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Enterprise Integration Modeling Linking Enterprise Integration Architecture With Business Strategy Planning

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Enterprise Integration Modeling: Linking Enterprise Integration Architecture With Business Strategy Planning

By

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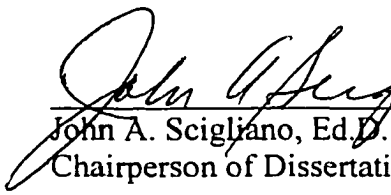
A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Graduate School of Computer and Information Sciences
Nova Southeastern University

2002

We herby certify that this dissertation submitted by Easton B. Rhodd, conforms to acceptable standards, and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.



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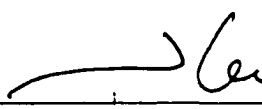

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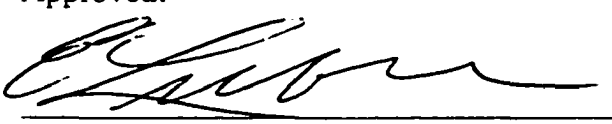

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An Abstract of a Dissertation Submitted to Nova Southeastern University
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The goals for this study were twofold. The first goal was to identify planning variables for linking both organizational and architectural objectives for developing enterprise integration architecture. The second goal was to validate enterprise integration modeling methodology as a viable planning tool for the design, development, and maintenance of the enterprise integration architecture.

This lack of linkage at the intellectual dimension level can be characterized as having a dysfunctional effect on enterprise integration strategy formulation and infrastructure development. There is a disjoint between adoption of appropriate information technology in relation to organizational objectives. This includes misapplication of investments in information technology selection and business systems development portfolio, failed information systems projects, architectures that do not support the strategic direction, and the organization's inability to manage change associated with environmental imperatives that impact the firm's ability to define information technology and systems requirements for competitive positioning.

In order to achieve the objectives the author in this research, developed a conceptual Enterprise Integration Architecture Planning Model and Methodology (EIAPM/M) model as the basis for linking enterprise integration architecture objectives and organizational objectives. Research data confirmed the need to effect linkages between organizational objectives and architectural objectives to achieve enterprise integration and validated enterprise integration modeling as the means by which enterprise integration architecture is developed.

Acknowledgements

To my Mother Beatrice Rhodd who instilled in me how
to persevere and never stop learning.

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Ideas grow from interactions with many fine individuals we meet during our daily travels. One individual to whom I am grateful is Dr. Peter Aikin, professor at the Virginia Commonwealth University and friend for seeding the idea for my dissertation project. My thanks go out to associates Emery Hite, John Fmacisconi and Vivian Brown who was kind enough to read many chapter revisions and provided valuable feedback that enhanced this research. Without this resource, the results of this project would not have met the objectives outlined in the dissertation.

My wife Dorothy along with my three daughters Colleen, Simone and Lesley-Ann are truly wonderful individuals. Throughout this journey, they collectively and individually, shared in some of my most challenging moments and in their own way, lifted my confidence and spirits thus keeping me on track. Their understanding, kindness, and continual support is unparallel; providing humor when needed, offering perspectives not considered, and dispelling any notion of quitting still resound even after reaching this final place. To them I say you earned this prize.

I must also express my sincere gratitude to my Dad, who many times over the course of this project counseled me on the virtue of patience. It is not uncommon to want to rush when your environment is ever changing at a rate you cannot comprehend. His perspectives having forged over time and have seen many changes, helped me to understand that there will be some events I cannot control and time must have its role in the outcome. I am also honored to have had my brothers, Keith and Victor, read, critique, and challenge me along the way. Their comments and suggestions were invaluable.

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Chapter 1

Introduction

Goal

The goal of the researcher in this study was to design a planning model and methodology to help solve the problem of the lack of linkages between enterprise integration architecture objectives and organizational objectives. This was accomplished by identifying the relevant planning variables for linking these objectives and incorporating enterprise integration modeling methodology as a planning tool for effective enterprise integration management.

