehouse is its ability to provide its users consolidated information in an intuitive and comfortable manner. The research model suggests that the competitive advantage of a data warehouse depends on the bulk of the organization’s employees being able to quickly and easily access the data and interpret the information.

From the Table 6.16 above it is evident that the users are highly dissatisfied with the ease of use of the data warehouse. Five of six users gave a rating of 1 (highly dissatisfied) and one user was only moderately satisfied (rating of 3). Again the users do not seem to be satisfied

with their understanding of the data warehouse functions and features. Three of the six users interviewed were dissatisfied (rating of 2), one user was moderately satisfied (rating of 3) and two users were satisfied (rating of 4 in Table 6.16 above). The users were also not satisfied with the amount of training they received on the data warehouse (average rating of 2.6). These findings suggests that the data warehouse should not simply be a very large database. It should be able to provide information necessary to answer business questions in a manner that is comfortable and intuitive to the business user.

Data Quality

To gain a comprehensive understanding, data quality has been studied in relation to three factors – accuracy of data, consistency and reliability of information and timeliness of data in the data warehouse.

Table 6.17 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
5.	Accuracy of data warehouse information.	3	2	4	3	4	3	3.1
6.	Consistency and reliability of the data warehouse information.	3	2	3	3	4	3	3
7.	Timeliness of data warehouse information.	4	2	3	2	4	2	2.8

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Dissatisfied, 1-Strongly Dissatisfied).

In response to the question, if the data warehouse provided accurate information, it was found that not all users were satisfied with the accuracy of the data provided in the data warehouse. It was found that though the data warehouse contained mostly accurate data, complete accuracy was sometimes questionable as it had discrepancies with data from older systems. Once given the source of the data, the discrepancies were sorted out. In some cases, data was not being drawn into the data warehouse from the right source. For instance,

Data base Administrator
for RJFS Group

In some areas like production, for some piece of information, some records don't make their way to the data warehouse. They are not drawing data from the right source for this piece of information.

Assistant to Chairman of RJFS

Whether the information is accurate or not, it depends. For example, we pull one set of numbers, and found out the data does not look right. There is some inclusion in the query string and we had to figure it out, find it out and had to question the data. The data you get may not be what you wanted.

Some users stated that the reports drawn from the data warehouse sometimes did not appear to be accurate. The discrepancies in the reports may not necessarily be because of problems in the data warehouse. They may occur because (a) of the way data was sourced into the data warehouse, or (b) the data warehouse reports may contain more data than similar reports made from other sources, resulting in disparate figures. These discrepancies are important as a minute difference in detail between two similar reports can often translate to significant differences in dollar terms. One user observed that these discrepancies lead to reduced acceptance of the data warehouse. When users encountered these inaccuracies early on in their use of the data warehouse, they did not want to use the data warehouse again. Again, inaccuracies found in one area of the data warehouse kept the users from using other areas of the data warehouse. For example,

Learning Specialist

There have been inaccuracies in the new accounts system. There have been discrepancies in the business analyzer and other systems. This has led to a potential issue. When in the first thing the user has problems, they won't go back to the system after that.

In response to the question if the data warehouse provided consistent and reliable information, it was found that while the data was mostly consistent (information was available on a monthly basis), it was not always reliable. The data in the data warehouse went back only to the beginning of 2005, hence occasionally the data had to be cross-checked with reports from other systems, to get a more complete picture. One user observed that the data in the data warehouse was consistent but the complexity of use was such that different queries run to find similar information resulted in different answers. For example,

Regional Administrative Manager	The data is mostly consistent and reliable. But there are times when one has to cross check the data. The user is not completely confident of the data from the business analyzer.
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Assistant Vice President, Sales Management	The data in the data warehouse goes back to only beginning of 2005. So sometimes one has to double check with data from other systems, to get a more complete picture.
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Assistant to Chairman of RJFS	It is consistent, but so complicated to use, that the queries may be different for finding similar information.
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Findings in response to the question if the data warehouse provided timely information, showed that for some users the data warehouse provided information in a fairly timely fashion and for some other users, it did not. It was found that the data was updated in the data warehouse daily on a nightly basis and reflected data as close of previous day. Additionally, the manipulation of data to satisfy some queries took time, affecting the user efficiency. One user observed that providing timely information was an area of opportunity for the data warehouse. For example,

Regional Administrative Manager	The user feels providing timely information is an area of opportunity for the data warehouse. The data is not as close of business yesterday, but of the day before. The data is therefore 2 days old. The user would like to see it as close of business yesterday. One can physically get the data from elsewhere but have to wait a day to get it from the data warehouse. It therefore affects the efficiency of the user.
Learning Specialist	Yes, fairly timely. The canned reports are timely. The data in the warehouse is a day behind. Sometimes, the manipulation of data to satisfy some queries take time.
Assistant Vice President Branch Administration	The information required is there in the data warehouse, but I can't always get it in the way how I need it. It takes longer to manipulate the data. Sometimes I need a report in 2 hrs, but I won't be able to do it till next day on the data warehouse.

Analysis

In response to whether the users were satisfied with the *accuracy* of the data warehouse information, two users were satisfied (ratings of 4), three users were moderately satisfied (ratings of 3) and one user was dissatisfied (rating of 2) as shown in Table 6.17 above. These ratings do not seem to be consistent with their interview responses. In response to the question if the user was satisfied with the *consistency and reliability* of the data warehouse information, one user replied that he was satisfied (rating of 4), four users replied that they were moderately satisfied (ratings of 3) and one user was dissatisfied (rating of 2) as also shown in Table 6.17. In response to the question if the users were satisfied with the timeliness of data warehouse information, two users replied that they were satisfied (rating of 4), three users were dissatisfied (rating of 2) and one user was moderately satisfied (rating of 3).

Overall the responses to the interview questions and the questionnaire suggest there is room for significant improvement in areas concerning accuracy, reliability and timeliness of the data in the data warehouse. The introduction of meta data into the data warehouse could address the data integrity issue to some extent. Previous research (Rahm and Do, 2000; Inmon, 1996; Schubart and Einbinder, 2000; Chaudhuri and Dayal, 1997; Moody and Kortink, 2000) suggests that a basic requirement for a successful data warehouse is its ability to provide business users with accurate, consolidated and timely information. Failure to gain credibility with the business users may lead to failure in aligning the data warehouse to business strategies. The above findings reveal the dissatisfaction of the business users with the accuracy, reliability and timeliness of the data in the data warehouse. This provides evidence to support that data quality is essential for user satisfaction and for the successful adoption and alignment of the data warehouse to business.

Assessment of business user participation and satisfaction

Previous research suggests that the degree of business user participation and satisfaction is critical to strategic alignment and successful adoption of the data warehouse. Interview responses showed that difficulties encountered in using the data warehouse had created dissatisfaction among the business users. The users were dissatisfied with the ease of use and the data quality of the data warehouse. Dissatisfaction also existed among the business users with their low level of participation in the development of the data warehouse. Previous research suggests that all these factors - user participation, perceived usefulness, ease of use and data quality are important to achieve user satisfaction. User satisfaction is important to achieve successful adoption of the data warehouse and its alignment to business strategies. Therefore the dissatisfaction of the users with the above factors stresses their importance in the strategic alignment and successful adoption of data warehouses and lends support to proposition 3.

Interview results at Raymond James Financial show that the data warehouse managers are aware of the dissatisfaction among the users and the importance of user satisfaction for the successful adoption of the data warehouse. Efforts are underway to address the current needs of the users

6.5.4 Assessing the degree of technical integration

A number of factors contribute to and facilitate technical integration of the data warehouse. Hence to gain a comprehensive understanding of the degree of technical integration, the alignment mechanisms of (a) value management, (b) technological capacity and (c) organizational capability were used to study the means of achieving technical integration in data warehouse projects.

To identify the level of technical integration of the data warehouse, questions were asked of data warehouse managers, business users and senior managers in the company. The following questions were asked of the data warehouse managers:

- How is the data integrated from different systems across the organization?
- How is the data warehouse architecture integrated into existing IT systems' architecture?
- How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

To understand the impact of degree of technical integration of the data warehouse on its success, from the users' standpoint, the following questions were asked of them:

- Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

To gain a comprehensive understanding of the impact of degree of the technical integration of the data warehouse on its success, the senior managers were asked the following question:

- Given a choice, what expertise would you like to add to the data warehouse team?

Value management

Value management is the organizational mechanism for ensuring that data warehouse resources invested throughout the organization deliver anticipated or greater returns (Henderson et al., 1996). The research model suggests that in a data warehouse, technology should be selected based on its ability to address business and user requirement. In response to questions to the users on ease of use of the data warehouse, it was found (as discussed above under sections on ease of use and perceived usefulness) that new technology at the user interface had low acceptance due to low perceived ease of use and low perceived usefulness. It seems that despite potential benefits of data warehousing the tools provided to the users cannot be used easily, resulting in non utilization of the tools, and therefore reducing return on investment.

Table 6.18 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
11.	Adequacy of user training.	4	4	2	1	3	2	2.6

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

In response to the question if the users were satisfied with the training provided to them, it was found that not all users found the training given to be adequate (average rating of 2.6 in Table 6.18 above). The level of training in users was varied. One user received two days of

training for the desktop version and web browser of the data warehouse, another received only two hours of an overview of the data warehouse and canned reports. For example,

Database Administrator for RJFS Group	There was 2 days of training for the desktop version and the web browser, which was adequate. A book for reference on Proclarity was also given.
Assistant to Chairman of RJFS	Did not have very much user training.
Assistant Vice President Sales Management	The user training felt adequate. The training is very basic. A need is felt for more directed training to their own needs from the data warehouse.

The users found the training given to them on the data warehouse was basic. A need was felt for more directed training to meet their needs. *This data is a perception of the users interviewed and does not reflect the training modules offered or attended by the users. This data was unavailable.*

Table 6.19 Results from questionnaires completed by data warehouse managers

No	Question	DW	DW	DW	Average Rating
		Mangr1	Mangr2	Mangr3	
9.	The data warehouse technology was evaluated after the decision to build it.	3	5	5	4.3

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

In data warehouse projects, evaluating technology after the business problem that it can help solve has been identified, saves time and resources and allows organizations to focus on developing business solutions, and not just technology architectures. In response to the question if the data warehouse technology was evaluated after the decision to build the data warehouse, two data warehouse managers replied to the affirmative (ratings of 5) and one was

unsure (rating of 3) as shown in Table 6.19 above. In response to the question on how the data warehouse was evaluated, it was found that the data warehouse was evaluated both through user feedbacks and through monitoring by the data warehouse development team. For example,

Product Manager The data warehouse is evaluated both through user feedbacks and through monitoring by the development team.

Data warehouse Supervisor The performance of the data warehouse is evaluated by (a) how long it takes to load the system, (b) Its OLAP processing speed and (c) by the user's drill down analyzing capabilities.

The data warehouse development team monitored how long the system took to load, its OLAP processing speed and the user's drill down analyzing capabilities. The user feedback received by the data warehouse managers' reflected the slow speed of the data warehouse and the need for more user training. For instance,

Data warehouse Manager We get analysis from key users within the company and the key financial advisors. Speed is a problem right now. More user training is also required as the system is not user friendly

Technological Capacity

Technological capability was studied under two sub-sections: (a) integration of data from other systems and (b) integration of data warehouse architecture into existing IT architecture.

Integration of data from other systems

Table 6.20 Result from questionnaires completed by data warehouse managers

No	Question	DW Mangr1	DW Mangr2	DW Mangr3	Average Rating
7.	Data is integrated from different systems across the organization.	4	5	5	4.6

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

There was agreement amongst data warehouse managers that data was integrated from different systems across the organization into the data warehouse. Two data warehouse managers agreed strongly (ratings of 5) and one gave it a rating of 4 as seen in Table 6.20 above.

Findings from responses to the question on how data was integrated from different systems across the organization show that the data warehouse was fed from a core CSS system which is a source of records for accounts, customers, demographics and product type information. The data warehouse also integrated data from 20 different databases maintained in the company. At a staging database, the data was cleansed and transformed before loading into the data marts. The data was available till previous close of day in the data warehouse. For instance,

Data warehouse Manager

The data warehouse is fed from core CSS. It is a source of records for accounts, customers, demographic and product type information. The data warehouse is also sourced from data maintained in the company from 20 different databases.

It was also found that the integration of data from different systems in the organization into the data warehouse was not always smooth and issues were encountered in the process of keeping the data warehouse in sync with all the other systems. Changes in the data in other

systems have to be accommodated into the data warehouse. Team meetings are held to communicate and keep abreast of these changes. Changes in data are notified in such meetings and target dates are set to align the data warehouse with the implementation dates of these changes. For instance,

Data warehouse Supervisor	The integration of data from different systems across the organization is as always, an issue. As data changes in other systems, the data warehouse team tries to accommodate these changes. Team meetings are held to communicate and keep abreast of these changes. Changes are notified in such meetings and target dates are set to align with their implementation dates, to keep the systems in sync.
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Integration of data warehouse architecture into existing IT architecture

In response to the question on how the data warehouse architecture was integrated into existing IT systems architecture, all the data warehouse managers interviewed responded that it was well integrated as seen in the Table 6.21 below (average rating of 4.6).

Table 6.21 Result from questionnaires completed by data warehouse managers

No	Question	DW	DW	DW	Average Rating
		Mangr1	Mangr2	Mangr3	
8.	The data warehouse architecture is integrated into existing IT systems architecture.	4	5	5	4.6

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

It was found from the interview responses that the data warehouse architecture was closely tied into existing IT system architecture. The data warehouse was integrated into the mainframe system in the company and replicated the mainframe data into sequential environment. The data warehouse interfaced with other IT systems through portal

applications. A page in the regular application interface was linked to the data warehouse. For example,

Data warehouse Supervisor The data warehouse architecture is closely tied into existing IT systems architecture. Raymond James is a Microsoft shop and the data warehouse's sequel server is a Microsoft solution. The data warehouse has been designed as an enterprise wide warehouse, so that any it is available to all. It is also integrated into the mainframe system by replicating the mainframe data into sequential environment. It keeps up with changes in the mainframe.

Product Manager The data warehouse is interfaces to other IT systems through portal applications. A page in the regular application interface is linked to the data warehouse.

Organizational capability

In response to the question if the data warehouse project team was highly skilled to manage and solve technical problems and how good the response of the data warehouse team was to user needs, it was found that the users were only moderately satisfied.

Table 6.22 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
12.	The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	3	3	3	3	3	3.3

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

Most users answered with a rating of 3, which is moderately satisfied, and only one user was highly satisfied with the response of the data warehouse team (rating of 5) as shown in Table 6.22 above. The users' interview responses suggest that while the data warehouse team members were very skilled, they were short staffed. For instance,

Assistant Vice President, Sales Management	The response from the current team is good. But there are too few members on the data warehouse team, to meet all user needs effectively. User wants to see more people added to the data warehouse team to support the data warehouse in the company, as the users (financial advisors in the field) find the data warehouse too technical to use on their own.
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While, they made a very good effort at solving technical problems, occasionally the responses took longer because there were fewer members on the data warehouse team to meet all user needs effectively. The data warehouse supervisor was perceived as being very competent and helpful in resolving user problems (In his absence, the users had to wait for days for the problem to be handled). The learning specialist provided support. But a lack of resources coupled with lack of sufficient members on the team led to a generally slow response to its users. For example,

Regional Administrative Manager	The data warehouse team is skilled to solve the user problems, but their response could be faster.
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Assistant Vice President , Branch Administration	The data warehouse team is skilled but not well staffed. Probably there are only 4 people on it now. They do not have enough resources. Their response is not quick because there are not enough people on the team.
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Findings from responses to the question to senior managers on what expertise they would like to see added to the data warehouse team, show that the senior managers are aware of the need

of more members on the data warehouse team. The product manager would like to add more human resources to the data warehouse.

Assessment of degree of technical integration

Previous research (Pollalis, 2003) suggests that strategic alignment between business and the data warehouse can have a positive impact if the data warehouse is a part of a well integrated organizational IT system. The above findings from the case study show that the data from other systems have been well integrated into the data warehouse and also the data warehouse architecture is well integrated into existing IT architecture. These findings from the case study therefore support a view that the degree of technical integration is critical to strategic alignment and successful adoption of the data warehouse.

Previous research (Hwang et al., 2004) also suggests that the skills of the data warehousing development team have a major influence on the outcome of the project and affect the adoption of data warehouse technology. A highly skilled team is better equipped to manage and solve technical problems. Findings from the interviews reveal that the business users, data warehouse managers and senior managers are aware of the need for and recognize the importance of a highly skilled and well equipped development team.

6.5.5 Assessment of flexibility in data warehouse planning

To study the impact of flexibility in the data warehouse framework and in data warehouse planning on its success, questions were asked of the senior business managers, data warehouse managers and the users of the data warehouse to get a complete perspective. The senior managers were asked the following questions:

- Over the last 5 years what are the major changes that have taken place in your business plans?
- How has the data warehouse responded to your changing needs?

The data warehouse managers were asked the following questions to study the degree of flexibility in the data warehouse architecture and planning:

- Over the last 5 years has the data warehouse architecture changed and how?
- In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?
- Do the database, application middleware and front-end tools have high scalability?

To understand the business users' perception on the flexibility of the data warehouse, they were asked to answer the following question:

- How does the data warehouse respond to a change in business need?

In response to the question on what major changes have taken place in the last 5 years in their business plans, it was found that a lot of changes had taken place. The business plans changed to respond to changes in the regulatory industry, to margin compression, to industry downturn after the 9/11 incident and to corporate scandals. Over the past five years these changes have led to increase in the trade volume of the company. The current management focus is on building systems that would provide information on unsuitable trade and on compliance within the company. The data warehouse was being used to address this focus. For example,

Vice President	Lots of changes have taken place. Response to changes in the regulatory
Software Development	industry, margin compression, industry downturn after the 9/11 incident and corporate scandals had sent our company into a tailspin. Since then,

trade volume has increased, but residual law suits remain. We have now gotten focused to building systems that provide information on unsuitable trade and general compliance. The data warehouse is being used to write reports against data in it, and sitting with the compliance team and querying against the compliance data. We have a lot of MDX skills in our marketing division and they are using the data warehouse for data mining.

Yet another major change has been in the way financial advisors affiliate with a firm or do business, in the brokerage industry. Over the past two years, there had been changes in the business plans and Raymond James Financial had introduced a new and unique recruitment model to the industry, becoming the leader in its segment. For instance,

Regional Administrative Manager, RJA Private Client Group	Over the past 2 years there has been a major change in the brokerage industry in the way Financial Advisors affiliate with a firm to do business. Raymond James has come up with a new model unique to the industry. Raymond James is the leader in its segment and sees this new model generate an excitement and demand in the industry.
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Table 6.23 Results from questionnaire completed by senior managers

No	Question	Busn Mangr1	Busn Mangr2	Busn Mangr3	Average Rating
11.	The data warehouse is responsive to a change in business needs.	3	5	4	4

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

In response to the question on how the data warehouse responded to his changing needs, the business managers felt that the response of the data warehouse team has been good to the end users, but their response to back office accounting and administration has not been good. For example,

Regional Administrative Manager, RJA Private Client Group The data warehouse team response to the end users has been good. But their response to back office type accounting and administration has not been good.

Business plans in some segments of the company had not changed in the past five years, e.g. focus on maintaining the growth and integrity of advisor relationships. The business plans require provision of best tools to the financial advisors to service their clients. The data warehouse was being used to implement this business plan, by supporting the financial advisors. For instance,

Senior Product Manager Over the last 5 years, no major changes have taken place in business plans. The business plans at Raymond James focus on growth and integrity of the advisor relationship. They want to affiliate with the best financial advisors. The business plans involves providing the financial advisors with the best tools to service the clients. RJ wants to establish the gold standard in FA relationships.

The managers confirmed that the data warehouse architecture had not changed in the past years as the architecture being used was scalable and could accommodate changing needs. For example,

Product Manager The data warehouse has remained the same over the last 5 years. The data warehouse data base, application middleware and front-end tools have high scalability.

Data warehouse Supervisor The data warehouse architecture has not changed over the past years. Yes, as the data warehouse has a Web front end and a large 64 bit server, it has high scalability.

Data warehouse Manager

The data warehouse architecture has not changed over the past years. Yes, it has high scalability. The data warehouse is built on HP Superdome with 12 processors, 48 GB memory and 64 bit server.

Table 6.24 Result from questionnaires completed by data warehouse managers

No	Question	DW	DW	DW	Average Rating
		Mangr1	Mangr2	Mangr3	
10.	The data warehouse is highly responsive to a change in business needs.	3	4	4	3.6
11.	The database, application middleware and front-end tools have scalability.	4	5	5	4.6

(The rating are: 5-Strongly Agree, 4-Agree, 3-Neither agree nor disagree, 2-Disagree, 1-Strongly Disagree).

From data warehouse managers' responses to the question on how flexible the data warehouse is to accommodate new business needs and changes, it was found that the existing architecture of the data warehouse was quite flexible and new dimensions could be added to it fairly easily. This is also supported by questionnaire results shown in Table 5.24 above. Recently, changes had been made to the data warehouses' existing dimensions and new levels of hierarchy were added. An example of the data warehouse' flexibility, it was observed that 95% of the requests from project management group to add more fields and data to the warehouse were accommodated and the rest were in the process of being incorporated. For example,

Data warehouse Manager

There have been requests from project management to add more data and more fields. 95% of the requests have been accommodated in the data warehouse. The rest will be taken care of in the next release. The data warehouse is flexible to add new dimensions. We added changes to structure recently, changes to dimension and added new levels of hierarchy.