Once such determination was made, linkage affects were explored by asking the question: If there are changes in the organizational objectives, to what extent do these changes effect a change in the enterprise integration architecture? This type of analysis requires a set of analytical tools with which to assess linkage transformation between these mutually exclusive processes. This tool represents a profile of planning variables to guide the enterprise architect during architecture planning and development project.

Strategy formulation and strategic actions are enacted through a series of goals and objectives that form the basis for measuring an organization's strategic alignment (Zviran, 1990). Strategies represent deliberate managerial decisions and actions for directing organizational process changes to respond to internal and external business drivers, and define performance measures with which to assess and evaluate business

strategy alignment with information technology artifacts implemented to support the enterprise mission.

An essential output from any well thought out information systems planning effort is a set of information systems policies, principles, and standards that guide the diffusion and infusion of information technology for strategy support. These planning statements are further distilled into a set information systems objectives that are aligned with organizational objectives (Zviran, 1990) and subsequently define the contents of enterprise integration architecture (Bernus, Nemes and Williams, 1996a; TOGAF, 1998).

The enterprise integration architecture defines the policies and guidelines that govern the arrangements of information technology tools and data (Cash, Eccles, Nohria and Nolan, 1994). It is the method used to identify sufficient human resources capabilities, define business models, and capture business rules (procedures) during information systems development process (Bernus, Nemes and Williams, 1996a). The architecture therefore is a plan that ensures effective decisions about information technology investments and use, and corresponds with corporate strategy and internal capabilities (Cash et al, 1994).

With the advent of complex information and communication technological innovations, connections between the information systems planning process and enterprise integration architecture development continues to be an essential issue among information systems executives (Barncheau and Janz, 1996). This is so because of the increased attention by business strategists leveraging the potential benefits of information technology for competitive advantage. This blueprint guides information technology

alignment with business strategy and information systems objectives and therefore ensuring that information technology investments support business strategies.

Contemporary research literature however provided no evidence (except anecdotal) that information technology infrastructure as implemented supported organizational objectives (Henderson and Venkatraman, 1991; Rosser, 1996; Reich and Benbasat, 1996; Joint Information Systems Committee [JISC], 1996). The literature is silent on what constitutes linkages between organizational objectives and enterprise integration architecture objectives, although such linkage is inferred in both practice-oriented and research-oriented literature (Petrie, 1992; Hsu, 1996; Bernus, Nemes and Williams, 1996a).

This apparent gap in the alignment literature was the motivation for conducting this investigation to determine if there are any relationships between organizational objective and enterprise integration architectural objectives. No direct mention was made in the enterprise integration architecture literature about the necessity to link these two sets of objectives. In addition, none of the known information systems planning methodologies provided any insights regarding linkage factors for architectural support of business strategy.

The literature on the other hand provided support for enterprise integration, modeling enterprise processes and activities, and development of enterprise integration architecture to manage information systems life-cycle planning (Bemelman and Jarvis, 1996; Bernus and Nemes, 1996b; Bernus and Nemes, 1996c; Bernus, Nemes and Williams, 1996a; Bernus and Nemes, no date; Fraser, 1994; GERAM, 1998; Gonzales and Molina, 1997). Because there were no public linkage models or planning frameworks

that addressed this type of alignment a conceptual model is required for enterprise integration architecture planning linkage.

Problem Statement

The problem investigated in this study was the lack of linkages in organizations between enterprise integration architecture objectives and organizational objectives, and the dysfunctional effect this lack of linkage variables could have on enterprise integration planning and strategy development, and architectural completeness. Lederer and Sethi (1996) in recognizing this failure characterized the effects of this failure in organizations as a disjoint between information technology and organizational strategy. Additional troubles included potential misapplication of information technology investments, failed information systems projects, architectures that do not support the business strategic direction, and the organization's inability to manage environmental imperatives.

Zachman (private communication, February 17, 1998) in looking at the impact of not linking strategy and architecture stated that the objective of information systems planning methodologies was primarily to identify a set of systems (i.e. a strategy) and not to build the architecture. He also observed that the people (organizations) who were not successful were the ones who never figured out that the underlying problem was semantic discontinuity and that the solution was enterprise integration. This statement by the "Father of architecture planning" attests to the need for architectural objective linkage with organizational objectives when enterprise integration is the strategic intent of the enterprise.

The literature is rich with planning frameworks and methodologies that address issues of alignment. Weston, delaHostra, Kosanke and Noxon (1997) noted the absence

of a common understanding of business, social, and technical problem perspectives relating to business opportunities specifications and development of enterprise systems. They also observed that investments in IT is discouraged by a lack of linkage between architectural objectives and organizational objectives since enterprise planners cannot justify the business benefits associated with enterprise integration architecture.

Information systems entities in response to business drivers have implemented autonomous and isolated information technology infrastructure. This has been done without knowledge of the extent to which alignment between business goals and information systems operation can support business strategies. Investments in new information technologies and systems that integrate with other information systems could then be difficult to cost justify and may prove costly and ineffective in the future (Weston et al, 1997).

Traditional planning methods used by several information systems organizations focused on cost benefit analysis during conception, design, and develop, and efficiency cost management during the operations phase. Measuring the effectiveness of information technology solutions implemented in concert with business strategy has been a major concern and can be correlated to information systems executives concerns regarding alignment of the business and information systems plan (Brancheau, Janz and Whiterbe, 1996).

Enterprise integration architecture is concerned with integrating information technology infrastructure and systems with business processes for strategic reasons and the lifecycle operations of the enterprise in response to evolving business models. This allows corporate planners to exploit information technologies for organizational

transformation and competitive advantage. Enterprise integration is a purposeful strategic action as companies focus on redesigning business processes that encompass the entire chain of value adding activities. In this a context, enterprise integration captures and describes processes, strategies, organizational structures, resources, goals, and constraints of the enterprise (Bernus, Nemes, and Williams, 1996a).

Effective strategic business engineering depends on an organization's ability to accurately analyze and methodically evaluate business opportunities, internal competencies, business processes, organizational structure, information use, and technology drivers (Whitman and Gibson, 1996). These business drivers were operationalized in this research as "environmental imperatives."

To design an enterprise and manage enterprise life-cycle issues, (Bernus and Nemes (1996b) recommend the following principles: the fundamental principles of architecture design; methodologies based on these principles; supporting tools for designing, building, and maintaining enterprise integration architecture. These principles facilitate the capturing of functions, descriptions, or behaviors of types of systems and their associated structures or frameworks provides (a) the right information at the right time, (b) the right information in the right place, (c) updated information in real time to reflect the actual state of the enterprise operation, (Kosanke, 1997).

Enterprise integration architecture forms the basis for the development of a device, system, or project for carrying out an information integration program for an enterprise (Bernus and Nemes, 1996b; Hsu, 1996). Information integration (Hsu, 1996; JISC, 1996) in this instance is not just a technology solution but instead represents an organizational strategy. It is therefore necessary to link objectives flowing from the

strategy process (Reich and Benbasat, 1996; Zviran, 1990) to the underlying architectural structures (TOGAF, 1998) that will implement both organizational and technical capabilities (Zachman, private communication, February 17, 1998).

The concept of linkage extends the potential for information technology to ensure competitive capabilities (Davenport and Short, 1990; Henderson and Venkatraman, 1991). Current information systems planning methodologies that address alignment between information technology (systems) objectives and organizational objectives deal with functional integration that is narrow in its definition.

Organizations use of traditional planning methods may not realize IT potential for strategic information systems development. Information systems strategy decisions focus on architectural descriptive properties for business applications, data requirements, and hardware configurations, primarily for satisfying the internal enterprise needs (Henderson and Venkatraman, 1991). The integration of physical system components (systems integration) and business application (enterprise application integration) marginally meets overarching business integration strategy (enterprise integration).