Data warehouse Supervisor The data warehouse is currently not flexible to accommodate new business needs and changes due resource constraints. But the existing data warehouse architecture can be added on fairly uneventfully

All the data warehouse managers agreed that the database, application middleware and front end-tools had high scalability (also shown by questionnaire results shown in Table 5.24 above) as the data warehouse is built on HP superdome with 12 processors, 48 gigabytes of memory and a 64 bit server along with a Web front-end.

Table 6.25 Results from questionnaire completed by business users

No.	Question	User1	User2	User3	User4	User5	User6	Average Rating
4.	Data warehouse response to change in business needs.	4	2	2	4	3	1	2.6

(The rating are: 5-Highly Satisfied, 4-Satisfied, 3-Moderately Satisfied, 2-Disatisfied, 1-Strongly Dissatisfied).

In response to the question to the users, on how the data warehouse responds to a change in business need, it was found that certain areas of the data warehouse responded well to changes and other areas did not. This is also evident from their responses in Table 6.25 above. A few users felt that the data warehouse responded fairly quickly to a change in business need. Once the need was communicated to the data warehouse team, the development team made the changes relatively fast. When there was a change in a business event, the data warehouse team made the event data available to the data warehouse and accessible to the users. For instance,

Assistant Vice President, The data warehouse responds fairly quickly to a change in business need.
Sales Management Once the need is communicated to the data warehouse team, the development team makes the changes relatively fast.

On the other hand majority of the users viewed the data warehouse as being unresponsive to accommodate their changing business needs. They felt that the response of the data warehouse was slow. For instance,

Assistant Vice President, Branch Administration	The response could take anywhere from a day to 2 weeks, depending on where you are on the queue and what requests are on the line.
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Learning Specialist	The data warehouse hasn't yet responded to any changes in business need. If it had to, the data warehouse would be unresponsive. It would take up to 7-8 months, based on other priorities. The data integrity needs to be addressed first.
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Database Administrator for RJFS Group	Not well. Data warehouse and senior IT managers consider the data warehouse to be a simple and great product, but that is not the case when you use it. It's not as easy. The management has spent a lot of time and money and do not want to agree to this view.
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Analysis

From the above responses (to the interview questions and questionnaire) it appears that not everyone interviewed in this study at Raymond James Financial views the flexibility of the data warehouse to changing business needs, in the same way. There seems to be a disparity between the perception of senior management and data warehouse managers with the users perspective.

The senior management views the data warehouse as being responsive to changing business needs (average rating of 4 in Table 6.23). The data warehouse managers also view the data warehouse as being responsive to changes in business needs (average rating of 3.6 in Table 6.24). They agreed that the database, application middleware and front-end tools have

scalability. But the users showed dissatisfaction (average rating of 2.6 in Table 6.25) with the data warehouse's responsiveness to changing business needs and viewed the data warehouse as being generally unresponsive.

It appears that though the existing architecture of the data warehouse is flexible to changes, and the database, application middleware and front end-tools have high scalability, the gap between emerging business needs and the data warehouse's ability to support them, is debilitating and of concern for its users. The infrastructure lags are not purely technical in nature. Organizational issues like resource constraints in financial investments and human resources for the data warehouse project, is preventing the changes in business needs from being accommodated in the data warehouse in a quick and satisfactory manner.

Assessment of degree of flexibility in data warehouse planning

The dissatisfaction of the users with the response of the data warehouse to changes in their business need corroborates with the research model and proposition 5. In the research model, the issue of flexibility in planning is pertinent to the data warehouse environment. Previous research (Armstrong, 1997; Moody and Kortink, 2000) suggests that as business needs change over time, a successful data warehouse needs to be flexible enough to be responsive to it. While the data warehouse at Raymond James Financial is flexible in architecture, it is not perceived as flexible by the users, based on the response time to their request. The resulting rigidity, due to resource constraints could frustrate the strategic initiative of the data warehouse.

6.6 Conclusion

This chapter presented the findings of the case study conducted at Raymond James Financial. It also presents an analysis of the case study to determine whether an alignment of the data

warehouse to business strategy and plans, has an impact on its successful adoption. The research findings indicate that the factors that facilitate strategic alignment of the data warehouse also influence the successful adoption of the data warehouse. It was found that joint responsibility between business and data warehouse managers, alignment between business plan and data warehouse plan, flexibility in the data warehouse framework, business user satisfaction and technical integration of the data warehouse, have a positive influence on the successful adoption of the data warehouse.

7 SUMMARY AND CONCLUSION

This chapter summarizes the issues and presents the main findings of this research based on the two case studies. It also comments on the contributions and limitations of this research and suggests recommendations for future research.

7.1 Introduction

This study sought to understand the impact of strategic alignment on the successful adoption of data warehouses. This study also addressed Wixom and Watson's (2001) concern that few academic empirical studies had been conducted on data warehousing. Data warehouse technology is inherently complex, requires significant capital investment and development time. Many organizations fail to realize the full benefits from it.

The literature review revealed that the data warehouses have unique features that make them different from other decision support applications. The data warehouse implementation process studied in this thesis showed that the data warehouse had an enterprise wide impact on the infrastructure of the organization. The literature review revealed that researchers have investigated factors that affect data warehouse implementation, applying IT implementation knowledge. Researchers have identified various success factors for data warehouse implementation. These include organization factors (project sponsorship, champions, management commitment, team skills, organizational culture) user factors (user acceptance, user participation, perceived benefits) technology factors (availability of resources, complexity, architecture selection, standardization, consolidation, warehouse population, flexibility) and data factors (data quality, evaluation, data integrity). However, data warehouse implementations have still been known to fail (Hwang et al., 2004; Wen et al., 1997).

This study, through the two case studies, has revealed that each data warehouse system has organization-specific sets of requirements, constraints, issues and implications that need to be addressed. The study shows that each data warehouse needs to be linked to the organizations objectives for it to succeed. This research explored the complexities and processes of a data warehouse and its alignment to business strategies. The research identified ways in which better alignment between the data warehouse plans and business strategies can be achieved, leading to a successful data warehouse adoption. This research also addressed the managerial and strategic aspects of data warehouses.

The importance of alignment is well known and documented in the literature (McLean and Soden, 1977; Chan et al, 1996; Henderson and Venkatraman, 1990; Lee and Bai, 2003), but it is not clear in that literature how to achieve and sustain alignment while building and implementing data warehouses. As long term success of the data warehouse is dependent upon the organization's ability to use the data warehouse to fulfill its strategic milestones, this study showed that aligning the data warehouse to business objectives and strategies became essential. Success involved overcoming difficulties in coordination, communication, priorities and vision on the part of the business and IS managers.

Based on the review of the literature, five factors had been identified as contributing to successful alignment of the data warehouse to business plan and strategy. These factors, were: joint responsibility between data warehouse and business managers, alignment between data warehouse plan and business plan, flexibility in data warehouse planning, technical integration of the data warehouse, and business user satisfaction.

This thesis investigated those factors then that facilitate the alignment between business strategy and data warehouse projects by adopting a two case study approach. The case studies

provided the organizational context for the study of the relationship between data warehouse technology and business strategy and allowed for valuable insights, assessing the data warehouses in its natural, unaltered setting (Yin, 2003).

A two-case case study was conducted rather than a single case study to strengthen the robustness, reliability and external validity of the findings (Eisenhardt, 1991; Tellis, 1997). The two case studies were carried out at Nielsen Media Research and Raymond James Financial. Both of the cases selected cases served as examples for a wide range of organizations, and were where the data warehouse seemed likely to grow in its impact on the participating organizations' business. The case studies described and helped understand strategic alignment from the participants' points of view. Evidence for the case studies was collected from documents, interviews, questionnaires and observations. The case studies undertaken assessed the cluster of factors leading to strategic alignment of the data warehouse to business plans. The findings from the interviews and questionnaires were discussed and analyzed in depth. A summary of the findings are presented below.

7.2 Case Study Analysis and Summary of Findings

Joint responsibility between business and data warehouse managers

This research sought to understand the impact of joint responsibility between business and data warehouse managers on the strategic alignment of the data warehouse. The association of senior management and its involvement with successful implementation of IS has been pointed out by researchers in Information Systems (Smaczy, 2001; Hwang et al. 2004). The research literature suggested that commitment by senior management and the involvement of IT in corporate strategy formulation is integral to better alignment (Tallon et al., 2000). IT managers and business managers need to be jointly responsible for defining alignment and collaborate continuously through strong partnerships and appropriate allocation of resources

(Tallon, Kraemer and Gurbaxani, 2000). IT managers need to be knowledgeable about how new technologies could be integrated into business and understand the strengths and weaknesses of the technology.

The two case studies conducted in this research study supported the findings in literature. The case study at Nielsen Media Research showed that the CIO initiated the project and the project was headed by a Senior Vice President during its development. Findings from the case study showed that the understanding, commitment and involvement of the CIO in the data warehousing process greatly improved the prospects for strategic alignment of the data warehouse to business strategy. Senior managers were found to be key decision makers in the planning as well as in the approval of budgets for the data warehouse. Senior management ensured that the data warehouse project had financial support, the inclusion of the best personnel and resources in business and technical knowledge, into the data warehouse development process. The support and commitment by senior management resulted in active promotion of the project. Their support and commitment ensured availability of capital, human support and internal resources during the development and implementation process of the data warehouse.

Likewise, the case study at Raymond James Financial showed the need for commitment and involvement of senior management through the life of the data warehouse project. Findings from the case study showed that the CIO was the champion of the data warehouse project and the CEO participated in investment decisions over 1 (one) million dollars. The CIO was instrumental in selling the data warehouse project to upper management, making it visible among senior management and finding support for it. The senior managers were involved in the data warehouse investment decisions and were responsible for funding the data warehouse. Senior managers were involved in getting resources for the data warehouse, from

the operating committee of the company and business units that had ownership of the data warehouse.

However, in recent times, the focus of the upper management at Raymond James Financial had shifted from the data warehouse to other priorities. This shift in focus was shown in the case study to be one of the causes that led to a misalignment of the data warehouse to business strategies.

The research literature also suggested that communication of the strategic direction within the organization was necessary for better alignment (Burn and Szeto, 2000; Beeson and Mahamid; 2003). Process integration, through the integration of business and information systems' planning processes, helped reduce the adverse effects of split responsibility.

The findings from the case studies corroborate the findings from the research literature. At Nielsen Media Research, good communication between the business and data warehouse managers enhanced alignment of the data warehouse to business strategies. Involvement of cross functional teams enhanced joint responsibility and integration in the data warehouse design and data decisions. The involvement of business managers and product manager in the data warehouse was especially pertinent at Nielsen Media Research where, unlike traditional data warehouses which have a support function, the data warehouse was the revenue earning arm of the business. Joint meetings between data warehouse managers and product manager at Nielsen Media Research led to better communication and understanding of the business plans and opportunities. Effective communication facilitated the identification of areas for development in the data warehouse with the best return on investments.

At Raymond James Financial, good communication between business and data warehouse managers was shown to be necessary for better alignment of the data warehouse. At Raymond James Financial the level of communication between business and data warehouse managers was found to be less than optimal. The data warehouse managers were not perceived as being highly involved in corporate strategy decisions by senior managers, though data warehouse managers considered their level of awareness of corporate strategies as high. This difference in perception affected the alignment of the data warehouse to business plans and the situation was being addressed at Raymond James Financial. A new layer in the form of product manager had been added to the data warehouse management who is now responsible for building a long term roadmap for the data warehouse. The product manager works with the business managers on all data warehouse issues and involves the CIO at higher level decisions on the data warehouse. This recent organizational change in the management structure of the company underlines the importance of the understanding and joint responsibility between data warehouse managers and business managers for a successful alignment and adoption of the data warehouse.

At both Nielsen Media Research and Raymond James Financial, it was shown that senior management commitment and involvement was necessary for the initiation of the data warehouse project. At Raymond James Financial, the CIO was the champion of the data warehouse project and at Nielsen Media Research, the CIO initiated the project and the project was headed by a Senior Vice President during its development. At Nielsen Media Research the awareness and involvement of data warehouse managers in corporate strategies was greater than their counterparts at Raymond James Financial. This awareness and involvement of data warehouse managers resulted in better mutual understanding and cooperation between business and data warehouse managers at Nielsen Media Research. This had a direct impact on the success of the data warehouse.

At Raymond James Financial the issue of better and effective communication is being addressed through organizational change in the management structure and inclusion of the product manager. The product manager, data warehouse managers and business managers are jointly trying to align the data warehouse, addressing deficiencies that have been observed. This case study provided a conclusive evaluation of level of joint responsibility between business and data warehouse managers in both organizations. These findings from the case studies confirms that the level of joint responsibility between business and data warehouse managers is critical to strategic alignment and successful adoption of the data warehouse.

Thus, through a combination of findings from the case studies and research literature, support is found for the research model (Figure 3.2, Chapter 3, page 82), showing that the level of joint responsibility between business and data warehouse managers had an affect on the strategic alignment and successful adoption of the data warehouse. Existing business and data warehouse managers can apply these findings to their own situation. In so doing, they can develop an awareness of possible alignment and communication issues and their implications. This awareness will help them to actively manage alignment challenges in the data warehouse and implement corrective steps that enable the strategic alignment of the data warehouse.

Alignment between business and data warehouse plans

This research study sought to understand the impact of alignment between business and data warehouse plans, on successful adoption of a data warehouse. The classic hierarchical view of strategic management suggests that business strategy is the driver for both organizational design and IT infrastructure choices (Henderson and Venkatraman, 1990). Research suggests that developing a data warehouse strategy, in response to a business strategy, and using the corresponding choices to define the required data warehouse infrastructure and processes, should bring about closer alignment (Murtaza, 1998).

It was shown in the case study at Nielsen Media Research that alignment of the data warehouse strategy and architecture to business strategy and architecture, helped ensure its successful adoption. At Nielsen Media Research, the decision to build a data warehouse and the selection of its subject areas were closely coupled with business needs and business strategies. The organizational strategic plans and objectives provided a roadmap for the data warehousing effort. The data warehouse was built in response to business plans and strategies, to service their needs for greater flexible and timely reporting, as well as for providing a wider breadth of data. The data warehouse architecture was selected after considering high level strategies and detailed level sources of data. The changes in the data warehouse plans over the past five years have also been driven by changes in business needs.

Similarly, at Raymond James Financial, it was shown that alignment of data warehouse strategy and architecture to business strategy is necessary and important, for a successful adoption of the data warehouse. This case study showed that initially the scope of the business vision dictated the architectural approach of the data warehouse. The data warehouse was developed in response to requests by business divisions and financial advisors, for better access to integrated data and information. However, over the past year, in spite of several user requests to analyze institutional data through the data warehouse and requests from business users to expand the data warehouse beyond the three core subject areas to areas such as expenses and bank data, the data warehouse plans have been scaled back due to resource constraints and institutional priorities. Though initially the scope of the business vision dictated the architectural approach of the data warehouse at Raymond James Financial, currently, the organizational vision and strategic plans do not provide a roadmap for the data warehousing effort. This has caused misalignment between business and data warehouse plans and dissatisfaction among business users. The research model suggests that there should be an alignment between data warehouse and business plans for a successful adoption of the

data warehouse. Awareness of this misalignment by data warehouse managers and senior management at Raymond James financial and remedial steps taken to address this disconnect between strategic vision and data warehouse plans, supports the research model.

Research literature also suggests that shared knowledge between business and data warehouse managers help in avoiding paradoxical decisions caused by business executives' lack of IT knowledge and data warehouse managers' inadequate business knowledge (Hirschheim and Sabherwal, 2001). Knowledge sharing avoids making decisions that take them out of alignment and helps in integrating the business and data warehouse planning process (Kearns and Lederer, 2003; Brazelton and Gorry, 2003).

Additionally, communication between all stakeholders of the data warehouse is essential for its alignment to business strategy and adoption by the business users (Pollalis, 2003; Hwang et al., 2004). Along with knowledge sharing and communication of the strategic direction to the data warehouse managers by the senior management, creating frequent communication channels between data warehouse managers and users is necessary to facilitate better understanding of the data warehouse and its ultimate successful adoption (Beeson and Mahamid, 2003).

The case studies support the above findings in the research literature. At Nielsen Media Research, shared knowledge and good dialogues between the data warehouse managers and business managers helped avoid paradoxical decisions. The data warehouse managers along with the product manager helped the business managers understand the advantages and limitations of the data warehouse technology and were in turn aware of the business plans and strategies. Further, through knowledge sharing and communication, the product management group was effective in integrating business needs and strategy with the data warehouse plans

at Nielsen Media Research. The integration of business and data warehouse planning process was further facilitated through portfolio reviews with senior management, and through a process of completing “contract books”.

Cross functional teams were also highly active in the data warehousing project at Nielsen Media Research, facilitating better understanding of the data warehouse. The data warehouse managers were well informed of business plans and strategies and the data warehouse plans sought to exploit data warehouse capabilities to meet business needs and strategies. Knowledge sharing and the strong and effective communication between the business managers and user on one hand, and the data warehouse manager on the other, brought about closer alignment between the business and data warehouse plans at Nielsen Media Research. These findings support the research model which suggests that knowledge sharing and communication between the data warehouse and business managers brings about better alignment between business and data warehouse plans.

Similarly, at Raymond James Financial, through knowledge sharing and communication, the data warehouse managers helped the business managers understand the advantages and limitations of the data warehouse and were in turn aware of the business plans and strategies. The data warehouse managers made the senior managers aware of the need for more resources and funds required for the incremental releases of the data warehouse. Recently, to enhance the cooperation and coordination between the data warehouse and the business, the position of the product manager had been added to the management structure of the data warehouse. The integration of business and data warehouse planning process was facilitated through the involvement of the product manager. The product manager prioritized the user needs and determined costs and ways to drive future releases of the data warehouse.

It was shown in the case study at Raymond James Financial that though both formal and informal communication channels existed within the organization, recently, there was a lack in the alignment of the data warehouse plans to business strategy and adoption by the business users. To redress the situation, the product manager now served as a fundamental and open line between the business and data warehouse managers and allowed free and open communication. Change management process used within the IT division and weekly staff meetings served as additional communication channels. Informal communications was found to exist between the users and the data warehouse managers (through emails, phone calls, occasional ad hoc meetings or through the learning specialist). But, it was revealed from the case study that there was a lack of reciprocal communication from the product and data warehouse managers to the users. The decision of the product manager or data warehouse manager was not adequately communicated back to the users. This lack in communication led to a lack in alignment of the data warehouse plans to business strategy, resulting in inadequate use of the data warehouse by the business users. These findings support the research model which suggests that alignment between business and data warehouse plans results in a successful adoption of the data warehouse.

The findings from both the case studies and research literature, support the research model and provide evidence for the importance of integration of data warehouse plans with business plans for strategic alignment and successful adoption of the data warehouse. It was seen in the case studies that integration between business and data warehouse planning process, knowledge sharing, effective communication between the business managers and user on one hand, and the data warehouse manager on the other, brought about closer alignment between the business and data warehouse plans.

The data warehouses at both the organizations were built in response to business needs. The findings from the case study at Nielsen Media Research revealed that the data warehouse planning process was well aligned with the business visions and plans. The business visions were the drivers for the data warehouse architecture at Nielsen Media Research. Their business and data warehouse planning process were integrated. At Raymond James Financial, in the initial two years the data warehouse plans were aligned to business strategies. However at the time of the case study, it was established that the data warehouse did not support the business vision closely. The data warehouse planning process did not seem well aligned with the business plans. At Nielsen Media Research the data warehouse was found to support the business plans more strongly than at Raymond James Financial.

From the findings of the case studies, it is also evident that a climate of clear communication becomes a necessity for alignment to succeed. The communication of the strategic direction between business and data warehouse managers was found to be greater at Nielsen Media Research than at Raymond James Financial. There was significant knowledge sharing among the stakeholders and frequent communication between the data warehouse managers and users at Nielsen Media Research. This facilitated better understanding of the data warehouse and its subsequent successful adoption. At Raymond James Financial, good two way communication between the data warehouse managers and the users was found to be lacking. The users were not satisfied with the level of communication and knowledge sharing. The divergence between the data warehouse plans and business needs and lack of effective communication had led to sub-optimal outcomes at Raymond James Financial. That a change in management structure had been effected to address this divergence and to improve communication, shows that the degree of alignment between business and data warehouse plans is critical to strategic alignment and successful adoption of the data warehouse.

User participation and satisfaction and data warehouse success

Research literature suggests that a basic requirement for a successful data warehouse is its ability to provide business users with accurate, consolidated and timely information (Triantafillakis et al., 2004; Little and Gibson, 1999; Ballou and Tayi, 1999; Strong et al., 1997). The competitive advantage of a data warehouse lies in an organization's employees being able to quickly and easily access the data and interpret the information. End user participation has a direct impact on the adoption of data warehouse technology (Wixom and Watson, 2001; Hwang et al., 2004; Gorla, 2003;Guimaraes et al., 2003; Nah et al., 2004). The importance of user related factors such as user participation, user training and user acceptance in the success of an information system has been recognized in the research literature (Guimaraes, Staples and McKeen, 2003; Strong et al., 1997).

Findings from both the case studies were in agreement with the research literature. In the case study at Nielsen Media Research, high levels of user satisfaction was found with the development of the data warehouse. User participation resulted in better communication and coordination of user needs. User participation was helpful in managing user expectations and satisfying user requirements at Nielsen Media Research. Senior managers found the data warehouse useful in their ability to respond to changes in business direction.

The data warehouse was perceived as useful and supportive of user needs as well, at Nielsen Media Research. The data warehouse supported business users by integrating data from multiple, incompatible systems into a consolidated data base. Users found the data warehouse easy to use, and the data warehouse functions and features easy to understand. They were satisfied with the data warehouse team support and the training they had received on the data warehouse. Numerous checks and balances incorporated into the quality assurance process at Nielsen Media Research ensured the accuracy, reliability and consistency of the data. The

data warehouse provided information in a timely manner, meeting service level agreements. All these reasons led to a successful adoption and use of the data warehouse to further the strategic initiatives of Nielsen Media Research. These findings support the research model which suggests that business user participation and satisfaction is critical to strategic alignment and successful adoption of the data warehouse.

In the case study at Raymond James Financial, the users were moderately satisfied with their participation in the development of the data warehouse. The users revealed a desire for greater involvement and participation in defining user requirements, report specifications and design of queries. It was shown that although users perceived the data warehouse as useful to their needs (availability of integrated data and canned reports), they were unable to use it adequately because of difficulty encountered in finding the desired information in the data warehouse. The difficulty in using the data warehouse was because of non-intuitive design of the user interface, the data warehouse 'locking up' while running reports and drawbacks in preparing reports. The data warehouse lacked user manuals and the users found the data warehouse functions and technical features difficult to understand. The users at Raymond James Financial felt that the data warehouse could be better used and had greater potential. Inadequate user participation, user training and user acceptance affected the success of the data warehouse at Raymond James Financial. These findings support the research model which suggests that user participation and satisfaction is necessary for a successful adoption of the data warehouse. Senior managers' perception of the usefulness of the data warehouse varied from its business user's perception at Raymond James Financial. Senior management found the access to organized and centralized information in the data warehouse as useful.

The research model proposes that the degree of user participation and satisfaction depends on perceived usefulness, ease of use as well as data quality of the data warehouse. The level of

accuracy of data in the data warehouse at Raymond James Financial affected the acceptance of the data warehouse by its users. Not all users were completely satisfied with the accuracy of the data provided in the data warehouse. It was found that though the data warehouse contained mostly accurate data, complete accuracy was sometimes questionable as it had discrepancies with data from older systems. These discrepancies in data lead to reduced acceptance of the data warehouse. Inaccuracies found in one area of the data warehouse kept the users from using other areas of the data warehouse. Findings from the case study at Raymond James Financial showed that concerns with accuracy, reliability and timeliness of the data in the data warehouse affected the successful adoption of the data warehouse. These findings provide evidence in support of the research model.

The findings from both case studies showed that user participation in the data warehouse project, perceived usefulness of the data warehouse, ease of use and data quality (accuracy, consistency, reliability and timeliness) were significant factors in strategic alignment of the data warehouse. The relevance of the data warehouse information to day-to-day decisions, the users understanding of the data warehouse functions and features, the ease of use and adequacy of user training were higher at Nielsen Media Research than at Raymond James Financial. At Nielsen Media Research, user participation, perceived usefulness of the data warehouse, ease of use and high data quality, led to greater user satisfaction and user acceptance of the data warehouse. The accuracy, consistency, reliability and timeliness of the data warehouse information were also significantly higher at Nielsen Media Research when compared to Raymond James Financial. There was significant room for improvement at Raymond James Financial in these areas. The dissatisfaction of the users and the efforts underway to address these needs at Raymond James Financial reinforces that business user participation and satisfaction is critical to strategic alignment and successful adoption of the data warehouse. These findings lend support to the findings in research literature and to the

research model which suggests that user participation and satisfaction is important for successful adoption of data warehouses.

Technical integration and data warehouse alignment and success

The research literature suggests value management, technological capacity and organizational capability mechanisms as ways of achieving technical integration in data warehouse projects (Henderson et al., 1996). Value management is the organizational mechanism for ensuring that IT resources invested throughout the organization deliver anticipated or greater returns. IT evaluation techniques help firms to improve strategic alignment, which in turn contribute to higher IT payoffs. Technological capability deals with the administrative process for creating the required IT capability for supporting and shaping the business strategy (Henderson et al., 1996; Pollalis, 2003). In the data warehouse environment, technological capability involves integration of data from other systems and integration of data warehouse architecture into existing IT architecture. Organizational capability deals with the administrative processes for creating the required human skills and the capability for supporting and shaping the business strategy (Hwang et al., 2004).

Findings from the case study at Nielsen Media Research lent support to the research model. The findings from the case study showed that a high degree of technical integration of the data warehouse led to better strategic alignment of the data warehouse and a successful adoption of the data warehouse. At Nielsen Media Research, the technology for the data warehouse was selected after comprehensive appreciation of business needs. The data warehouse was built after careful technical evaluation consisting of both technical criteria and business metrics. The technology selected was appropriate to address business and user requirements and had acceptance at the user interface due to ease of use and perceived

usefulness. According to the CIO, the technology invested had delivered more than anticipated returns, as the data warehouse had exceeded its expectation with respect to return on revenue.

Additionally, at Nielsen Media Research, the data in the data warehouse was well integrated from different systems across the organization into the data warehouse. The data warehouse architecture was closely tied into existing IT infrastructure and was fairly transparent to source systems. Data was received into the data warehouse from existing IT systems and data was passed from the data warehouse to these IT systems easily.

As suggested by findings in research literature, administrative processes for creating the required human skills for supporting and shaping business strategy was found to be satisfactory at Nielsen Media Research with regards to the data warehouse. Findings from the case study revealed that the business users, data warehouse managers and senior managers recognized the importance of a highly skilled and well equipped data warehouse development team and were satisfied with them.

At Raymond James Financial, the degree of technical integration of the data warehouse was found to affect the strategic alignment and successful adoption of the data warehouse, lending support to the findings in research literature and the research model. The case study at Raymond James Financial showed that even though the data warehouse was built in response to business needs, and though the data warehouse was evaluated through user feedbacks and through monitoring by the data warehouse development team, the resources invested in the data warehouse had not delivered anticipated returns.

At Raymond James Financial, the data warehouse architecture was shown to be closely tied into existing IT system architecture and data was integrated from different systems across the organization into the data warehouse. But the integration of data from different systems in the organization into the data warehouse was not always smooth and issues were encountered in the process of keeping the data warehouse in sync with all the other systems. Also, the data warehouse technology did not contribute adequately to business initiatives because new technology selected at the user interface had low acceptance among users due to low perceived ease of use and low perceived usefulness. It was shown that despite potential benefits of data warehousing, the tools provided to the users could not be used easily, resulting in non utilization of the tools, and reduced return on investment. The training given to the users on the data warehouse was also shown to be inadequate and a need was felt for more directed training to meet user needs. These findings from the case study at Raymond Jame Financial, support the research model which suggested that alignment mechanisms of value management and technological capacity were necessary for a successful adoption of the data warehouse.

The data warehouse capability to support and shape the business strategy at Raymond James Financial was further affected due to a lack of a sufficiently staffed data warehouse team. Findings from the case study at Raymond James Financial revealed that the data warehouse managers and senior managers were aware of the need for and importance of a highly skilled and well equipped development team. The users of the data warehouse were shown to be moderately satisfied with the response of the present data warehouse team. It was shown that even though the data warehouse team made a good effort at solving technical problems, the responses took long because of fewer members on the data warehouse team to meet all user needs effectively. These finding support the research model which suggests that alignment

mechanisms of organizational capacity was necessary for a successful adoption of the data warehouse.

Thus, the findings from both the case studies reveal that technology selection based on its ability to address business and user requirements led to better alignment of the data warehouse to business plans and strategies. In both organizations, the data from other systems had been integrated into the data warehouse and the data warehouse architecture was integrated into the existing IT architecture. At Nielsen Media Research, the selection of technology based on business requirements and plans, and evaluation of the data warehouse technology investment, had contributed to higher than anticipated returns and business value. Unlike the data warehouse at Nielsen Media Research which delivered greater than anticipated returns, the data warehouse resources invested at Raymond James Financial seemed to deliver less than anticipated returns. The low acceptance among the users of the technology selected at the user interface, difficulty in its use and inadequacy in the training received by the users to meet their needs led to reduced returns from the data warehouse.

It was also found that the skills and response of the data warehousing team had a major influence on the outcome of the project and affected the adoption of the data warehouse. The data warehouse team members were highly skilled and competent at both organizations to manage and solve technical problems. But the users of the data warehouse at Raymond James Financial were not as satisfied as the users of the data warehouse at Nielsen Media Research, because of the slow response of the data warehouse team to their requests. This was due to lack of resources and insufficient team members. These findings support the research model and present evidence that the degree of technical integration is critical to strategic alignment and successful adoption of the data warehouse.

Flexibility and data warehouse planning success

This research study sought to understand the impact of flexibility on the strategic alignment of the data warehouse and its successful adoption. Research literature suggested that strategic alignment needed to embrace flexibility (Loebbecke and Wareham, 2003; Prahalad and Krishnan, 2002). Alignment was described as a process requiring continuous adaptation and coordination of plans and goals. A rigid information technology infrastructure could frustrate even the best strategic initiatives in a data warehouse, making it difficult to introduce change in cost and time efficient ways (Prahalad and Krishnan, 2002). The reasons for inflexibility could be purely technical reasons, infrastructural lags or organizational issues like IT governance and senior managers approach to IT investment (Armstrong, 1997; Sen, 2004).

Findings from the case study at Nielsen Media Research supported the above findings in research literature. In the case study at Nielsen Media Research it was shown that the data warehouse was responsive to frequent reprioritization of business needs, leading to a successful adoption of the data warehouse. Major changes had taken place in the last 5 years in the business plans, due to a dramatic increase in complexity in the media industry resulting from technological advances and introduction of new methodologies for measuring television audiences. The data warehouse at Nielsen Media Research was flexible enough to adapt to changes in the business needs and provide the information users needed to run the business, thereby maintaining the advantage that the information provided to the organization. The data warehouse could accommodate new business needs and changes because it had been built keeping flexibility in mind. The data warehouse at Nielsen Media Research allowed data structures to be extended efficiently to handle changes. The existing architecture of the data warehouse was extremely flexible and embraced re-factoring and continuous delivery. The database, application middleware and front end-tools had high scalability. Quick, iterative developments of the data warehouse at Nielsen Media Research addressed the shifting of

business requirements in a satisfactory manner. These findings provided evidence in support of the research literature and the research model which proposed that flexibility in data warehouse planning was critical to strategic alignment and successful adoption of the data warehouse.

It was shown in the case study at Raymond James Financial, that there was a disparity between the perception of senior management and data warehouse managers with the perception of data warehouse users, with regards to the flexibility of the data warehouse. In the past few years the business plans in some segments of the company had changed in response to changes in the regulatory industry, to margin compression, to industry downturn after the 9/11 incident and to corporate scandals. Business plans in other segments of the company had not changed in the past five years, focusing on maintaining the growth and integrity of financial advisor relationships. It was found in this case study that senior managers were satisfied by the response of the data warehouse to their changing needs. On the other hand, many users viewed the data warehouse as being unresponsive to accommodate their changing business needs. Though the existing architecture of the data warehouse was flexible to changes, and the database, application middleware and front end-tools had high scalability, the gap between emerging business needs and the data warehouse's ability to support them, was of concern for its users. Organizational issues like resource constraints in financial investments and human resources for the data warehouse project, was preventing the changes in business needs from being accommodated in the data warehouse in a quick and satisfactory manner.

The case studies showed that flexibility to respond to changes in business needs allowed for a more successful adoption of the data warehouse. The data warehouse at Nielsen Media Research was highly responsive to changes in business needs due to flexibility in its

architecture and planning, and its database, application middleware and front end tools were found to be scalable and highly available. At Raymond James Financial it was found that although the data warehouse was flexible in architecture, and the database, application middleware and front end tools had scalability, the data warehouse was not perceived as flexible to accommodate changing business needs of the users. The gap between emerging strategic direction and the data warehouse's ability to support it, had led to dissatisfaction of the users with the data warehouse at Raymond James Financial. The rigidity, resulting from resource constraints was seen as frustrating the strategic initiative of the data warehouse. These findings emphasize that the degree of flexibility in data warehouse planning is critical to strategic alignment and successful adoption of the data warehouse, and lend support to the research model and the findings in research literature.

7.3 Research Model

This research study had proposed a research model (Figure 3.2, page 82) based upon the research propositions, to address the problem of successful adoption of the data warehouse along strategic alignment principles in Chapter 3. The comprehensive model produced in this research identified the factors critical for strategic alignment of the data warehouse and showed the relationship of the factors and their affect on the strategic alignment of the data warehouse. Following Yin's (1994) suggestion, the evidence collected during the case studies was analyzed based on the research propositions. The research model was evaluated by two case studies in the industry. The findings from this study confirmed findings in existing research literature relating to strategic alignment. The factors identified in the research model as necessary for the strategic alignment of the data warehouse and its successful adoption, have been shown to be valid and critical in the two case studies.

The research model developed in this study provides a comprehensive illustration of the impact of strategic alignment on the successful adoption of data warehouse technology along five factors. The interpretive approach taken through the two case studies has led to a greater understanding of the way in which organizations can achieve strategic alignment while implementing data warehouses for a successful adoption. This thesis has supplemented the findings from literature with the experience of practitioners. The knowledge gained from the interviews with the business managers, data warehouse managers and the business users of the data warehouse in the two case studies, have provided insights to the research question and has yielded useful answers.

This research study found that the factors identified in the research model are critical to the alignment of data warehouses to business strategy and plans. These factors are (a) joint responsibility between data warehouse and business managers, (b) alignment between data warehouse plan and business plan, (c) business user satisfaction, (d) flexibility in data warehouse planning and (e) technical integration of the data warehouse. This study showed that positively addressing these factors will result in a successful implementation of a data warehouse.

The key findings from this study, are:

- a) Senior management commitment and involvement are necessary for the initiation of the data warehouse project. A strong mandate from senior management and promotion of the project by senior management leads to a successful implementation of the data warehouse. The awareness and involvement of data warehouse managers in corporate strategies and a high level of joint responsibility between business and data warehouse managers is critical to strategic alignment and the successful adoption of the data warehouse. Continuous collaboration through strong partnerships and appropriate

allocation of resources is necessary for a successful adoption of the data warehouse. Integration of business and data warehouse planning processes reduce the adverse effects of split responsibility and facilitates alignment.

- b) Communication of the strategic direction between the business and data warehouse managers is important for strategic alignment of the data warehouse. Significant knowledge sharing among the stakeholders of the data warehouse and frequent communication between data warehouse managers and users, facilitate better understanding of the data warehouse and its successful adoption. Organizational inertia and underestimation of problems lead to problems in aligning the data warehouse to business strategies. Knowledge sharing aids strategic realignment efforts.
- c) Alignment between data warehouse plans and business plans facilitate strategic alignment of the data warehouse and its successful adoption. Business strategy driving data warehouse design and infrastructure choices leads to better alignment. The scope of the business vision dictating the architecture approach of the data warehouse facilitates better alignment. A data warehouse that answers the needs of the business users, brings greater alignment of the data warehouse to the business needs and ensures its success by providing a high return on investment. Misalignment between data warehouse plans and business goals lead to higher costs and loss of opportunities.
- d) User participation in the data warehouse project, perceived usefulness of the data warehouse, ease of use and data quality (accuracy, consistency, reliability and timelines) are significant factors in strategic alignment of the data warehouse and its successful adoption. Data in the data warehouse that is easy to access, interpret and use lead to greater user satisfaction, user participation and successful adoption of the data warehouse. User training is a significant factor for user participation.

- e) Alignment mechanisms of value management, technological capacity and organizational capability lead to technical integration of the data warehouse. Technology selection based on its ability to address business and user requirements, along with a skilled and responsive data warehousing team lead to better alignment of the data warehouse to business plans and strategies. Addressing all aspects of the technological assimilation process in data warehouse projects, result in better value management. Evaluation of data warehouse technology after the business problem has been identified improves strategic alignment, saves time and resources, and contributes to higher return on investments. Perceived compatibility of the data warehouse technology, perceived ease of use and user attitude are significant determinants in the adoption of data warehouses.
- f) Flexibility to respond to changes in business need, and flexibility in data warehouse planning is critical to strategic alignment and successful adoption of the data warehouse. Alignment is a process requiring continuous adaptation and coordination of plans and goals. A shared understanding and a shared agenda between business managers and data warehouse managers is necessary for flexibility. Scalability, high availability and robust manageability of the data warehouse database and application middleware, as well as tool integration are important factors for the long term alignment and success of the data warehouse.

Thus, this research provides a pathway for facilitating successful adoption of data warehouse along strategic alignment principles. The model developed in this research allows data warehouse professionals to ensure that their project when implemented, achieve the strategic goals and business objectives of the organization.

7.4 Contribution of the research

This research study makes useful contributions to the field of information systems. The lessons learned from this study contribute to ongoing discussions in the fields of data warehousing, strategic alignment and business. This study has researched an area in which few previous studies have been carried out. Strategies and practices to align the data warehouse to business strategies, which was the focus of this study, were not well researched in IT management literature. Data warehousing was dealt from largely a technical point of view. This research study considers data warehousing from a business perspective. It expands the existing research in this area and provides a starting framework for future research.

According to Walsham (1995) theory is used in the earlier stages of case studies to create an initial theoretical framework, which takes account of previous knowledge, and which creates a sensible theoretical basis to inform the topic and approach of early empirical work. This study therefore, gathered research from three different fields, information technology, strategic planning and management, to source literature to form a theoretical basis, because of the limited research literature available specific to data warehouses. The amalgamation of different fields of knowledge to inform the topic of data warehousing is a contribution of this research.

This work has also contributed to the field of strategic alignment. This research studied the problem of strategic alignment of data warehouses in its natural setting. This study contributed to the understanding of the nature and complexity of the process taking place. Valuable insights were gained regarding the causes and processes behind strategic alignment in data warehouses, using case research methodology. This research study identified the need to align data warehouses to the organizations business strategies and goals for a successful

adoption. The most significant finding in this study, through the two case studies, was that the strategic alignment of the data warehouse to business plans and strategy was found to contribute to the success of the data warehouse. The impact of strategic alignment was visible both at implementation and user levels of the data warehouses.

A fourth contribution of this study is that it expands the existing research in the area of data warehousing. The subject of data warehouse effectiveness has been the subject of many researchers in IS. A survey of prior literature reveals that there have been many attempts to identify important factors that can reduce the difficulties in building and implementing a successful data warehouse (Hwang et al., 2004; Tyagi, 2003; Cooper et al., 2000; Wixom and Watson, 2001; Guimaraes et al., 2003; Nah et al., 2004; Ang and Teo, 2000; Chen et al., 2000; McFadden, 1996; Sigal, 1998; Inmon, 1996; Kimball, 1996). Most researchers focused on the technological and operational aspects of data warehouse. There was little research addressing the managerial or strategic aspects of data warehouses. This research focused on how organizations achieve alignment between business strategy and the data warehouse while developing and implementing a data warehouse project, for a successful adoption. Empirical evidence on how to carry out alignment in large projects like data warehouse was absent in previous research literature. This thesis investigated the factors that facilitate the alignment between business strategy and data warehouse projects for a successful adoption of data warehouses.

Another contribution of this research is capturing the knowledge of experienced practitioners in this study to present a different perspective to theoretical work found in the literature. This research study has documented the experiences of practitioners. This study has demonstrated the importance of using the knowledge and experience of the people working in the organization. Research into practical problems relating to application of strategic alignment in

data warehouse projects benefits from this body of work. This study provides practical insights into how to best align the data warehouse to business goals and strategies for its successful adoption. This study can form the basis for the development of prescriptive management guidelines for strategic alignment in data warehousing projects.

A further contribution of this study is that it has produced a comprehensive model which facilitates the alignment between business strategy and information technology in data warehouse projects. This research model can assist IT managers and data warehouse practitioners in organizations to increase the success strategies of their data warehouse. This research model helps to expand the body of data warehouse knowledge and acts as a framework for further research into strategic alignment activities in organizations. Interview instruments were also developed in this research to capture and gather relevant information while conducting case studies. As presented in the previous chapters, the questions in the interview instruments based on the research model, were successful in identifying the issues and potential problems in the case study organizations. The research model suggested areas at Raymond James Financial where efforts need to be made to enable better alignment and increase the chances of success of data warehousing. The research model when applied to Nielsen Media Research, confirmed that these alignment issues, that were already addressed, contributed to the success of the data warehouse.

A final contribution of this study is that it has identified factors that enable the alignment of data warehouses to an organizations' business strategies and goals. Based on this research, alignment between data warehouse and business strategy can be facilitated by paying attention to these alignment factors – joint responsibility between data warehouse managers and business managers, alignment between data warehouse and business plans, business user satisfaction and participation, flexibility in the data warehouse framework and technical

integration of the data warehouse. It has been shown in this study that achieving strategic alignment enhances the successful implementation and use of the data warehouse.

7.5 Limitations of this study

This research study had the following limitations:

This study was a qualitative study conducted through case studies. Case study research elicits concerns such as researcher bias and inability to generalize from such studies (Tellis, 1997). This research addresses these concerns to some extent in the form of replication (Yin, 2003) and extension among individual cases (Eisenhardt, 1991) by adopting a two case study approach. Future research through survey methodology could further address the issues of bias and generalization.

This study has researched an area in which few previous studies have been carried out. Research was gathered from information technology, strategic planning and management sources of literature because of the limited research literature available specific to data warehouses. Research literature to form a theoretical basis was limited to these three fields. It is possible that other branches of knowledge such as organizational science, cognitive science and economics, could further enlighten this research issue. This is an opportunity for future research.

Another limitation of this research is that this study is a two-case research study. The study looked at two data warehouse projects. Interview participants were limited to the two organizations where the case studies were carried out. Also, the study examines strategic alignment issues at a particular point in time. As business and data warehouse functions

continue to evolve, the challenges the data warehouse and business managers may face are also likely to evolve.

This study adopted a qualitative approach based on case study methodology. Findings were based on the perceptions of three groups comprising of senior business managers, data warehouse managers and business users in the two organizations studied. Other groups of business and IT managers and users may have different perspectives and views of the problems and challenges in achieving alignment. Future research using survey approach should provide a reasonably accurate description of real world situations from a variety of viewpoints.

Another limitation of this study is that this study did not explore all the technical factors responsible for successful implementation of data warehouse. The study was limited to exploring and studying factors that enhanced the strategic alignment of the data warehouse to business strategies, resulting in more successful adoption of the data warehouse.

7.6 Recommendations for Future Research

In the contemporary global economy, information and knowledge have become increasingly valuable as sources of competitive advantage for organizations. Data warehouse will continue to play an important role in managing organizational knowledge strategically. This study examined the role of strategic alignment of data warehouses to business plans and strategies, for a successful adoption of the data warehouse. This study provides a number of opportunities for future research.

This study was a qualitative study based on case research methodology. A weakness of this method is the fact that its application is restricted to single/few organizations and it is difficult

to acquire similar data from a statistically meaningful number of similar organizations. Given the generally large sample size of surveys, the findings of this study could be further generalized by adopting a survey methodology.

Another opportunity for future research would be to address the limitations identified through replication of this research study. This study provided a research model for strategic alignment of the data warehouse to business plans and strategies. The research model was evaluated through only two case studies. The research propositions made in this study can be further refined and the research model can be further tested through replication of this research study through more case studies.

This study has employed an interpretive design to enhance understanding and develop theory. This study employed case study method to research data warehouses in two different industries (finance and media), to explore strategic alignment issues and establish the validity of the research model. An opportunity for future research would be to conduct this study in a wider range of industries to further validate and generalize the results of the findings. There may now be a place for a positivist approach to test general propositions.

This study developed a set of interview instruments to collect data for the study of strategic alignment of the data warehouse. A fourth opportunity for future research would be to carry out this study in diverse industries (for example, processing, manufacturing, telecommunication, aviation and hospitality) to evaluate whether the data collection instrument developed in this research can be deemed as truly universal. Future research could further refine these instruments.

A further opportunity for future research would be to explore the influence of organizational factors (data warehouse project team selection, user attitude) and organizational learning while implementing data warehouses, on the strategic alignment of the data warehouse. This study focused on the strategic alignment of data warehouses only. Future studies may replicate this study to determine whether the same factors identified in this research, are relevant to other enterprise wide systems. A final opportunity for future research would be to study the impact of strategic alignment of the data warehouse on organizational success.

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APPENDIX 1 - DESIGN OF RESEARCH INSTRUMENTS

This appendix discusses the design of the research instruments used to conduct this empirical research. The case studies were conducted using semi-structured interviews and questionnaires. This chapter presents the interview questions and the design of the questionnaires based on the conceptual model.

Design of the Interview Instruments

The following five research questions pursued in this research provided the background to the design of the interview questions.

RQ-1: In practice, how is joint responsibility established between business and data warehouse managers ?

RQ-2: How are the data warehouse plans aligned to business strategy and business plans?

RQ-3: What is the impact of flexibility in the data warehouse framework on its success?

RQ-4: How does business user involvement and satisfaction affect data warehouse success?

RQ-5: What is the impact of degree of technical integration of the data warehouse on its success?

Each of the research questions are linked directly to each arm on the conceptual model and to each of the theoretical propositions made in this study. The questions in the interview instruments explore each of these research questions, providing a pathway to study the conceptual model.

The questions (below) were divided into 3 groups to address each group of stakeholders in the data warehousing process: the senior business managers, the data warehouse managers/team and the business users respectively. In addition to these open-ended questions, each participant filled out a five point graded questionnaire to each of these questions. This served to capture the degree of agreement or disagreement with the research element and the degree of satisfaction or dissatisfaction of the interview participants.

A.1 Design of Interview Instruments for Senior Business Managers

At the outset of the interview, questions were asked of the senior business manager to gather an overview of the organization, such as:

- Name, locations and subsidiaries of the organization
- History
- Industry/business function
- Employee strength
- Gross turnover/ Net income
- Organizational structure

A.1.1 Questions for Senior Business Managers

1. Over the last 5 years what are the major changes that have taken place in your business plans?
2. Does the data warehouse provide you with information you need and has that resulted in changing business direction?
3. How well does the data warehouse support (a) your business plans and (b) organization's plans?

4. Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?
5. How good is the response of the data warehouse team to your needs?
6. How has the data warehouse responded to your changing needs?
7. How involved are you in the data warehouse investment decisions?
8. In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?
9. How often do data warehouse managers participate in your strategy meetings?
10. Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?
11. What are the formal communication channels between you and data warehouse managers?
12. Given a choice, what expertise would you like to add to the data warehouse team?
13. Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

A.1.2 Questions for Senior Business Managers regrouped according to research questions

RQ-1: In practice, how is joint responsibility established between business and data warehouse managers?

How involved are you in the data warehouse investment decisions?

In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?

How often do data warehouse managers participate in your strategy meetings?

RQ-2: How are the data warehouse plans aligned to business strategy and business plans?

How well does the data warehouse support (a) your business plans and (b) organization's plans?

Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?

Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?

What are the formal communication channels between you and data warehouse managers?

RQ-3: What is the impact of flexibility in the data warehouse framework on its success?

Over the last 5 years what are the major changes that have taken place in your business plans?

Does the data warehouse provide you with information you need and has that resulted in changing business direction?

RQ-4: How does business user involvement and satisfaction affect data warehouse success?

How good is the response of the data warehouse team to your needs?

How has the data warehouse responded to your changing needs?

RQ-5: What is the impact of degree of technical integration of the data warehouse on its success?

Given a choice, what expertise would you like to add to the data warehouse team?

Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

Table A.1 Questionnaire to be completed by Senior Business Managers

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
1. The data warehouse strongly supports the business plans	5	4	3	2	1
2. The data warehouse drives business decision	5	4	3	2	1
3. Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1
4. Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1
7. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
8. Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1
9. There are established communication channels to facilitate better understanding	5	4	3	2	1
10. The data warehouse team is aware of the business plans and strategies	5	4	3	2	1
11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13. The data warehouse is successful .	5	4	3	2	1

A.2 Design of Interview Instruments for Data warehouse Managers

At the outset of the interview, questions were asked of the senior IT/data warehouse manager to gather an overview of the IT infrastructure and the data warehouse infrastructure.

- Please describe your company's data warehouse architecture?

- What are the applications supported by the data warehouse?
- What are the tools you are using in the data warehouse and why?
- How many users currently access the data warehouse?
- How do the users access the data warehouse (through what access tools)?

A.2.1 Questions for Data warehouse Managers

1. How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?
2. Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?
3. Over the last 5 years has the data warehouse architecture changed and how?
4. Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?
5. What in your opinion are your users key requirements now?
6. How involved are you in corporate strategy decisions?
7. Over the last 5 years what are the major changes that have taken place in your organization's business plan?
8. How is the integration of business and data warehouse planning process achieved?
9. How is the data integrated from different systems across the organization?
10. How is the data warehouse architecture integrated into existing IT systems' architecture?
11. How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)
12. In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?

13. Do the database, application middleware and front-end tools have high scalability?
14. Do the database, application middleware and front-end tools have high availability?
15. From your experience, what are the problems you have encountered in the data warehouse project?
16. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?
17. In your opinion, what factors are responsible for the data warehouse success?

A.2.2 Questions for Data warehouse Managers regrouped according to research questions

RQ-1: In practice, how is joint responsibility established between business and data warehouse managers?

How involved are you in corporate strategy decisions?

Over the last 5 years what are the major changes that have taken place in your organization's business plan?

RQ-2: How are the data warehouse plans aligned to business strategy and business plans?

How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?

Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?

How is the integration of business and data warehouse planning process achieved?

RQ-3: What is the impact of flexibility in the data warehouse framework on its success?

Over the last 5 years has the data warehouse architecture changed and how?

In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?

Do the database, application middleware and front-end tools have high scalability?

RQ-4: How does business user involvement and satisfaction affect data warehouse success?

Do the database, application middleware and front-end tools have high availability?

Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?

What in your opinion are your users key requirements now?

RQ-5: What is the impact of degree of technical integration of the data warehouse on its success?

How is the data integrated from different systems across the organization?

How is the data warehouse architecture integrated into existing IT systems' architecture?

How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

From your experience, what are the problems you have encountered in the data warehouse project?

Overall questions

Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

In your opinion, what factors are responsible for the data warehouse success?

Table A.2 Questionnaire to be completed by Data warehouse Managers

Strongly Agree	Agree	Neither agree nor Disagree	Disagree	Strongly Disagree
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1.	Data warehouse managers are aware of the corporate strategies.	5	4	3	2	1
2.	Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
3.	Data warehouse plans support the business plans and strategies.	5	4	3	2	1
4.	Business decisions are the driver for the data warehouse design.	5	4	3	2	1
5.	Business and data warehouse planning processes are integrated.	5	4	3	2	1
6.	Business visions are the drivers for data warehouse architecture.	5	4	3	2	1
7.	Data is integrated from different systems across the organization.	5	4	3	2	1
8.	The data warehouse architecture is integrated into existing IT systems' architecture.	5	4	3	2	1
9.	The data warehouse technology was evaluated after the decision to build it.	5	4	3	2	1
10.	The data warehouse is highly responsive to a change in business needs.	5	4	3	2	1
11.	The database, application middleware and front-end tools have scalability.	5	4	3	2	1
12.	The database, application middleware and front-end tools have high availability.	5	4	3	2	1
14.	The data warehouse is successful	5	4	3	2	1

A.3 Design of Interview Instruments for Business Users

A.3.1 Questions for Business Users

1. Were you involved in the data warehouse project and how did you participate?
2. How well does the data warehouse support your needs?
3. How are your needs communicated to the data warehouse team and vice versa?
What are the formal communication channels between you and data warehouse team?
4. How does the data warehouse respond to a change in business need?
5. Does the data warehouse provide accurate information?
6. Does the data warehouse provide consistent and reliable information?
7. Does the data warehouse provide timely information?

8. Is the data warehouse easy to use?
9. Does the data warehouse enable day-to-day-decisions?
10. Is the data warehouse functions and technical features easy to understand?
11. Was the user training adequate to carry out your functions?
12. Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?
13. In your opinion, what factors are responsible for the data warehouse success

A.3.2 Questions for business users regrouped according to research questions

RQ-1: In practice, how is joint responsibility established between business and data warehouse managers ?

RQ-2: How are the data warehouse plans aligned to business strategy and business plans?

How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?

RQ-3: What is the impact of flexibility in the data warehouse framework on its success?

How does the data warehouse respond to a change in business need?

RQ-4: How does business user involvement and satisfaction affect data warehouse success?

Were you involved in the data warehouse project and how did you participate?

How well does the data warehouse support your needs?

Is the data warehouse easy to use?

Does the data warehouse enable day-to-day-decisions?

Is the data warehouse functions and technical features easy to understand?

Was the user training adequate to carry out your functions?

Is the data warehouse easy to use?

RQ-5: What is the impact of degree of technical integration of the data warehouse on its success?

Does the data warehouse provide accurate information?

Does the data warehouse provide consistent and reliable information?

Does the data warehouse provide timely information?

Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

Overall question

In your opinion, what factors are responsible for the data warehouse success?

Table A.3 Questionnaire to be completed by business users

	Highly satisfied	Satisfied	Moderately satisfied	Dissatisfied	Highly Dissatisfied
1. Users participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

APPENDIX 2 INTERVIEW SCRIPTS NIELSEN MEDIA RESEARCH CASE STUDY

This appendix contains the interview transcripts from all the participants in the case study conducted at Nielsen Media Research.

The following is the list of participants who were interviewed at Nielsen Media Research. (Their names are kept confidential on request). A brief description of their function and role in the company is provided below.

Senior Business Manager 1

Chief Information Officer

He is the CIO at Nielsen Media Research.

Senior Business Manager 2

Senior Vice President, Monitor Plus

He had earlier headed the Platform team that was responsible for the development of the data warehouse.

Senior Business Manager 3

Senior Product Manager, Foundation Strategy

She is part of Local Product Management and is the Product Manager for the data warehouse.

Senior Business Manager 4

Senior Vice President, Local Products

She is the senior Vice President for all 220 Local products. Vice Presidents of Local Product Management and Local IT report to her.

Data Warehouse manager 1

IT Director

She is the Director of Foundation Systems & Data Architecture. Six Project Managers including the Data warehouse project manager, reports to her. Earlier, she headed the data warehouse project.

Data warehouse Manager 2

Data warehouse Project Manager

She heads the data warehouse project and reports to the IT Director.

Data warehouse Manager 3

Data Warehouse Architect

She is the senior data architect on the data warehouse project.

User 1

Senior Product Manager, Viewer Insight

She heads the Stellar product. The data warehouse provides information to the Stellar product.

User 2

Product Manager, Currency Overnights

He is the product manager for Currency Overnights. The data warehouse provides overnights data to Currency Overnights.

User 3

Product Manager, Strategy and Research

The data warehouse provides information to the products managed by her and receives feeds from the local hubs.

Senior Business Manager 1 and 2

1) Over the last 5 years what are the major changes that have taken place in your business plans?

Business plans have remained the same over the past 5 years. The same business model has existed for a long term. The only change has been a dramatic increase in complexity in the industry.

2) Does the data warehouse provide you with information you need and has that resulted in changing business direction?

No, the data warehouse does not provide us with information. It provides our customers with information. We hope our customers have found it to make better business decisions. The Toolbox application is for internal use to answer to the client base and for custom analysis. We use it to look at data and give guidance to our clients.

3) How well does the data warehouse support (a) your business plans and (b) organisation's plans?

The data warehouse supports the business plans very well. It was designed to increase revenue, and it has exceeded in doing that. We are focusing on the 3rd generation of the data warehouse and it has demonstrated that it supports business plans. The 3rd generation data warehouse has extended to match the business plans and has done well.

4) Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?

Yes, the data warehouse managers have a good dialogue with the business managers. Everyone at Nielsen Media is interested in technology. The product managers work along with the IT people in regard to the data warehouse. The product manager belongs to the

product management group but represents the data warehouse if someone comes with a new product. The product manager manages the strategic value of the data warehouse, ahead of the curve.

5) How good is the response of the data warehouse team to your needs?

The response of the data warehouse team is good. The challenge is not to become a bottleneck. Within the data warehouse team there is a data technology group, which consists of business analysts who know where the data is. There is also someone from the business service team to get the best way to get the data to you. And a third group is the repository group, to keep the data up and running.

6) How has the data warehouse responded to your changing needs?

The data warehouse allows the products to be developed faster. Since the data warehouse has gained critical mass, the products are coming to the data warehouse. Its 100 % everything is built in data warehouse. Strategically, the data warehouse is being leveraged to do modernization and cost effective programs, though it was originally put up as a revenue generating thing.

7) How involved are you in the data warehouse investment decisions?

The CIO has involvement in the data warehouse as he has to approve all major requests for investments. Then there are the line of business managers who are financially involved in the data warehouse. The CFO reviews all investments requests, finally.

8) In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?

The CIO and SVP are involved at the very top level only. We are not that much involved. These ideas are decided at the data warehouse manager's level and teams below that. What the CIO does is reinforce general technical policy, see that it fits the product strategy and

business values. If these things make sense, then the design is run by cross-functional team process.

9) How often do data warehouse managers participate in your strategy meetings?

The data warehouse manager participate in strategy meetings with the business, sometimes. Not as much as they could be. They are sometimes involved in business strategy planning. If it is regarding local business units, then within the line of business, Marie Gutgesell (Director-IT Operations, DW manager reports to her). She is occasionally involved at higher levels only because the CIO wants her to be present. It is to make sure other people know the Data warehouse architecture and how they can leverage it, and also so that she can see other ways the data warehouse can be used.

10) Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?

The product management group. It is a continuous process and is part of the product development cycle. It is very effective. A new DW is kicking off now for a different division. IT thinks that the solution is the data warehouse. Product manager is involved to make sure the business is driving the answers. It lets the product management vision drive and design the data warehouse product. The product manager represents both sides of the business. It represents IT and product management. There are 25 people in this cross-functional team. It consists of the product manager, QA, application developers and data warehouse developers (8-10), ETL (extract-transform-load) developers, data architects, business analysts and DBAs. For every product being developed, there is a business analyst and a data warehouse person assigned to it. It is to see that the data service can be reused.

11) What are the formal communication channels between you and data warehouse managers?

The CIO gets briefed on planning and occasional status updates..

12) Given a choice, what expertise would you like to add to the data warehouse team?

We have all the right people. Maybe need more good data architects. Data architecture is a mix of art and science, to take the product requirement and come up with a product model or dimensional model that would support them.

13) Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

Yes. The factors are (a) chose the right technology. Through evolution, we took the best and added to them. (b) architectural design – highlighted putting right function in right place with freedom to leverage. Companies fail because they want to build, develop and deploy all at once. Here we built and developed a little – became more capable. Iterative development. (c) the right people are responsible for success. We had the right business, IT, product manager and data warehouse manager.

Senior Business Manager 3

1) Over the last 5 years what are the major changes that have taken place in your business plans?

In the last 5 years, Local People Meter was implemented. It collects household information and person by person data. This is a major shift, to get person data everyday instead of quarterly. Another change is the introduction of new TV technology in the form of DVR (digital video recorder) and VOD (view on demand) services in the market.

2) Does the data warehouse provide you with information you need and has that resulted in changing business direction?

Yes, the data warehouse does provide information for the products that are using it. There still are a lot of legacy systems that do not use the data warehouse. We are developing an overarching product strategy to rework customer analysis system that will be using the data warehouse exclusively some day.

3) How well does the data warehouse support (a) your business plans and (b) organisation's plans?

The data warehouse supports the business plans very well. The IT director (ultimately responsible for the data warehouse) works closely with the product manager and we prioritize what data gets put into the data warehouse, depending on business needs.

4) Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?

Yes, the data warehouse managers do help us understand the advantages and limitations of the data warehouse. The product manager, due to past experience, understands the business as

well as the technology side. She advises the business on what the data warehouse can and can not do. The product manager educates the business on data warehouse possibilities.

5) *How good is the response of the data warehouse team to your needs?*

The response of the data warehouse team is wonderful.

6) *How has the data warehouse responded to your changing needs?*

The data warehouse response has been amazingly flexible. We reprioritize frequently. As client needs change, the business and data warehouse changes with them.

7) *How involved are you in the data warehouse investment decisions?*

The product manager is very involved in the data warehouse investment decisions. If the data warehouse is not able to meet the business needs, then she will lobby for more people. The data warehouse is well funded now. Sometimes, the product manager has to fight off other priorities to keep the resources with the data warehouse team.

8) *In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?*

The senior management are highly involved in data decisions. But from technology viewpoint , there is no input..

9) *How often do data warehouse managers participate in your strategy meetings?*

The product manager meets every week with the IT director. The IT director was a member of product strategy team originally.

10) *Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?*

Several teams are involved in the strategy with the data warehouse to the extent of what data they need to have. Several product managers are involved (Jim, Rhonda). The product manager for the data warehouse works with other product managers and with the senior management to balance across the projects and prioritize.

11) What are the formal communication channels between you and data warehouse managers?

The communication is very informal. We meet whenever it is needed. Plans are published to the business and made available to senior management and all other managers. We use a tool IT Governance to communicate, where schedules and project priorities are entered. Another communication channel is the product portfolio reviews held 3-4 times a year. Priorities are communicated in this venue and decisions are made if there are any questions.

12) Given a choice, what expertise would you like to add to the data warehouse team?

We have all the right people. Maybe add more of the same people. Present team is sufficient. We would like to clone them.

13) Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

Yes. Very successful. The factors are (1) We received funding to build it the way we wanted to build it in the beginning. (2) The fact that it was loaded in stages. It was developed in iterative cycles and scope was increased with each iteration. (3) The fact that there were not that many users of the data warehouse in the beginning and it was sheltered. It lets you establish what you wanted the data warehouse to be. The user base is now expanding. (4) Attitude – The can do attitude that everyone has.

Senior Business Manager 4

1) Over the last 5 years what are the major changes that have taken place in your business plans?

In the last 5 years, the major change has been the addition of the Local People Meter. It's a new methodology for measuring TV audiences. There is the national and local markets. There are 210 local markets we measure. We measure by using (i) diaries for demographics in the smaller markets, (ii) diaries and meters in the medium sized markets, (iii) new People meter for demographics and household data. Going from (i) and (ii) to (iii) caused lots of changes in Nielsen Media environment and caused the data warehouse.

2) Does the data warehouse provide you with information you need and has that resulted in changing business direction?

Yes, it provides the data we need incrementally. It responded to help our ability to respond to changes in business direction.

3) How well does the data warehouse support (a) your business plans and (b) organisation's plans?

The data warehouse was built in response to business plans. It is added on as we add products.

4) Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?

Yes.

5) How good is the response of the data warehouse team to your needs?

The response of the data warehouse team is very good

6) How has the data warehouse responded to your changing needs?

The data warehouse is very good to respond to changing needs.

7) How involved are you in the data warehouse investment decisions?

I was very involved in the data warehouse investment decisions. I was a key decision maker in the plans and approval of budgeting, to make sure data warehouse has business plan and financial support.

8) In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?

Initially the senior management was very involved to make decisions to invest in it. Now, we leave it up to the data warehouse team. It's the same with the CIO. As we give the data warehouse the business plans, they make adjustments.

9) How often do data warehouse managers participate in your strategy meetings?

The IT director is the ultimate data warehouse manager. She (Marie) is a key member of local strategy team. High level decisions are relayed to the data warehouse managers and they are left to implement.

10) Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?

Yes, the product management group, and they are very effective. For the data warehouse there are 2-3 people. The whole group consists of between 20-30 people.

11) What are the formal communication channels between you and data warehouse managers?

Every two weeks *status meetings* are held to review current work in progress. When there are new projects, we have *contract books*.

The strategy team holds a meeting once a month which the data warehouse managers attend.

Informally we communicate infrequently, occasionally, on a need to know basis.

We use a tool IT Governance where all the IT managers and project managers have all the projects, IT staffing and priorities.

12) Given a choice, what expertise would you like to add to the data warehouse team?

I would like to offload some of the production and operational type of work from the data warehouse team to an operational department. For example, loading of the data warehouse, fixing errors and monitoring load. It's still being done by the data warehouse group because the data warehouse is new. It's expensive for IT resources to do it. It's on the business plan. It's taken longer to deliver operational process.

13) Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

Absolutely successful. Its making Nielsen Media more agile. We can now deliver item faster off the data warehouse. Its been successful in our strategy to reducing the existing data bases and in reducing costs. The data warehouse has helped respond to data needs outside the group faster.

Factors that make it successful are:

- (i) Right people on the team. Marie brought valuable learning from other companies. She is strategic thinking.
- (ii) Committed ti it financially – bid positive.
- (iii) The platform team – isolated from day-to-day support and running of applications
- (iv) Having business and product managers working closely with data warehouse managers has been very successful.

Data Warehouse Manager 1

1. *How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?*

The data warehouse architecture was selected after considering high level strategies and detailed level sources of data. It is a reconciliation of top-down as well as bottom-up approach to architecture. The broad vision of the data warehouse had the concepts of data marts in it, but the emphasis was first on building the base repository and then servicing the products.

2. *Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?*

In the last 5 years, Nielsen Media Research has taken the data warehouse from concept to reality. The first year was spent in planning and listening to vendors. The data warehouse project started 4 years ago. The first release of the data warehouse was in 10 months time. The first release was a subset and did not have every table or every data base. It was a finite set of deliverables. There have been major releases every 6 months since then.

3. *Over the last 5 years has the data warehouse architecture changed and how?*

Yes. The data services layer in the data warehouse has been continuously refined. There have been 2-3 iterations to make it work. The rest of the data warehouse structure has remained the same, except for some fine tuning.

4. *Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?*

All users have been provided with custom tools by Nielsen Media Research to access the data warehouse. The users do not select the technology.

5. *What in your opinion are your users key requirements now?*

The key requirements of the users now are twofold – (a) completeness of information and (b) faster performance. The data warehouse feeds data to other engines that produce reports from these other systems. Some of these systems are growing obsolete in technology terms. There is also an ongoing consolidation of disparate products and systems to bring them under the fold of the data warehouse.

6. *How involved are you in corporate strategy decisions?*

The Director, IT Operations is involved in corporate strategic decisions. She has been the IT representative on local product strategy team. She interacts closely with senior management and is very tied into what happens on the business side. For example, she is involved in decisions regarding where revenue will come in and how products will be rolled out.

7. *Over the last 5 years what are the major changes that have taken place in your organization's business plan?*

The industry as a whole has been changing over the last 5 years. Technology is driving this change as the broadcasters are re-inventing themselves. The traditional broadcasting model is falling. The biggest challenge is Nielsen Media Research's ability to service these needs for more flexible reporting, timely reporting and providing a wider breadth of data. The industry landscape is changing and Nielsen Media Research is racing to stay relevant.

The country has been divided into 210 clusters to capture viewership ratings. In different markets, the amount of money spent for advertising is different. Nielsen Media has different measurement markets. In small markets, paper diaries are used that are mailed out to the households. In mid – tier markets, some meters are supplemented with diaries and algorithms combine and co-relate the data. In the top 10 markets, no diaries are used, only people meters are used.

New challenges are faced in collecting data from new devices and gadgets such as iPods and cross media type gadgets. Advertisers are interested in the total picture, on what the consumers are doing as a whole. Nielsen media is working towards a single meter strategy in the future. They are also looking into lower cost diary solutions.

8. How is the integration of business and data warehouse planning process achieved?

The integration of business and data warehouse planning process is achieved through portfolio reviews with senior management 4 times a year. These portfolio reviews drive the IT projects and defines the projects that will be set off. Product managers look at high level strategies and translate them into IT projects and products. The integration of business and DW planning is thus a structured method, stemming from the portfolio reviews. It involves strategy and prioritization of projects and planning of resources. Management from Directors to the General Manager level is involved in this review.

Major projects (like when the DW project was initiated) have to go through a contract book with details on finance, justification, plans risks etc. This book has to be signed by the CIO and the Hardware data center folks.

9. How is the data integrated from different systems across the organization?

Data is integrated from Reference Hub and ETL process. Data is transformed to align all the elements. The element of Time presents the biggest challenge in the integration process due to differing time zones and different timings of the source data.

10. How is the data warehouse architecture integrated into existing IT systems' architecture?

The data warehouse architecture is integrated into the existing IT infrastructure and is fairly transparent to source systems. The Data Warehouse intercepts the data from the source systems and cleans them. It integrates the data back into existing legacy systems that are not yet part of the data warehouse. The data warehouse bridges back into the legacy world without it having to change.

There are 110 different variations of the product. Nielsen media is in the process of stream lining the products and repurposing the product due to aging technology. The DW is a pre-cursor to that effort to service the products in a new way.

11. How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

The data warehouse is evaluated both through user feedbacks and through monitoring tools for hardware and CPU which send an alert if something is wrong. The primary feedback is from user s and if they are happy. The users complain if they are unhappy with the performance of the data warehouse or the quality of the data in it. As the numbers the data warehouse produces affects the revenues directly, the feedbacks are rather quick.

12. In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?

The data warehouse is very flexible because of the way it is architected. If it had been a monolithic structure, any changes to the data warehouse would have been challenging. Changes have been made to the base structure of the data warehouse, and the changes have rippled through to the products with minimum down time and effect.

13. Do the database, application middleware and front-end tools have high scalability?

Yes, the data warehouse data base, application middleware and front-end tools have high scalability.

14. Do the database, application middleware and front-end tools have high availability?

Yes, the data warehouse data base, application middleware and front-end tools have high availability. The products are available 24/7 and the data warehouse is available .for the most part due to the technology (Sybase IQ) being used. There are 2 reader nodes and 1 writer node for the data warehouse. Sybase IQ switches between the modes subtly and automatically. While the writer nodes updates the database, the data base can be used through the reader nodes.

15. From your experience, what are the problems you have encountered in the data warehouse project?

A data warehouse is never easy and there are always challenges. It is a challenge to get people to understand the technical limitations – example, one cannot run complex queries against huge amounts of data, and get responses instantaneously. It is also hard to explain to users why the products cannot run off the data warehouse directly. ETL development

has taken longer than it should be and it is hard for people to understand. Expectation management is a challenge.

16. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

For most parts, it's working. We should continue to do what we are doing.

17. In your opinion, what factors are responsible for the data warehouse success?

The data warehouse is highly successful because of a combination of factors. It had senior management support and the data warehouse team consisted of the right skill set and the right technical people. There has been a lot of support and understanding for the data warehouse among senior management even before the data warehouse project was started. The DW was not an IT sponsored project. IT responded to the DW request by senior management.

The data warehouse team had the right skill set with the right people. An experienced and capable project manager was brought in from outside to head the project. There were 2 very good data architects who understood the business rules, the data and had great data dimensional modeler skills. One of these data architects had 25 years of experience in the company. The data warehouse team also hired members experienced in ETL.

Data Warehouse Manager 2

1. How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?

The data warehouse architecture was selected after an inhouse architect did the research and explored the different options. Different data warehouse DBMSs were considered and the vendor evaluations were completed by Nov 2002. Each of the vendors were quizzed on technical and business metrics and the weighted values were given to each criteria. Input was also received from Gartner Group and proof of concept was done for the products evaluated. Sybase IQ was finally selected over NCR Teradata and IBM DB2.

There were several reasons for selecting Sybase IQ. As Sybase databases already existed in-house for OLTP type systems, there was a shorter learning period. The CIO had a good relation with SYBASE and it had his support since it was an existing vendor. The in-house architect went through Kimball's teachings on conformed dimensions and was familiar with the company's data bases, as he had created many of them. He maintained consistency in the design and dimensions of the data warehouse. For example, all column names meant the same thing across systems. The data architect wore many hats and tested his design, loaded code and wrote the summary codes. He added things into the fact tables for easier navigation of queries. The data warehouse has had no issues with the core design he provided.

2. Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?

The major change is the implementation of the data warehouse. It is hard to pitch a data warehouse to any organization. So we had to piggy back off an existing budgeted project.

We did not have management support for it until 2002. We pitched CRM so that the data warehouse could evolve.

There is a new measurement for viewing call PeopleMeter. The data warehouse was able to react to change more quickly and put data that was more usable to the mainframe type system and feed it back to the mainframe. The data warehouse could adapt to new technology in industry more quickly than the old systems and was our justification. Data warehouse was also an attractive solution to our programmers who preferred open systems to writing mainframe code.

3. *Over the last 5 years has the data warehouse architecture changed and how?*

No, because this is the initial implementation..

4. *Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?*

There is an initiative internally for service oriented architecture. There is a team that advises on how to develop programs and sees that there is a consistent approach, to encourage reuse.

5. *What in your opinion are your users key requirements now?*

The key requirements are to have data loaded correctly and efficiently. The struggle is to have the source send the data consistently. At present there is no way to notify users of delayed service or upload. Secondly, the lack of metadata needs to be corrected.

6. *How involved are you in corporate strategy decisions?*

The data warehouse project manager is somewhat involved in strategy decisions. She is involved more than other managers because of the good relations with the product manager. The product manager makes the data warehouse team aware of all business plans and strategies. The data warehouse team consists of 5 developers, 3 QA, 1 project leader and 1 director who directs 4 other projects besides the data warehouse.

7. *Over the last 5 years what are the major changes that have taken place in your organization's business plan?*

At a high level, business plans have to come up with alternative methods to collect information to get client viewing data and data to support out of home viewing. Business plans have to see that designs are in place to support viewing collection methods for DVR (digital video recording) and VOD (video on demand). Business plans are trying to keep up with new technologies.

8. *How is the integration of business and data warehouse planning process achieved?*

The integration of business and data warehouse planning process is achieved through working closely with the product manager and director. They are the voices to upper management to say how the data warehouse can be best used to achieve business initiatives.

9. *How is the data integrated from different systems across the organization?*

Depending on the sources, they are integrated differently. Sunopsis is the tool used for ETL. Data is integrated from mainframe, UNIX and other sources into a staging table. This is mapped into the target table and data transforms through some more tables before

getting into the target table. Finally the target tables get committed into the destination tables which hold the raw data.

10. How is the data warehouse architecture integrated into existing IT systems' architecture?

The data warehouse architecture is integrated into the existing IT infrastructure. We try and conform to the naming standards. Data is received into the data warehouse and from existing IT systems and data is also passed from the data warehouse to these IT systems. A layer in between them helps in adapting the source data to the target .

11. How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

Since the data warehouse feeds the data marts that feeds systems downstream, the data warehouse tries to meet the SLAs (Service Level Agreements). Usually, if there is a problem, it is not with the data warehouse but with the sources providing data to the data warehouse. The performance of each load into the data warehouse is not closely monitored, though there is a cursory monitoring going on from the ETL team. As new development goes on, base lines are created and we measure against that.

12. In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?

The data warehouse is extremely flexible. Its been built keeping flexibility in mind. The data warehouse is new and extremely useful. If the data warehouse is not flexible to react quickly to changing conditions, its usefulness will decline. New events become a priority for the data warehouse.

13. Do the database, application middleware and front-end tools have high scalability?

Yes, the data warehouse data base, application middleware have high scalability. The front-end is somewhat scalable. The front end tools are the ones by comparison, the most lacking. For example the front-end used in Stellar application has issues with growth in its user base.

14. Do the database, application middleware and front-end tools have high availability?

Yes. The down time for loading the data warehouse is 12 – 3 am. But for the customers, the data warehouse is available 24/7, except if there is a planned maintenance.

15. From your experience, what are the problems you have encountered in the data warehouse project?

The first problem encountered was (a) justification of the data warehouse. The second problem encountered was due to the Agile methodology adopted (b) lack of metadata. The Agile methodology defies the concept of a traditional data warehouse. It was adapted to meet the needs of the project. To get the data warehouse to the market sooner, the metadata strategy was not built in from the beginning. For example, descriptions for the code columns were not put in. We don't have the resources right now and it is hard to justify allocating resources for non revenue generating requests.

17. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

(a) Metadata and (b) approach for access by outside users. Access by users is not controlled and we want to avoid contention among users.

18. In your opinion, what factors are responsible for the data warehouse success?

The data warehouse is highly successful because of (a) strong management support and (b) The right people working on the data warehouse. They are knowledgeable about the business and knowledgeable about the technology. The product manager has been in the company for 30 years and the director has had data warehousing experience. The data warehouse team has people experienced in business, data warehouse and technological know how.

Data Warehouse Manager 3

1. *How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?*

The data warehouse architecture was a combination between applying existing technology investments with tool evaluations to fill in the architectural and technical components. We evaluated and selected Sybase IQ.

2. *Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?*

The changes are (1) The content is tightly coupled with business direction and so we are able to rotate on changing need in a Agile way. There was a need for overnight data, and it was brought into the data warehouse. We are adding commercial data this year. The changes are very driven by business.

(2) Integration, collection and presentation layer. Data warehouses fail when they run reporting off the data warehouse itself. Presentation layer needs to be ways of delivering the data. The presentation should not be directly into the data warehouse. The base data is very insulated. That's been a very stable factor. There have been changes in the presentation layer – the data marts.

3. *Over the last 5 years has the data warehouse architecture changed and how?*

Added an overnight ODS called ODW. This allows equal opportunity to get data. This product needed data recency i.e. next day. It shifted the program name priority.

Data services framework evolved from the measurement data which is cyclical to couple to the ODW. We now have a framework to handle the throughput.

4. *Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?*

A lot of applications are custom. We sell our data and want a structured access to it. Now emphasis is on internal analytics. When we have new types of data, as in case of DVR, advertisers want to have some idea of how we explore it. We did the tool evaluation on the IT side and translated our recommendation to the product managers and internal data analysts. We chose the BI tool for their function. Proclarity (for the cube) and Microstrategy (for relational).

5. *What in your opinion are your users key requirements now?*

For external products (i) performance – Users want to do a lot. Some queries run for a long time. We are building custom programs to give operational type query performance in BI query.

In the data warehouse, aggregate levels are calculated at the root by household level data by applying business rules and check points. These are the base level aggregates used for BI. It's a multi-step process. So to improve performance we are building JAVA mixed with sequel file system logic. Using flat file sequential structures make the queries run faster.

(ii) Report parameter flexibility – custom grouping of things against the data warehouse.

6. *How involved are you in corporate strategy decisions?*

Not very, I am the recipient of the knowledge. The data warehouse manager and product manager are involved in it..

7. *Over the last 5 years what are the major changes that have taken place in your organization's business plan?*

Need for new types of data. Changes have occurred in technology in the television industry. New devices and measurement technology came out to handle these changes. Changes have occurred in the engineering aspects of encoding to the stations to collect the data.

8. *How is the integration of business and data warehouse planning process achieved?*

We worked closely with the product manager and they bridge with the marketing.

9. *How is the data integrated from different systems across the organization?*

Data is integrated in the staging area. ETL is the integration tool.

10. *How is the data warehouse architecture integrated into existing IT systems' architecture?*

The data warehouse architecture tends to lead the way. Even though the data warehouse faces different pressures, we tend to continue building. So data warehouse architecture is helping lead the technology in the IT architecture. .

11. *How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)*

The loads into the data warehouse is continuously monitored. Performance on loading is evaluated and we are evaluated by the users. We react more than anticipate. There are also email alerts if something is not right.

12. *In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?*

The data warehouse is extremely flexible. We have embraced re-factoring and continuous delivery as much as we have added new types of data (eg. Time shifting data) into the data warehouse. We are able to efficiently extend data structures to handle it. We have people working with data long enough to make these design decisions by translation of business rules into design patterns.

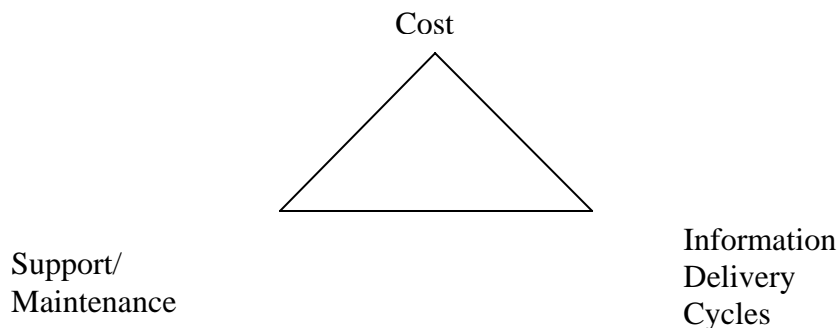
13. Do the database, application middleware and front-end tools have high scalability?

Yes, the data warehouse data base, application middleware have high scalability. We looked for that when selecting the hardware. We can scale up the cube.

14. Do the database, application middleware and front-end tools have high availability?

Yes. This is because we have an integration system and a presentation system and the pipeline is built like that. Collection environment makes sure the data is adequate to provide the currency. The architecture of the data warehouse by function keeps availability more manageable, controllable and higher.

15. From your experience, what are the problems you have encountered in the data warehouse project?



The problem encountered is the maturing of maintenance which has lagged behind delivery of information. As the data warehouse focused on delivery, it skimmed on maintainability. With the bringing in of new types of data into the data warehouse (DVR, VOD, Overnight data), ETL gave 80% of its time to support. It was always contentious and we solved problems as they came. Re-processing was sometimes manual. For example when hurricane Katrina wiped out New Orleans. We had to develop new business rules. The sampling aspect is not technical (people diaries) and developed over the years.

18. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

Continue to strive on every project and constantly enhance the products with superior QA-ing. Make the QA process automated, consistent and happen earlier.

19. In your opinion, what factors are responsible for the data warehouse success?

The data warehouse is highly successful because of (a) exemplary leadership (Don-SVP and Marie-IT Director) and team. (b) Right kind of guiding principles. Go in with the best intentions, ok to make mistakes, re-factoring. Management removes obstacles and defensiveness.

User 1

1. Were you involved in the data warehouse project and how did you participate?

Yes, was informed about the data warehouse project. 4-5 projects were identified that needed to use low level detail of data from the data warehouse. Stellar was one of these projects. Low level variables that I needed were captured by the data warehouse team when gathering requirements.

Also, we are building a new product on the data warehouse called Custom Market Breaks. I continue to interact with the IT director (Marie) and the data warehouse team to make sure that the data pieces are included in the data warehouse as it matures.

I also make sure that the 3-5 year strategy in business plan are aligned into the data warehouse. We negotiate timelines.

So I am involved from the beginning to now.

2. How well does the data warehouse support your needs?

The data warehouse supports my needs very well. Recently, the IT organization went through an organizational shift to align with product management. I am involved on the product side and am partnered with the IT side to focus on the custom product.

We continue to work as a foursome, IT director (Marie) and DW Product manager (Shannon) on the DW side, and IT manager (Greg) and Business manager (Rhonda) on the business side. We are looking at grouping of characteristics needed in new product in this timeframes

and make sure we include the missing variables. The XP methodology facilitates communications across business and data warehouse units.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

We communicate with the data warehouse team formally and informally. From formal project perspective, if a product needs information, it initiates the communication and meet with the data warehouse team leader Lynn. They hold meetings and brainstorm.

We work together informally as well. We pick up the phone and call as needed. We also have weekly meetings, project by project and daily stand-up meetings for 10-15 minutes everyday to check status. The stand-up meetings bring members from all disciplines together- Local DW, Stellar, MTS (media tech services), Helpline and product management.

4. *How does the data warehouse respond to a change in business need?*

The data warehouse responds well. The data warehouse team has a lot on its plate and they have to prioritise. We meet at a strategy group with the data warehouse manager on a regular basis, and we meet with the senior management to prioritise the business needs. If a business need comes in that is not taken into account in the prioritization for the year, then we reassess the priorities and reassemble as a group. Or we add it to the next cycle of the data warehouse. Business gives the data warehouse manager what they need and when they need it.

5. *Does the data warehouse provide accurate information?*

Yes.

6. *Does the data warehouse provide consistent and reliable information?*

The data warehouse is fairly consistent. Its built only in the early 2004 and has been much more stable in the past year.

7. *Does the data warehouse provide timely information?*

The data warehouse provides timely data. If there is a delay up-stream, its not the data warehouse's fault. The data warehouse meets the SLA (Service level agreement).

8. *Is the data warehouse easy to use*

Yes, the clients are happy and there are no complaints.

9. *Does the data warehouse enable day-to-day-decisions?*

For clients – yes. The applications use the information. The Stellar product uses the information cyclically. Every month there are 10 markets that draw information and it depends on the market. So far the data warehouse has missed the SLA only once and that was a Stellar problem, not DW problem.

10. *Is the data warehouse functions and technical features easy to understand?*

Yes. I can understand the data model and the data tables.

11. *Was the user training adequate to carry out your functions?*

The IT director (Marie) maintains a tight grip on who can access the data warehouse to keep consistency on the code. No training was provided. We are the recipients of service. The data warehouse team provides the service.

12. Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

The data warehouse team is very responsive to our needs. The team is also highly skilled and has lost only one person since its inception. Nobody had built a data warehouse before so there was a lot of on the job training involved. They need to disseminate information.

13. In your opinion, what factors are responsible for the data warehouse success

Several factors. (1) ***Isolation***- The project team was identified early and carved out of the local IT organization. 35 managers and developers were isolated from day – to – day management of other projects they were involved in, to form the platform team. The platform team had only one focus – all new development of the data warehouse. They did not have to bother about other applications.

(2) ***Senior management support*** – Senior management recognized that 30 year old mainframe systems required retro fitting. They recognized that they needed to put resources, attention and money to build a data warehouse.

The Senior VP (Don) heading the Platform team identified the critical path that people needed to take to build the data warehouse. He picked the best subject matter and people, brought in consultants, introduced the XP methodology, enabled the team to work smarter and faster. The senior managers spent the time and money to facilitate that.

(3) ***Open communication*** and XP Methodology. It allows a open workspace. Weekly planning meetings are held to plan weekly iterations.

In XP Methodology requirement and analysis phase is combined. The development and QA phase is also combined. Business is always involved and weekly tasks are identified. Instead of six month development cycles, there were 13 week development cycles. There were check points for every week and every day. There were several iterative releases before the final product.

(4) ***Paired Programming*** – This is a success factor. Two developers worked on a task together. This allowed for a complete assessment of the requirements and better and faster development.

14. What difficulties have you faced with the data warehouse?

Resource constraints – the data warehouse team have too many things on their plate.

User 2

1. Were you involved in the data warehouse project and how did you participate?

Yes, was involved the data warehouse pertaining to ratings data, program names data and overnight data. I was involved in the scenarios that occur infrequently. For example, what happens when a new network launches or a network changes its affiliation, what happens when daylight saving time changes, what happens in the different time zones across the country and how are the feeds to the applications going to be handled. I am involved in things that are not predictable, things that don't occur on a daily basis and how will you handle that.

2. How well does the data warehouse support your needs?

The data warehouse very much supports my needs. For instance, a lot of improvements that client's have asked for, have been incorporated in the Overnight's data warehouse (ODW). The ODW offers a tremendous amount of flexibility. It will allow leverage with future product development. It was a smart move by Nielsen Media to gather and put into repositories the data, so that one only needs to plug in to play applications on it. It is a win-win situation as it will get the products to market faster and the clients will see huge performance gains and the enhancements they had requested included in the data warehouse. The user interface is much more event driven. The client's support interface to deal with Nielsen Media will go down.

3. How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?

There is a fundamental understanding of the basic requirement. We communicate the enhancements to them. Anytime the data warehouse people have a question, for guidance, direction or decision, they come to me.

We have daily stand-up meetings to communicate what we did yesterday, what we will do today and what is in my way. We write user stories at the beginning of a project. These are different from user requirements. It tells the developers that as a client I would like to do this. Then they figure out the best solution. The project managers go on client visits and we also have clients come to Nielsen Media to speak to the group.

4. How does the data warehouse respond to a change in business need?

The data warehouse responds well. It generally comes with a little resistance because it's a change of requirements. The changes ultimately get made, but it depends on the severity of the request. As we use Agile, the response is fluid. The DW group may start development on a particular component and questions may come up later and they check back.

5. Does the data warehouse provide accurate information?

Yes, absolutely. We are currency for the business and are therefore held to a higher standard than our competitors. Competitors are on the software application side. We have to certify our data going out the door.

6. Does the data warehouse provide consistent and reliable information?

Yes, the data warehouse is very consistent. There is input from over 25,000 home between 3 to 4 am everyday and the data gets passed along the mainframe and different systems and fed into the data warehouse. Then the data is released from the data warehouse as published data starting at 7 am and goes out to the clients at 7 am, 7.20 am, 7.40 am and so on.

Does the data warehouse provide timely information?

Yes, absolutely. The overnight data from the overnight data warehouse is critical, it is urgent. If it is not ready at 7 am, phones will start ringing at 7.01 am. For Local data warehouse, its not so urgent.

7. Is the data warehouse easy to use

Yes. The clients touch an extract of the overnight data warehouse. Some applications are intuitive and some are not so intuitive. We are getting better and are trying to have a common look and feel across products. The products look different due to different tools that they use. 4 different applications for same client look different even though they use the same data source. There was not much communication across groups before. Now, with the data warehouse, there is much more cross-fertilisation.

8. Does the data warehouse enable day-to-day-decisions?

Absolutely. The overnights data is the currency for 80 billion dollar advertising industry. It enables day to day decisions. It dictates programming decisions, buying decisions, selling decisions. Data mining is done off this data.

85% of the revenue is derived from local news channel. It drives every day-to-day decisions for local channels. Everyday analysis dictates what program would be a lead-in into the news, how it affects the ratings, how to retain an audience etc. A point in the rating for local market in Tampa is worth about \$20 million in the local market.

9. Is the data warehouse functions and technical features easy to understand?

Yes. Its getting better, much easier than what it used to be. A lot of the changes was dictated by clients. Client input was incorporated into the design and architecture of the data

warehouse. The performance is also better. Earlier you could see data *at* 7 am, now with better performance, it is see data *by* 7 am in the contracts. In some cases data is ready by 5 am.

10. Was the user training adequate to carry out your functions?

Yes, because clients were engaged very early on in the process. For example NBC is a big client. We asked NBC for a wish-list to treat and service you the best we can. We asked them for a meeting to tell us what they want. Then if we build it, will you come. Now we have build it, compiled it, validated it for the marketplace, now will you buy it. Clients were asked if we can build something in fashion X or Y, what do you want. They were involved in the process, so the data warehouse is a huge success.

11. Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

The data warehouse team is absolutely skilled and highly motivated and talented. Overall response is good. If a requirement changes, depending on what it is, how it is prioritized, response could be slow from user expectation standpoint.

12. In your opinion, what factors are responsible for the data warehouse success

Clients don't buy technology, they buy solutions. The developers have a tendency to talk hi-tech, client just wants the business problem solved. Fro, clients perspective, they are sheltered from the high tech talk and the data warehouse is a success.

13. What difficulties have you faced with the data warehouse?

From time to time, because it is so technical, they speak a language I don't speak, its hard to make sense till we are on a level set.

User 3

1. *Were you involved in the data warehouse project and how did you participate?*

Yes, was involved but I was not on the data warehouse team specifically. I was involved in defining user requirements, user needs and helping validate the output of the data warehouse.

I was involved in the local hub feeds into the data warehouse and in the Stellar project where the cube was loaded from the data warehouse. I was involved in loading of tables specific to local reference data as well. Now I am involved with the BI tool Microstrategy, looking for viewing patterns on the minute level views of data.

2. *How well does the data warehouse support your needs?*

The data warehouse has been wonderful.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

We have contact persons in the data warehouse in the product manager and Marie the IT Director who manages the data warehouse. We communicate if there is a project that would impact the data warehouse or if a deliverable is required out of the data warehouse or if there is a modification to be made. We work very closely with them and based on the issue we have conversations as well as formal meetings. We keep the project community up-to-date on where they are progressing.

4. *How does the data warehouse respond to a change in business need?*

The data warehouse quickly and thoroughly. We have very experienced people on the team, experienced in both data knowledge and the technology. One ETL developer has been here for 30 years.

(aside- Knowledge transfer will be a huge problem. Xp process is a productive solution for knowledge transfer. Pairing the developers helps, they communicate a lot. Constantly swapping pairs helps in knowledge sharing.)

5. *Does the data warehouse provide accurate information?*

Yes.

6. *Does the data warehouse provide consistent and reliable information?*

Yes. There are a lot of checks and balances within the QA role. Also the people like Lynn (project leader for DW) and Jay (data base administrator) make sure the data warehouse is consistent.

7. *Does the data warehouse provide timely information?*

Yes.

8. *Is the data warehouse easy to use*

Yes. I understand the table structure and data. It's easy and transparent to the end-user for the end-user experience. The data warehouse data is complicated but the internal users with the data warehouse teams support find it easy to use.

9. *Does the data warehouse enable day-to-day-decisions?*

Yes

10. *Is the data warehouse functions and technical features easy to understand?*

Yes.

11. Was the user training adequate to carry out your functions?

The training was as needed and sufficient. There is no formal training, its ad hoc, as needed informal training. The data warehouse team is very accommodating. If you need help, just ask.

12. Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

The data warehouse team is very skilled and there is very good response from them.

13. In your opinion, what factors are responsible for the data warehouse success

The people, senior management. Don Carlson (SVP, Platform team) had the opportunity to get the best in business and technical knowledge and experience, within the organization and outside. Members in the data warehouse team, they understand the data well.

14. What difficulties have you faced with the data warehouse?

Getting on their priority list is difficult as the data warehouse has a long list of users. For instance if you need new data loaded, it can be a wait potentially, based on who else needs the data.

APPENDIX 3 - INTERVIEW SCRIPTS RAYMOND JAMES FINANCIAL CASE STUDY

This appendix contains the interview transcripts from all the participants in the case study conducted at Raymond James Financial.

The following is the list of participants who were interviewed at Raymond James Financial. (Their names are kept confidential on request). A brief description of their function and role in the company is provided below.

Business Manager 1

Senior Product Manager

He has been in various senior positions in the financial field of RJFS for the last five years. He now represents the business side of the company in the technology division. His group works with IT operations and IT engineering to decide on the size of various IT teams, their resource distribution and funding decisions.

Business Manager 2

Regional Administrative Manager, RJA Private Client Group

He oversees and manages the private clients, institutional equity and fixed income institutional sales, investment banking, trading activities, operations and administration for his region.

Business Manager 3

Vice President Software Development

He is one of the senior most managers at RJFS and heads the software development division of IT at RJFS. He reports directly to the CIO and CEO and participates in strategic corporate decisions.

Data Warehouse manager 1

Product Manager

He manages the data warehouse at the product management level. He interfaces with the other functions of IT – operations, data base administration and project management.

Data warehouse Manager 2

Data warehouse Supervisor

He is the supervisor of the data warehouse development team and oversees the work of the system analysts, programmers and business analysts associated with the data warehouse. He is responsible for the progress and development of the data warehouse and addresses all user issues.

Data warehouse Manager 3

Data Warehouse Manager

He is the manager of the data warehouse, which is one of many applications he heads within the IT function. He is closely associated with the data warehouse from its very initiation and was its chief developing officer for the initial years.

User 1

Asst. Vice President, Sales Management

She belongs to the RJFS division. She is responsible for direct supervision of contracts with banks, and their day to day activities. She is also responsible for overseeing recruitment and

relationship management of financial advisors. She helps them achieve their business goals and optimize their business practices. She also oversees their compliance with legal and regulatory agencies.

User 2

Regional Administrative Manager

He is one of the top 20 users of the data warehouse. He is a senior business manager He helps branch managers and financial advisors become more effective and help increases the efficiency of their business practices. He provides information on business planning and development, branch structure models, strategic coaching programs and guides financial advisors in choosing products and services.

User 3

Assistant Vice President, Branch Administration

She provides branch and individual advisor performance measurements which are used for firm recognition and national conference qualification levels. She also provides specialized support in branch building, with focus on business acquisitions and transitions to retirement. She also assists with business succession planning in order to maintain continuity for the financial advisors clients.

User 4

Assistant to Tom James, the Chairman of RJFS

He is a key official within the company. He is the Assistant to the Chairman and Founder of the company. He compiles and provides every information requested by the Chairman and contributes to all decisions taken.

User 5

Learning Specialist

He heads the training function for any new application or software for the company. He is responsible for introducing and holding training sessions for the data warehouse for the financial advisors in the field as well as in-house users. He and his team is also the first point of contact for many users when they encounter any difficulty with the data warehouse or have a question about the data warehouse.

User 6

Database Administrator for RJFS Group.

She is one of top five users in the home office. She oversees and administers the data for all applications in her area and helps prepare executive reports for her division.

Business Manager 1

1) Over the last 5 years what are the major changes that have taken place in your business plans?

Over the last 5 years, no major changes have taken place in business plans. The business plans at Raymond James focus on growth and integrity of the advisor relationship. They want to affiliate with the best financial advisors. Better financial advisors does not translate to greater assets or money, but meeting the client's needs. The business plans involves providing the financial advisors with the best tools to service the clients. RJ wants to establish the gold standard in FA relationships.

2) Does the data warehouse provide you with information you need and has that resulted in changing business direction?

The data warehouse has been available to the Financial advisors for 1-1/2 years. During this time span some changes have been facilitated by the data warehouse. Departments have made policy changes, and enforced these policies based on data from the data warehouse. As an example, a business unit wanted to institute a certain fee. Before the data warehouse was available, it was expensive to procure data on who to charge such fees. Manual intervention to collect data made it too costly for the fee to be worth while. But with data coming directly from the data warehouse, applying this fee was viable and made a direct impact to profitability.

3) How well does the data warehouse support (a) your business plans and (b) organisation's plans?

The data warehouse has supported the business plans of the company. Initially there were growing pains and the data seemed overwhelming. But it has helped the financial advisors

plan their business. It has given the financial advisors tools to analyse from top-down. Before the warehouse, they had to depend on scattered reports.

4) Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?

Data warehouse managers help the business managers understand the advantages and limitations of the warehouse well.

5) How good is the response of the data warehouse team to your needs?

The response of the data warehouse team to business managers needs are good.

6) How has the data warehouse responded to your changing needs?

The data warehouse is relatively new, and it is in its 1st version. Its too early to tell how it responds to changing needs.

7) How involved are you in the data warehouse investment decisions?

The product manager was involved in building a long term roadmap for the data warehouse. He participated in defining the deliverables of the system as well as its display layouts. He was also responsible in getting the resources from the operating committee of the company and the business units together who have the ownership.

8) In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?

The product manager and his colleagues are very much involved in data warehouse decisions. The VP of product management areas meets with the CEO and COO of RJF for presentations and funding.

9) How often do data warehouse managers participate in your strategy meetings?

The data warehouse managers do participate in strategy meetings with the business. But with the recent organizational change, the product manager is increasingly taking up this role, and the involvement of the data warehouse managers will progressively reduce. The data warehouse team is being shielded from participating directly so they can concentrate on development efforts. Also the product manager speaks the language of business better than the DW team who use a lot of technical terms.

10) Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?

The product manager is a new position responsible to integrate business needs and strategy with the data warehouse. The product manager has spent the last 5 years in the business side of the company and understands it well. This position is created to enhance the cooperation and coordination between business and the data warehouse. It has shown signs of being effective and has had good feedback from the business.

11) What are the formal communication channels between you and data warehouse managers?

Communication between the business and the data warehouse managers flows through the product manager. It's a fundamental and open line between the two sides and allows open and free communication. The product manager validates the different requests coming through the different divisions before conveying it to the data warehouse managers. If changes are required, the data warehouse goes through a change management process.

12) Given a choice, what expertise would you like to add to the data warehouse team?

The product manager would like to add more human resources to the data warehouse.

13) Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

The data warehouse has been successful, but not as successful as it could be. This is because of other technicalities that have to be put in place before the data warehouse can be fully implemented. At present only 50% of users have access to the data warehouse because of connectivity issues. Some of the offices do not have secure connections to access the data warehouse. These connectivity problems are being worked out at present.

Business Manager 2

1) Over the last 5 years what are the major changes that have taken place in your business plans?

Over the past 2 years there has been a major change in the brokerage industry in the way Financial Advisors affiliate with a firm to do business. Traditionally, a broker could become an employee of a large brokerage firm like Raymond James or Merrill Lynch or be an independent contractor and trade through the firm. Over the past 2 years, Raymond James has come up with a new model unique to the industry. Raymond James is the leader in its segment and sees this new model generate an excitement and demand in the industry.

2) Does the data warehouse provide you with information you need and has that resulted in changing business direction?

The data warehouse is useful in studying the after effect of this new model for recruitment and in monitoring its progress. Also, because of the integrated data available on the data warehouse, an individual does not have to make several points of contact to find information. It has made access to information more organized and centralized.

3) How well does the data warehouse support (a) your business plans and (b) organisation's plans?

The data warehouse does not support the business plans very well. The different functional groups function differently. There is a need to share appropriate data. The data warehouse does not reflect this. There has been ownership issues with data. But to realize the vision of the company, the data warehouse could help in taking down the boundaries

and sharing the information. It could help in the de-segregation of data by combining the efforts and presenting a united front.

4) *Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?*

The data warehouse managers are receptive to their needs and vision. But some areas in the data warehouse are not flexible enough to adapt to their needs and they are struggling with it.

5) *How good is the response of the data warehouse team to your needs?*

Some are good and some are not.

6) *How has the data warehouse responded to your changing needs?*

The data warehouse team response to the end users has been good. But their response to back office type accounting and administration has not been good.

7) *How involved are you in the data warehouse investment decisions?*

Not involvement in data warehouse investments. Only involved in defining user needs.

8) *In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?*

Not involved in data warehouse decisions. They are struggling to have their vision well received.

9) *How often do data warehouse managers participate in your strategy meetings?*

The involvement of the data warehouse managers in business strategy meetings depends on the attitude of the managers. Some do not want to have anything to do with IT. The data warehouse team also is happy because it can continue to do its own thing.

10) Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?

The business manager deals directly with the data warehouse managers. Sometimes they deal with the data warehouse team who then relate to the 3rd party vendor involved. Occasionally, the business manager deals with the 3rd party directly for his needs

11) What are the formal communication channels between you and data warehouse managers?

There is a formal IT order form that serves as a channel of communication. But as it is formal and hard to fill out, the business managers talk directly to the data warehouse managers. The formal channel is occasionally circumvented as the system is open and flexible to your needs.

12) Given a choice, what expertise would you like to add to the data warehouse team?

The business manager would like to see an improvement in the speed of the data warehouse. There is a long time elapsed between request and a response now. Also he would like to see a control on the scope creep and some tangible outputs.

13) Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

The data warehouse has been a success with regard to the business analyzer. But there are still some major issues with its CRM component that he would like addressed.

Business Manager 3

1)Over the last 5 years what are the major changes that have taken place in your business plans?

Lots of changes have taken place. Response to changes in the regulatory industry, margin compression, industry downturn after the 9/11 incident and corporate scandals had sent our company into a tailspin. Since then, trade volume has increased, but residual law suits remain. We have now gotten focused to building systems that provide information on unsuitable trade and general compliance. The data warehouse is being used to write reports against data in it, and sitting with the compliance team and querying against the compliance data. We have a lot of MDX skills in our marketing division and they are using the data warehouse for data mining.

2)Does the data warehouse provide you with information you need and has that resulted in changing business direction?

No. But has seen it being used by the largest business unit. For example, it is being used to easily see the correlation between the account side and revenue. Its being used to drive behavior from sales management.

3)How well does the data warehouse support (a) your business plans and (b) organisation's plans?

It supports recruiting. Its also being used to support business plans. For example, to decide the impact of a rise in a particular fee being imposed. How many accounts will it impact? How can the fee be instituted? But the very complexity that makes the data warehouse powerful is making it hard to use. More expertise is required to use the data warehouse fully. A cell of power users is required to run queries against the data warehouse

4) Do the data warehouse managers help you understand the advantages and the limitations of (a) what the data warehouse can do and (b) what they can currently do for your needs?

It is very hard to justify financially. More resources are required for the data warehouse and funds are required for the incremental releases.

5) How good is the response of the data warehouse team to your needs?

They have been extremely helpful. Some other sources may tell you differently.

6) How has the data warehouse responded to your changing needs?

All requests go through the product manager to the development team.

7) How involved are you in the data warehouse investment decisions?

Extremely involved. The VP of software development reports to the CIO who reports to the CEO. The head of software development oversees 330 people and works closely with the heads of product management and project management. The product management group, along with the product manager for the data warehouse make decisions about moving people to the data warehouse and other teams, sizing the teams and allocating resources. Decisions about moving forward in a project and funding resources is made along with IT operations and IT engineering groups.

8) In your opinion, how involved are you and your colleagues (including CEO) in data warehouse decisions?

The VP of software development is involved in data warehouse decisions. The CEO was involved in the fact that building it was a good idea and in seeing the demo of the data

warehouse. He is involved in all decisions involving over a million dollars, though the individual pieces of the data warehouse has not been priced.

9) How often do data warehouse managers participate in your strategy meetings?

The data warehouse managers do not participate in strategic meetings. They are involved in an ad hoc manner. For example when information is required on who has access to what, or for compliance issues, the DW managers are leveraged.

10) Are you aware of a team that is integrating business needs and strategy with the data warehouse? If yes, how effective is this cooperation?

Yes, the product manager's cooperation is quite good. The needs of the private client group and the needs of the capital groups are quite different. The product manager surveys the landscape and uses that to drive future releases of the data warehouse. He prioritizes the needs across the different user groups. He determines the costs and the way to go ahead.

11) What are the formal communication channels between you and data warehouse managers?

There is a weekly staff meeting with all the VPs in his area. Also works with the business on an ad hoc basis.

12) Given a choice, what expertise would you like to add to the data warehouse team?

The data warehouse team needs to quickly integrate sources. They should not be writing reports. The business should be writing reports. There should be a centralized reporting team. Writing reports should be put in the hands of experts who know the data well enough. Again, the business users don't know the data well enough, so it's a vicious circle.

13) Finally, in your opinion, has the data warehouse been successful? What factors do you think are responsible for the data warehouse success?

Absolutely, though don't know at what cost. I am not comfortable with the return on investment. Would I do it again knowing the cost, I don't know. But I am glad we did it.

The data warehouse has had its share of start up problems. It has got to have a backup. Users want a backup before committing to using it to run their reports.

Data Warehouse Manager 1

1. *How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?*

The data warehouse is a collection of data marts but was originally architected to be an enterprise wide.

2. *Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?*

There has been no major changes in the data warehouse plans or strategies over the last 5 years.

3. *Over the last 5 years has the data warehouse architecture changed and how?*

The data warehouse has remained the same over the last 5 years.

4. *Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?*

All users have been provided with the same front-end tools to access the data warehouse. It provides them to create their own custom queries.

5. *What in your opinion are your users key requirements now?*

The key requirements of the users now is a faster and easier to use data warehouse.

6. *How involved are you in corporate strategy decisions?*

The data warehouse product manager is moderately involved in corporate strategic decisions. The upper management involves them in task forces dealing with new initiatives to improve current processes and to improve advisor relationships.

7. *Over the last 5 years what are the major changes that have taken place in your organization's business plan?*

There have been no major changes that have taken place in the organizations business plans over the last 5 years.

8. *How is the integration of business and data warehouse planning process achieved?*

The integration of business and data warehouse planning process is achieved through the product managers who are involved on both sides.

9. *How is the data integrated from different systems across the organization?*

Integration of data from different systems across the organization is lacking. They want to build reporting services and web services into other applications. As of now, asset and production data is pulled into the data warehouse after cleaning. Data in the warehouse is 2 days behind.

10. *How is the data warehouse architecture integrated into existing IT systems' architecture?*

The data warehouse architecture is not integrated into the existing IT infrastructure. It is stand alone and pulls information from other places. The data warehouse is interfaces to other IT systems through portal applications. A page in the regular application interface is linked to the data warehouse.

11. How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

The data warehouse is evaluated both through user feedbacks and through monitoring by the development team.

12. In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?

The data warehouse is flexible to accommodate small changes in business needs. But it is not easy to accommodate something larger like an asset category change. Such major changes involve a massive amount of data, changes to the data table structure and a ripple effect that is much larger.

13. Do the database, application middleware and front-end tools have high scalability?

The data warehouse database, application middleware and front-end tools have high scalability.

14. Do the database, application middleware and front-end tools have high availability?

The data warehouse database, application middleware and front-end tools have high availability.

15. From your experience, what are the problems you have encountered in the data warehouse project?

The problem most often encountered is managing user expectation. It is set too high.

16. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

The data warehouse manager would like to improve the performance of the data warehouse. The front-end analytical tool- Proclarity is slow in response and could be made faster. For branches located in remote locations, the performance is affected due to lower speed. The issue of ease of use of the warehouse also needs to be addressed.

17. In your opinion, what factors are responsible for the data warehouse success?

The factors identified that are responsible for the success of the warehouse are the business buy-in to build and fund the data warehouse development. The business managers and business leaders played the major role in marketing this product to the user. They introduced and discussed the data warehouse at company conferences. The CEO has also promoted it.

Data Warehouse Manager 2

- 1. How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?***

The data warehouse architecture was selected using Kimball's approach. Three data marts were formed for Assets, Revenues and Accounting. Microsoft Consulting architected it.

- 2. Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?***

The Data warehouse project initiated 2 years ago and went live a year ago. Since its gone live, The plans have been scaled back. There is also less focus on its use across the firm by adding additional subject areas. There was more focus on the initial roll out of one piece – the business analyzer.

Since then several users have requested the VP to analyse institutional data. The VPs are waiting for the business to come to them, though they had voiced there needs to the data warehouse team. The data warehouse team is gathering requests and presenting their case to the senior management in strategy and technical planning meetings with the CIO. There is a need for resources to incorporate the user requests. Even though the data warehouse has taken a turn for the worse, the data warehouse team does realize the need for more.

- 3. Over the last 5 years has the data warehouse architecture changed and how?***

The data warehouse architecture has not changed over the past years.

4. *Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?*

The users have to use the front-end tool given to them. It's a desk-end tool which is more powerful for ad-hoc query of the cubes of data. The next item on the agenda is to initiate relational reporting underlying the data warehouse and utilize reporting services.

5. *What in your opinion are your users key requirements now?*

The key user requirements now are

- performance of the data warehouse - The users want better performance in the speed of the analytical tool Proclarity in drilling down the information.
- usability of the data warehouse – For example, the users need training on how to use the powerful tools to explore the different attributes of the accounts datamart. As of now they were used to receiving the data via reports. The amount of data that they now have to delve into to retrieve the information and the complexity of it, is overwhelming to the users. The data warehouse team is trying to change the attitude of the users to analyzing the data versus just reporting.
- reconciling the data warehouse data against existing systems and addressing the format of the data - adding more detailed extracts of the data.

6. *How involved are you in corporate strategy decisions?*

There has been a shift in the corporate strategy decisions. The corporate goal now is to acquire Financial Advisor and the assets under their management. There is a focus on technology as being a differing factor for recruiting Financial Advisors aboard. The data warehouse is being used as a strategic as well as a competitive tool.

7. *Over the last 5 years what are the major changes that have taken place in your organization's business plan?*

Within IT there have been changes that have taken place. There have been efforts to improve processes and new software development methods have been rolled out. An analyses of buy versus build is ensuing and there is focus on 3rd party products.

8. *How is the integration of business and data warehouse planning process achieved?*

The integration of business and data warehouse planning is a slow process. At present the data warehouse is not tied strategically to the business plans. The filtering down of business plans through the management layers is slow. To address this issue, product manager group was created to better integrate business and IT planning.

9. *How is the data integrated from different systems across the organization?*

The integration of data from different systems across the organization is as always, an issue. As data changes in other systems, the data warehouse team tries to accommodate these changes. Team meetings are held to communicate and keep abreast of these changes. Changes are notified in such meetings and target dates are set to align with their implementation dates, to keep the systems in sync.

10. *How is the data warehouse architecture integrated into existing IT systems' architecture?*

The data warehouse architecture is closely tied into existing IT systems architecture. Raymond James is a Microsoft shop and the data warehouse's sequel server is a Microsoft solution. The data warehouse has been designed as an enterprise wide warehouse, so that any it is available to all. It is also integrated into the mainframe system by replicating the mainframe data into sequential environment. It keeps up with changes in the mainframe.

11. How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)

The performance of the data warehouse is evaluated by (a) how long it takes to load the system, (b) its OLAP processing speed and (c) by the user's drill down analyzing capabilities.

12. In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?

The data warehouse is currently not flexible to accommodate new business needs and changes due to resource constraints. But the existing data warehouse architecture can be added on fairly uneventfully.

13. Do the database, application middleware and front-end tools have high scalability?

Yes, as the data warehouse has a Web front end and a large 64 bit server, it has high scalability.

14. Do the database, application middleware and front-end tools have high availability?

Yes, the data warehouse has high availability during the day. It is unavailable from 8pm to 7 am when the batch processing is executed to upload into the warehouse.

15. From your experience, what are the problems you have encountered in the data warehouse project?

One of the major problems being encountered is managing user expectations. Many users confuse it with a reporting system. Since the data warehouse is built as an analytical tool, it is a poor reporting system. The data warehouse was not designed for reporting data even though it started to replace monthly reports. Recognising that the users are not always

looking at the data warehouse as an analytical tool, steps are being taken to incorporate standard pre-defined reports at the next stage.

Another concern for the data warehouse managers is changing the attitude of the users from reporting to analytical mind-set. There is a misconception among the users on what the data warehouse can do. The users should use it for the right reasons and not use it for everything. There are other systems at Raymond James that provide reports and information from corporate data bases.

17. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

Improvements the data warehouse manager would like to see are more infrastructure around relational reporting and see the data warehouse expand beyond its initial scope of retail data into areas like human resources.

18. In your opinion, what factors are responsible for the data warehouse success?

A large proportion of the financial advisors use the data warehouse for analytical purposes. Training sessions are available to educate the users on what a data warehouse is, what it can give you and how to use the business analyzer. Training and question answer sessions are also available on-line to the users.

Data warehouse Manager 3

- 1. How was the data warehouse architecture selected (enterprise-wide DW, data mart, other)?***

There were business requests from the financial advisors and from retail for data on assets and revenue, historical and statistical data. There was no place to analyse all this data together. So an enterprise wide data warehouse was selected to allow financial advisors to see all aspects of the business.

- 2. Over the last 5 years what major changes have taken place in the data warehouse plans and strategies?***

The data warehouse project goal was to structure in one system, all the information for the financial advisors and the management. It has three major subject areas – assets, revenue and account statistics. The project scope was a joint effort between the business users and IT. There is a wish list to expand the subject area list to cover expenses, RJ banks, heritage RJ, RJ Canada and so on. Data mining does not figure on the wish list yet.

- 3. Over the last 5 years has the data warehouse architecture changed and how?***

The data warehouse architecture has not changed over the past years.

- 4. Do users have to comply with the tools and outputs you give or do you choose tools to get the output that users want?***

The users have access to the data warehouse through a front end custom application. It contains some preformatted reports. Pro clarity is the tool provided for analysis to the users.

5. *What in your opinion are your users key requirements now?*

The users want greater access to the data warehouse. Initial access were limited by the security requirements, to those who have secured access to VPN or frame relay. They also want new subject areas added to the data warehouse.

6. *How involved are you in corporate strategy decisions?*

The data warehouse decision was made at the CIO and VP levels. The CIO was involved in initiating and selling the data warehouse to the business. The senior product manager works with the business manager and involves the CIO at higher level decisions.

7. *Over the last 5 years what are the major changes that have taken place in your organization's business plan?*

There have been talks of data warehouse applications in marketing and compliance, performance reporting, workflow and contact management..

8. *How is the integration of business and data warehouse planning process achieved?*

A new layer has been added to the management structure. The product manager has been brought in to facilitate the integration of business and data warehouse planning. This would leave more time for the data warehouse manager to concentrate on development work. In the first two years the data warehouse was aligned to the business. Now, there have been changes to the business strategy and business demands. The data warehouse's speed of change to meet these demands and changes in direction has not been able to keep up, due to resource constraints.

9. *How is the data integrated from different systems across the organization?*

The data warehouse is fed from core CSS. It is a source of records for accounts, customers, demographic and product type information. The data warehouse is also sourced from data maintained in the company from 20 different databases. The data is available till previous close of day in the data warehouse. There is a staging data base where the data is cleaned up and transformed before loading into the data marts.

10. *How is the data warehouse architecture integrated into existing IT systems' architecture?*

The data warehouse architecture is closely tied into existing IT systems architecture.

11. *How is the performance of the data warehouse evaluated? (Does your evaluation primarily depend on feedback by users?)*

We get analysis from key users within the company and the key financial advisors. Speed is a problem right now. More user training is also required as the system is not user friendly.

12. *In your opinion, how flexible is the data warehouse to accommodate new business needs or changes?*

There have been requests from project management to add more data and more fields. 95% of the requests have been accommodated in the data warehouse. The rest will be taken care of in the next release. The focus is more on enhancing the reports and enhancing the Dashboard, not on subject areas.

The data warehouse is flexible to add new dimensions. We added changes to structure recently, changes to dimension and added new levels of hierarchy.

13. Do the database, application middleware and front-end tools have high scalability?

Yes, it has high scalability. The data warehouse is built on HP Superdome with 12 processors, 48 GB memory and 64 bit server.

14. Do the database, application middleware and front-end tools have high availability?

Yes, they have high availability.

15. From your experience, what are the problems you have encountered in the data warehouse project?

One challenge we faced was to convert the user mindset from reporting to analysis. It was a challenge getting their hands around multi dimensional data. They have been provided with training. At the home office training was held department wise.

Also the data warehouse team has felt resource constraints. The user interface is now through the product manager so that the data warehouse team can concentrate on developing.

18. Given an option, what are the things you would like to improve or change in the data warehouse? What need would these changes fulfill?

We need more people on the development team. We need to add more subject areas to the data warehouse. The current three subject areas are the core. It will always be useful. For example, we should provide all the customer and stock data, and let the financial advisors see all customer assets, business manager see all financial advisor data.

There is no real analytical tool on the relational side. The current tool is not very conducive to custom query. This could be improved.

19. In your opinion, what factors are responsible for the data warehouse success?

The initiation of the project by the CIO and its high visibility among senior management is one of the reasons for its success. Also there had been requests coming in over years, for a place where data on assets, revenue and accounts could be seen together. The data warehouse provides this integrated data to the financial advisors and upper management for analysis of performance factors and business planning.

User 1

1. Were you involved in the data warehouse project and how did you participate?

She is one of the top user of the data warehouse at RJ according to Scott Friedas , the Product manager.

She herself is surprised at being called the top user. She started using the system recently from July 2005 and was not involved in any way in the development of the data warehouse.

2. How well does the data warehouse support your needs?

She feels that the data warehouse supports her needs very well. She finds all the information she is looking for 9 out of 1. times. Sometimes for a particular item, she calls the data warehouse team members, and they respond to her needs shortly. Sometimes she knows the information is there in the data warehouse , but does not know how to extract it. She is not familiar enough with all the functions to use to get the data she needs.

3. How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?

There is no formal procedure established to convey user needs to the DW team. Generally, the user communicates to the data warehouse team over the phone or via email. As there are no dedicated resources at the DW team to address user needs, the user directly gives specifics to the development team members, who then walk the user through the system.

4. *How does the data warehouse respond to a change in business need?*

The data warehouse responds fairly quickly to a change in business need. Once the need is communicated to the data warehouse team, the development team makes the changes relatively fast.

5. *Does the data warehouse provide accurate information?*

Reports drawn from the data warehouse sometimes do not appear to be accurate. This is for several reasons for this. The data warehouse reports sometimes contain more information or data than similar reports made from other sources and so the disparity in the figures. There are discrepancies in the reports which may not be necessarily problems with the data warehouse. It may be because of the way the data was sourced into the data warehouse.

But it does cause a problem and involves legwork to explain the differences in the reports. A minute difference in detail between two similar reports can often translate to huge differences in dollar figures. A small change can have significant impacts, and so definitely becomes a problem at times.

6. *Does the data warehouse provide consistent and reliable information?*

The system provides consistent data. But it is a new system containing information on only certain products. The data in the data warehouse goes back to only beginning of 2005. So sometimes one has to doublecheck with data from other systems, to get a more complete picture.

7. *Does the data warehouse provide timely information?*

The data warehouse provides timely data. Data is updated on a nightly basis, daily.

8. *Is the data warehouse easy to use*

The data warehouse is not easy to use. There are many options available, that the user has not yet touched upon. The user finds it very highly technical. One has to know how and what to do, to use it. There are no user manuals to refer to. There is also no intuitive way to do it.

9. *Does the data warehouse enable day-to-day-decisions?*

The data warehouse is not used for day- to – day decisions. It is used on a monthly basis for analysis and decisions based on such analysis.

10. *Is the data warehouse functions and technical features easy to understand?*

The data warehouse functions and technical features are not easy to understand. The user views it as a learning experience and hopes to get used to the new system. For any requirement which is tailored or customized to their needs, they rely on inhouse data warehouse teams help to create the queries or reports.

11. *Was the user training adequate to carry out your functions?*

The user training felt adequate. The training is very basic. A need is felt for more directed training to their own needs from the data warehouse. At present such training or help is available from the data warehouse team on an individual level.

12. *Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?*

The response from the current team is good. But there are too few members on the data warehouse team, to meet all user needs effectively. User wants to see more more people added to the data warehouse team to support the data warehouse in the company, as the users (financial advisors in the field) find the data warehouse too technical to use on their own.

13. In your opinion, what factors are responsible for the data warehouse success

The data warehouse is viewed as a success because it integrates data from across different systems in the company. This was the main purpose for its existence. It has provided the financial advisors with greater analytical powers, which it did not possess before. They can do greater what-if analysis and analyse factors important to them. The data warehouse has helped the Financial Advisors in their decisions and reports.

14. What difficulties have you faced with the data warehouse?

The greatest difficulty they face with the data warehouse is its speed. It is slow. When data is pulled from from many different dimensions to form a query, the resulting data set is so large that the system gets bogged down. The system crashes 25% of the time, resulting in lost time and rework. Getting information from the data warehouse is time consuming and slow.

Besides speed, the other difficulty faced by the users is knowing which cube the information they are looking for lies in and how to extract it. They find the data warehouse to be complex and lacking a user's guide. The user interface needs improvement.

Thirdly, the data warehouse team is battling from a time management perspective as well as from lack of human resources. The data warehouse team also needs to communicate with other IT divisions that affects the data warehouse, for consistency. The user feels there is a need for more effective communication and knowledge sharing among the various IT divisions, so that when a new piece of information is introduced in one system, it gets incorporated in the rest.

User 2

1. *Were you involved in the data warehouse project and how did you participate?*

The user was involved in the data warehouse project in defining the user specification.

2. *How well does the data warehouse support your needs?*

Supports user needs adequately, but it can do better.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

Communicates with the data warehouse team via email if needed.

4. *How does the data warehouse respond to a change in business need?*

Certain areas in the data warehouse respond well to change in business needs, others don't.

5. *Does the data warehouse provide accurate information?*

The data warehouse mostly contains accurate data. Its complete accuracy is sometimes questionable as it has discrepancies with data from other older systems. This may be because the data warehouse has more aggregate and summarized data. Once given the source of the data, the discrepancies are sorted out.

6. *Does the data warehouse provide consistent and reliable information?*

The data is mostly consistent and reliable. But there are times when one has to cross check the data. The user is not completely confident of the data from the business analyzer.

7. *Does the data warehouse provide timely information?*

The user feels providing timely information is an area of opportunity for the data warehouse. The data is not as close of business yesterday, but of the day before. The data is therefore 2 days old. The user would like to see it as close of business yesterday. One can physically get the data from elsewhere but have to wait a day to get it from the data warehouse. It therefore affects the efficiency of the user.

8. *Is the data warehouse easy to use*

The user finds the warehouse useful, but it could be more intuitive. But he would like additional ways to slice the data. As of present, data can be sliced by region, but a combination of regions is not possible.

9. *Does the data warehouse enable day-to-day-decisions?*

The data warehouse enables weekly or monthly decisions. It's not used on a day to day basis.

10. *Is the data warehouse functions and technical features easy to understand?*

The data warehouse functions and technical features are easy to understand.

11. *Was the user training adequate to carry out your functions?*

The user training was adequate.

12. *Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?*

The data warehouse team is skilled to solve the user problems, but their response could be faster

13. In your opinion, what factors are responsible for the data warehouse success

The data warehouse should be faster. It is not easy to pull information. To generate their reports, the user has to manually create a list and after running it, has to manually add things. The user has to extract information from the data warehouse, and then use that to build his reports. Certain analysis are not automated well in the data warehouse, for example analyzing by division, by assets for independent employees. The user could see more advantages if the data warehouse integrated the data for independent employees. The data warehouse needs to be integrated with other It applications, like accounting. There are resource issues with the data warehouse.

User 3

1. *Were you involved in the data warehouse project and how did you participate?*

No. But have been involved in testing reports that come out of the data warehouse. To see if the outcome of the report looks alright, does the data seem what it should be. Have participated as a user for over 18 months.

2. *How well does the data warehouse support your needs?*

Not greatly, just used for monthly reports.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

There are no formal communication channels. The data warehouse team communicates to us by email and vice versa. At times there are ad hoc meetings. When necessary, we talk to the data warehouse team members over phone.

4. *How does the data warehouse respond to a change in business need?*

The response could take anywhere from a day to 2 weeks, depending on where you are on the queue and what requests are on the line.

5. *Does the data warehouse provide accurate information?*

Yes, it provides accurate information.

6. *Does the data warehouse provide consistent and reliable information?*

Sometimes it has to be checked to see if the parameters were put in correctly, be it canned reports or my own.

7. *Does the data warehouse provide timely information?*

The information required is there in the data warehouse, but I can't always get it in the way how I need it. It takes longer to manipulate the data. Sometimes I need a report in 2 hrs, but I won't be able to do it till next day on the data warehouse.

8. *Is the data warehouse easy to use*

No. It is not intuitive to build reports that you need. Financial Advisors in the fields may have different perspectives. We can build queries easily on other systems, but not the data warehouse. I would use it more often, if not so difficult to use.

9. *Does the data warehouse enable day-to-day-decisions?*

If one can get the information, it can be used for day-to-day decisions. But I can't use it as much as I would like to, and I have to get the information from other systems. Since in a particular report there are 3,400 financial advisor records, it gets locked up when running the report. For example, to get all financial advisor's production and asset figures, I have to do the production and assets separately and then combine it.

10. *Is the data warehouse functions and technical features easy to understand?*

It is not easy. I am familiar with the functions but it is not easy.

11. *Was the user training adequate to carry out your functions?*

The user training was inadequate. There was an overview of what the data warehouse can do for 2 hours and some canned reports were shown. They did not actually show how the data warehouse works or how to build your own reports.

12. Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

The data warehouse team is skilled but not well staffed. Probably there are only 4 people on it now. They do not have enough resources. Their response is not quick because there are not enough people on the team.

13. In your opinion, what factors are responsible for the data warehouse success

It is not a success yet. From what I can gather, I don't think the data warehouse is yet complete. It was much touted and talked about. It came out before enough of the bugs were worked out. It often hangs up while running. The back office uses it, but its not well designed for us, so it is frustrating. The expectation before it came out was it would be for the corporate, but was really for the financial advisors. I am as a corporate user, disappointed.

User 4

1. *Were you involved in the data warehouse project and how did you participate?*

I was not involved in the development of the data warehouse. I am involved as a user of the data warehouse.

2. *How well does the data warehouse support your needs?*

The data warehouse supports my needs. Its better than what we had before. Before we had limited ability to collect, integrate and analyse data. But the interface is not easy to use. It is not intuitive. Even though it has a fancy user interface design, finding data is difficult.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

The communication with the data warehouse team is informal. When we need something specific, they write special queries for it.

4. *How does the data warehouse respond to a change in business need?*

When there is a change in business need, the data warehouse team is getting the event data. The data warehouse makes the data more accessible and making it relevant to user needs.

5. *Does the data warehouse provide accurate information?*

The data is hard to get to in the data warehouse. Whether the information is accurate or not, it depends. For example, we pull one set of numbers, and found out the data does not look right. There is some inclusion in the query string and we had to figure it out, find it out and had to question the data. The data you get may not be what you wanted.

6. *Does the data warehouse provide consistent and reliable information?*

It is consistent, but so complicated to use, that the queries may be different for finding similar information.

7. *Does the data warehouse provide timely information?*

Yes.

8. *Is the data warehouse easy to use*

Its not easy to use. To write the logic of how you sort the data is not simple.

9. *Does the data warehouse enable day-to-day-decisions?*

Not really. We use it foe weekly and monthly reports. We use it for querying and for looking at historical data.

10. *Is the data warehouse functions and technical features easy to understand?*

It is not easy to navigate.

11. *Was the user training adequate to carry out your functions?*

Did not have very much user training.

12. *Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?*

Yes, the data warehouse team is very skilled to manage the data warehouse. But their response is slow.

13. *In your opinion, what factors are responsible for the data warehouse success*

It is not a total success. Training for the users is required. Parts of it is difficult to navigate. The logic and to find the data is challenging. They could use more people on the data warehouse team. They could provide a basic training package to help people learn how to use it.

Other comments by user

People think it is important to address customer needs and identify support within the company. The data warehouse can be used for this.

The Chairman and CEO don't use the data warehouse daily. But they are aware of the benefits of the data warehouse to the organization. The data that is presented to them, the presentations come out of the data warehouse.

User 5

1. *Were you involved in the data warehouse project and how did you participate?*

I was not involved in the development of the data warehouse. I was involved in the training area of the data warehouse, but not extensively. Involved in how do you propose to train people.

2. *How well does the data warehouse support your needs?*

The data warehouse supports some of the users needs. In production, it is somewhat misleading and not accurate. In assets it provides just the snapshots of today. It provides the client demographics and ratings. The data in the warehouse is summarized by time. There are no aggregates. There is no unique identifier. It does not go down to account number level. One can't see what revenue a household generated. We meet for 1 hour with the data warehouse developers every week to alleviate user problems.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

We meet face to face with the data warehouse developers for an hour every Tuesday. That is the main way to communicate with them. The users communicate through the training team to the development team. In this forum, the user issues are communicated to the data warehouse team, but there s no resolution. It is a compounding list that is communicated.

The users are supposed to communicate directly to the product manager, but they communicate to the business analyzers on the data warehouse team directly. The business analyst then communicates to the product manager who makes his decision on resources and puts out the product time line. But this is not communicated back to the users, there is no feedback to the user. There is a lack of communication which could be improved.

We also have focus groups in national conferences which serve as a channel for communication.

4. *How does the data warehouse respond to a change in business need?*

The data warehouse hasn't yet responded to any changes in business need. If it had to, the data warehouse would be unresponsive. It would take up to 7-8 months, based on other priorities. The data integrity needs to be addressed first.

5. *Does the data warehouse provide accurate information?*

Yes, but not necessarily the way user wants to see it. There have been inaccuracies in the new accounts system. There have been discrepancies in the business analyzer and other systems. This has led to a potential issue. When in the first thing the user has problems, they won't go back to the system after that.

6. *Does the data warehouse provide consistent and reliable information?*

The information available is consistent. But reliability is not always there. Certain areas like new accounts, is not reliable. Assets are reliable.

7. Does the data warehouse provide timely information?

Yes, fairly timely. The canned reports are timely. The data in the warehouse is a day behind. Sometimes, the manipulation of data to satisfy some queries take time.

8. Is the data warehouse easy to use

No, it is not easy to use. For the sales men, the financial advisors, finding data is time consuming. It is not easy to use by any means..

9. Does the data warehouse enable day-to-day-decisions?

No. It is used for business planning.

10. Is the data warehouse functions and technical features easy to understand?

No. The software doesn't lend to much flexibility.

11. Was the user training adequate to carry out your functions?

No, there is an e-learning course. There is a wide variety of things that you can do with the data warehouse. It is so uncommon, the user can not understand what you just did. Lots of hand holding is required. A background in a data base tool seems necessary, as the application does not tell you what to do. The users need a manual. They do not want to read 20 pages to get to what they need. It is a big commitment for something that's not so valuable. So the users default to systems that are easier to navigate, easier to manage, for their information needs.

12. Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?

Yes, the data warehouse team is very skilled. They dropped some people. They make a very good effort to solve technical problems. Some things take a time to get fixed. They are very short handed. They get a lot of phone calls on using the business analyzer. There will be 7 user classes in February '06, 40 people per class will do the training. There will be 3 overviews and 4 actual training sessions. The team wants to make sure that the data is accurate before the users are involved.

13. *In your opinion, what factors are responsible for the data warehouse success*

The integration of data is responsible for its success. The usability needs to be user friendly. Training is the No.1 thing required to be successful. Not many people want to spend 1 1/2 to 2 hours on applications that will be used once in a quarter. Inaccuracies in one area keeps people from using other areas.

Production issue in household area is the main issue now. Most of the queries are account driven. The business analyzer pulls all the data together. It is more high level view, looking down. It is not account specific. Also the data warehouse is not linked to other systems.

There is a difference between analyzing and reporting. The users want a reporting tool. The people wanted to embrace this tool. They found the idea of the data warehouse appealing. The resistance came when you are baffled on opening it.

One way to address this could be taking users who have success with the data warehouse and using them in advertising and training others. The users need to be informed of actually using and making decisions based on the data warehouse. Not just giving the data to the users, but to show how to use the bunch of numbers that you get from the data warehouse.

There is no meta data available. The questions on data integrity could be addressed by it.

Another fact is that the original designers of the data warehouse have moved to other positions in the company and are not available now. So they can't address the problems as well. The data warehouse has a lot of potential, but the issues need to be sorted out.

User 6

1. *Were you involved in the data warehouse project and how did you participate?*

I was not involved during the development of the data warehouse. I am involved only as a user.

2. *How well does the data warehouse support your needs?*

Not well. The way it is now, the front-end is designed to extract the data. It is at an individual level. One financial advisor being able to see his assets. When one wants to see at a corporate level, it has to pull up volumes of data. The data warehouse is not set up for that. One can find the data. But the way they house the data, in the data warehouse, it is not easy. Information needs to be integrated with external files, spreadsheets etc. The data warehouse needs to merge information together.

As the data warehouse information has no unique identifier, it can't take two files and merge them easily. For example, the name field that identifies the financial advisor, is put in lastname,firstname,suffix in one file and another way in another file. There is no continuous format to the records. One has to pull data into Access and run through queries to put it into some semblance to use it. Another example is the branch number that identifies the location around the nation. The field has the branch number along with the location. It needs to be truncated, to match with other files. It is a tedious process. Where it should take minutes, it takes hours and days. It is very frustrating. There is a need to clean up the files.

The data warehouse does fine with the canned reports. But to use the information from the data warehouse to create executive reporting, information has to be pulled from various sources into the report. This beats the purpose of having a warehouse.

The platform of data warehouse has all the information needed. The data warehouse too pulls it from the same sources. But they did not involve the people who use the data to design the data warehouse. The data warehouse is to provide competitive advantage. The users need the data in it. They are thrilled to know that the data is there, but they cannot use it readily.

3. *How are your needs communicated to the data warehouse team and vice versa? What are the formal communication channels between you and data warehouse team?*

We used to directly go to the data warehouse team. But now we communicate through the learning specialist. We had committees initially and communicated through email group and intranet test sites. That was for moving forward to prepare for the first implementation of the data warehouse.

4. *How does the data warehouse respond to a change in business need?*

Not well. Data warehouse and senior IT managers consider the data warehouse to be a simple and great product, but that is not the case when you use it. It's not as easy. The management has spent a lot of time and money and do not want to agree to this view.

5. *Does the data warehouse provide accurate information?*

Overall, yes. In some areas like production, for some piece of information, some records don't make their way to the data warehouse. They are not drawing data from the right source for this piece of information.

6. *Does the data warehouse provide consistent and reliable information?*

The information available is consistent. Information is there on a monthly basis.

7. *Does the data warehouse provide timely information?*

Yes, in a fairly timely fashion.

8. *Is the data warehouse easy to use*

No, it is not easy to use for the wide spectrum of users. We need to export the data into Excel to make it usable. For example, the financial advisor number by which trade is done, is alphanumeric. Excel has to convert it into a formula if the last letter is DE. The financial advisor's number has to be manually cleaned up to use it. It is frustrating.

The data warehouse is difficult to use for day to day decisions. It cannot pull up all the information at the same time. For example, to see all the records for a division in the data warehouse, the query has to be broken up into 4 different regions, to pull all the records. The data warehouse will not pull all the records at the same time.

Again, if the data warehouse is given a query that it can not accommodate, it keeps on going for ever. It does not come back with a message that it cannot do it. The user gets tired of waiting. One cannot even do a CTRL BREAK to break out of the query. The

application has to be closed and it eventually hangs the PC. The data warehouse query can't tell upfront or after x number of minutes if it is still running. There are no prompts to warn the user. The user can't verify if the query is running or should one break out of it.

9. *Does the data warehouse enable day-to-day-decisions?*

The data warehouse primarily enables executive reporting on a monthly basis. It is also used to pull data from the data warehouse for other people. They compile and extract information from it to provide clean data for management projections.

10. *Is the data warehouse functions and technical features easy to understand?*

The data warehouse takes getting used to. It is easier to maneuver around once one learns to use it.

11. *Was the user training adequate to carry out your functions?*

There was 2 days of training for the desktop version and the web browser, which was adequate. A book for reference on Proclarity was also given. We were not told about how the data warehouse was designed and how data was stored in it

12. *Is the data warehouse project team highly skilled to manage and solve technical problems? How good is the response of the data warehouse team to your needs?*

The data warehouse supervisor is very competent. He heads the data warehouse team and has helped resolve problems. When he is absent, one has to wait days for the problem to be tackled. The learning specialist is a good support person as well.

13. *In your opinion, what factors are responsible for the data warehouse success*

The data warehouse has been a success to the degree that data is in one central location that everyone can pull from. Prior to the data warehouse, everyone used their own set of data to build reports. The data warehouse contains all the historical data. Eventually everyone will use the same data records and that would be good.

The data warehouse is used to compare production numbers from fiscal year to year or assets from year to year or how different sections of the business has changed from year to year. It is used for corporate analysis (for eg. Given a set of factors, how is the business keeping up) and corporate decision making (eg. How many credits to give a financial advisor to send him to a conference).

The data warehouse was primarily developed for the financial advisors. It still has a way to go to fit into the home office as an adequate tool to use. There have been overwhelming requests coming in for access to be granted to the data warehouse. As some views are in a restricted table, requests have come in to set up replicated views. If the replicated views are set up, it could take care of three quarters of the requests to the data warehouse. There has also been requests to access the raw data contained in the data warehouse.

APPENDIX 4 QUESTIONNAIRE DATA

This appendix contains the raw questionnaire data from all the participants in the case study conducted at Nielsen Media Research and Raymond James Financial.

NIELSEN MEDIA RESEARCH CASE STUDY

Questionnaire to be completed by senior business managers.

Please circle the appropriate rating for each question

	Strongly Agree	4	3	2	1	Strongly Disagree
1. The data warehouse strongly supports the business plans	5	4	3	2	1	
2. The data warehouse drives business decision	5	4	3	2	1	
3. Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1	
4. Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1	
7. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1	
8. Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1	
9. There are established communication channels to facilitate better understanding	5	4	3	2	1	
10. The data warehouse team is aware of the business plans and strategies	5	4	3	2	1	
11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1	
13. The data warehouse is successful .	5	4	3	2	1	

Questionnaire to be completed by senior business managers.

Please circle the appropriate rating for each question

	Strongly Agree	4	3	2	Strongly Disagree
1. The data warehouse strongly supports the business plans	5	4	3	2	1
2. The data warehouse drives business decision	5	4	3	2	1
3. Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1
4. Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1
7. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
(BU) 8. Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1
9. There are established communication channels to facilitate better understanding	5	4	3	2	1
10. The data warehouse team is aware of the business plans and strategies	5	4	3	2	1
11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13. The data warehouse is successful .	5	4	3	2	1

Questionnaire to be completed by senior managers familiar with the business strategy of the organization.

	Strongly Agree	4	3	2	Strongly Disagree
1. The data warehouse strongly supports the business plans	5	4	3	2	1
2. The data warehouse drives business decision	5	4	3	2	1
3. Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1
4. Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1
7. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
8. Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1
9. There are established communication channels to facilitate better understanding	5	4	3	2	1
10. The data warehouse team is aware of the business plans and strategies	5	4	3	2	1
11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13. The data warehouse is successful .	5	4	3	2	1

Questionnaire to be completed by business users of the data warehouse.

Please circle the appropriate rating for each question.

	Highly satisfied				Highly Dissatisfied	
1. User's participation in the data warehouse project.	5	4	3	2	1	
2. Communication of users needs to the data warehouse team.	5	4	3	2	1	
3. Communication by the data warehouse team to the users	5	4	3	2	1	
4. Data warehouse response to change in business needs.	5	4	3	2	1	
5. Accuracy of data warehouse information.	5	4	3	2	1	
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1	
7. Timeliness of data warehouse information.	5	4	3	2	1	
8. Ease of use of the data warehouse.	5	4	3	2	1	
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1	
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1	
11. Adequacy of user training.	5	4	3	2	1	N/A
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1	
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1	

Questionnaire to be completed by business users of the data warehouse.

Please circle the appropriate rating for each question.

	Highly satisfied				Highly Dissatisfied
1. User's participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

Questionnaire to be completed by data warehouse managers

	Strongly Agree					Strongly Disagree
1. Data warehouse managers are aware of the corporate strategies.	5	4	3	2	1	
2. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1	
3. Data warehouse plans support the business plans and strategies.	5	4	3	2	1	
4. Business decisions are the driver for the data warehouse design.	5	4	3	2	1	
5. Business and data warehouse planning processes are integrated.	5	4	3	2	1	
6. Business visions are the drivers for data warehouse architecture.	5	4	3	2	1	
7. Data is integrated from different systems across the organization.	5	4	3	2	1	
8. The data warehouse architecture is integrated into existing IT systems' architecture.	5	4	3	2	1	
9. The data warehouse technology was evaluated after the decision to build it.	5	4	3	2	1	
10. The data warehouse is highly responsive to a change in business needs.	5	4	3	2	1	
11. The database, application middleware and front-end tools have scalability.	5	4	3	2	1	
12. The database, application middleware and front-end tools have high availability.	5	4	3	2	1	
14. The data warehouse is successful	5	4	3	2	1	

Questionnaire to be completed by data warehouse managers

Please circle the appropriate rating for each question.

	Strongly Agree				Strongly Disagree
1. Data warehouse managers are aware of the corporate strategies.	5	4	3	2	1
2. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
3. Data warehouse plans support the business plans and strategies.	5	4	3	2	1
4. Business decisions are the driver for the data warehouse design.	5	4	3	2	1
5. Business and data warehouse planning processes are integrated.	5	4	3	2	1
6. Business visions are the drivers for data warehouse architecture.	5	4	3	2	1
7. Data is integrated from different systems across the organization.	5	4	3	2	1
8. The data warehouse architecture is integrated into existing IT systems' architecture.	5	4	3	2	1
9. The data warehouse technology was evaluated after the decision to build it.	5	4	3	2	1
10. The data warehouse is highly responsive to a change in business needs.	5	4	3	2	1
11. The database, application middleware and front-end tools have scalability.	5	4	3	2	1
12. The database, application middleware and front-end tools have high availability.	5	4	3	2	1
14. The data warehouse is successful	5	4	3	2	1

Questionnaire to be completed by data warehouse managers

Please circle the appropriate rating for each question.

	Strongly Agree	4	3	2	Strongly Disagree
1. Data warehouse managers are aware of the corporate strategies.	5	4	3	2	1
2. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
3. Data warehouse plans support the business plans and strategies.	5	4	3	2	1
4. Business decisions are the driver for the data warehouse design.	5	4	3	2	1
5. Business and data warehouse planning processes are integrated.	5	4	3	2	1
6. Business visions are the drivers for data warehouse architecture.	5	4	3	2	1
7. Data is integrated from different systems across the organization.	5	4	3	2	1
8. The data warehouse architecture is integrated into existing IT systems' architecture.	5	4	3	2	1
9. The data warehouse technology was evaluated after the decision to build it.	5	4	3	2	1
10. The data warehouse is highly responsive to a change in business needs.	5	4	3	2	1
11. The database, application middleware and front-end tools have scalability.	5	4	3	2	1
12. The database, application middleware and front-end tools have high availability.	5	4	3	2	1
14. The data warehouse is successful	5	4	3	2	1

Questionnaire to be completed by senior business managers.

Please circle the appropriate rating for each question

	Strongly Agree	4	3	2	Strongly Disagree
1. The data warehouse strongly supports the business plans	5	4	3	2	1
2. The data warehouse drives business decision	5	4	3	2	1
3. Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1
4. Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1
7. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
8. Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1
9. There are established communication channels to facilitate better understanding	5	4	3	2	1
10. The data warehouse team is aware of the business plans and strategies	5	4	3	2	1
11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13. The data warehouse is successful .	5	4	3	2	1

Questionnaire to be completed by business users of the data warehouse.

Please circle the appropriate rating for each question.

	Highly satisfied				Highly Dissatisfied
1. User's participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training. <i>N/A</i>	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

RAYMOND JAMES FINANCIAL CASE STUDY

Questionnaire to be completed by business users who use the data warehouse.

	Highly satisfied				Highly Dissatisfied
1. Users participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

Questionnaire to be completed by business users of the data warehouse.

Please circle the appropriate rating for each question.

	Highly satisfied				Highly Dissatisfied
1. User's participation in the data warehouse project.	5	4	3	(2)	1
2. Communication of users needs to the data warehouse team.	5	(4)	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	(2)	1
4. Data warehouse response to change in business needs.	5	4	3	2	(1)
5. Accuracy of data warehouse information.	5	4	(3)	2	1
6. Consistency and reliability of the data warehouse information.	5	4	(3)	2	1
7. Timeliness of data warehouse information.	5	4	3	(2)	1
8. Ease of use of the data warehouse.	5	4	3	2	(1)
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	(2)	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	(2)	1
11. Adequacy of user training.	5	4	3	(2)	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	(3)	2	1
13. Level of satisfaction with the data warehouse success.	5	4	(3)	2	1

Questionnaire to be completed by business users who use the data warehouse.

	Highly satisfied				Highly Dissatisfied
1. Users participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

Questionnaire to be completed by business users who use the data warehouse.

	Highly satisfied				Highly Dissatisfied
1. Users participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

Questionnaire to be completed by business users who use the data warehouse.

	Highly satisfied				Highly Dissatisfied
1. Users participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day- decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

Questionnaire to be completed by business users who use the data warehouse.

	Highly satisfied				Highly Dissatisfied
1. Users participation in the data warehouse project.	5	4	3	2	1
2. Communication of users needs to the data warehouse team.	5	4	3	2	1
3. Communication by the data warehouse team to the users	5	4	3	2	1
4. Data warehouse response to change in business needs.	5	4	3	2	1
5. Accuracy of data warehouse information.	5	4	3	2	1
6. Consistency and reliability of the data warehouse information.	5	4	3	2	1
7. Timeliness of data warehouse information.	5	4	3	2	1
8. Ease of use of the data warehouse.	5	4	3	2	1
9. Relevance of the data warehouse information to day-to-day-decisions.	5	4	3	2	1
10. Users' understanding of the data warehouse functions and features.	5	4	3	2	1
11. Adequacy of user training.	5	4	3	2	1
12. The data warehouse project team's skill to manage and solve technical problems, response of the data warehouse team	5	4	3	2	1
13. Level of satisfaction with the data warehouse success.	5	4	3	2	1

Questionnaire to be completed by senior managers familiar with the business strategy of the organization.

	Strongly Agree				Strongly Disagree
1. The data warehouse strongly supports the business plans	5	4	3	2	1
2. The data warehouse drives business decision	5	4	3	2	1
3. Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1
4. Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1
7. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
8. Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1
9. There are established communication channels to facilitate better understanding	5	4	3	2	1
10. The data warehouse team is aware of the business plans and strategies	5	4	3	2	1
11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13. The data warehouse is successful .	5	4	3	2	1

Questionnaire to be completed by senior managers familiar with the business strategy of the organization.

		Strongly Agree				Strongly Disagree
1.	The data warehouse strongly supports the business plans	5	4	3	2	1
2.	The data warehouse drives business decision	5	4	3	2	1
3.	Senior management has a high level of commitment to the data warehouse project.	5	4	3	2	1
4.	Business managers are highly involved in the data warehouse investment decisions..	5	4	3	2	1
7.	Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
8.	Cross-functional teams are highly active in the data warehouse project	5	4	3	2	1
9.	There are established communication channels to facilitate better understanding	5	4	3	2	1
10.	The data warehouse team is aware of the business plans and strategies	5	4	3	2	1
11.	The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13.	The data warehouse is successful .	5	4	3	2	1

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1. The data warehouse strongly supports the business plans	5	4	3	2	1
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11. The data warehouse is responsive to a change in business needs.	5	4	3	2	1
13. The data warehouse is successful .	5	4	3	2	1

Questionnaire to be completed by data warehouse managers

	Strongly Agree				Strongly Disagree
1. Data warehouse managers are aware of the corporate strategies.	5	4	3	2	1
2. Data warehouse managers are highly involved in corporate strategy	5	4	3	2	1
3. Data warehouse plans support the business plans and strategies.	5	4	3	2	1
4. Business decisions are the driver for the data warehouse design.	5	4	3	2	1
5. Business and data warehouse planning processes are integrated.	5	4	3	2	1
6. Business visions are the drivers for data warehouse architecture.	5	4	3	2	1
7. Data is integrated from different systems across the organization.	5	4	3	2	1
8. The data warehouse architecture is integrated into existing IT systems' architecture.	5	4	3	2	1
9. The data warehouse technology was evaluated after the decision to build it.	5	4	3	2	1
10. The data warehouse is highly responsive to a change in business needs.	5	4	3	2	1
11. The database, application middleware and front-end tools have scalability.	5	4	3	2	1
12. The database, application middleware and front-end tools have high availability.	5	4	3	2	1
14. The data warehouse is successful	5	4	3	2	1

Questionnaire to be completed by data warehouse managers

		Strongly Agree				Strongly Disagree
1.	Data warehouse managers are aware of the corporate strategies.	5	4	3	2	1
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14.	The data warehouse is successful	5	4	3	2	1