Strategic fit (Henderson and Venkatraman, 1991) between an enterprise's business strategy and information technology (systems) strategy is a desirable management action (Goodman and Lawless, 1994) and is supported by studies in information processing theory (Bothamley, 1993). This theory provides the strategic orientation for alignment theories and for understanding relationships between information systems and business strategy (Mirchandani, 1997). Information theory implies that there is a fit between information processing requirements of a business strategy and that the information

processing capabilities provided by information technology structure is in alignment (Bothamley, 1993).

There are many information technologies (systems) planning approaches prescribed in the literature. Several planning models and methodologies reflect mixed results in their ability to describe the nature and factors for achieving alignment between information technology (systems) objectives and organizational objective (Walsh, 1992). Henderson and Venkatraman (1991) proposed a strategic alignment model as an alternative to traditional functional linkage models for information technology planning. His model requires an integrated strategic management process.

Burn's (1996) longitudinal study of alignment between business strategies and information systems strategies identified two streams of research that has emerged from the literature: Strategic studies that focus on competitive analysis and market environment and other external concerns, and organizational studies that emphasize internal concerns such as organizational design, human resource systems, and culture. Using Henderson and Venkatraman (1991) strategic model, Burn (1996) examined the external-internal alignment relationships of both information systems and business strategies for strategic integration and concluded that a strategic alignment model exists at the functional level (internal alignment) and a dynamic model of change at the strategic level (external alignment).

Alignment theories (internal and external) although representing an integrative model, focuses primarily on contingency strategic factors within a linkage framework that seeks to co-align an organization's environmental opportunities and constraints during strategy formulation. Organizations in an effort to remain competitive are

employing supply chain relationships that require a strategic management planning process that goes beyond co-alignment, thus pursuing enterprise integration goals to overcome issues resulting from "island of automation", "island of information", and "island of solution" (Goranson, 1992; Vernadat, 1996) commonly found in organizations.

Enterprise integration is a strategic method for developing an integrative business strategy. Information technology (systems) is a pivotal component of this (Hollocks, Goranson, Shorter and Vernadat, 1997). The introduction of information technology (systems) into the strategy development process is a departure from the traditional functional approach to information systems planning. This moves information systems planning from the realms of "reactive" linkage with organizational objectives to a state in which information technology (systems) is embraced as one of the many business drivers in defining competitive positioning and the development of an enterprise integration architecture to support organizational objectives.

Enterprise integration architecture is the product of business information systems planning activity following full integration planning transformation (Teo, 1994). It is through this architecture, information systems objectives are manifested by the definition of a set of architectural objective from which architectural components are designed, developed, and maintained from a life-cycle perspective. Many researchers on the subject of alignment continue to stress the importance of aligning business strategy with systems objectives (Henderson and Venkatraman, 1991; Teo, 1994; Reich and Benbasat, 1996). This position is supported by empirical data in the literature although, as noted previously, with mixed results. Interestingly however, there is the lack of empirical data

to support the need for enterprise integration architecture or insights into linkage between business strategy and the architecture.

Dissertation objective

In this study, this researcher explored intellectual dimensional factors based on Reich and Benbasat (1996) linkage construct between organizational objectives (Zviran, 1990) and enterprise integration architecture objectives for strategic alignment (Woolfe, 1993). These variables represent a planning profile of specific enterprise integration architecture objectives in accordance with the organizational objectives (Zviran, 1990). The objective was to identify a set of planning variables for strategic alignment with enterprise integration architecture and provide the basis for developing enterprise systems models that support horizontal and vertical integration strategies is the primary use of this profile.

To achieve this level of integrative planning, an Enterprise Integration Architecture Planning Model and Methodology was developed to facilitate linkages between organizational objectives and the enterprise integration architecture. This planning model relies on enterprise integration modeling methodologies as a planning tool (Whitman and Gibson, 1996) along with adapting Reich and Benbasat (1996) conceptual model for studying linkages between organizational objectives and information system planning objective factors.

This proposed architectural planning model is a tool that describes a family of related architectures, allowing individual architecture to be created by selection from and modification of the model components. The model describes an information system made up from a set of conceptual building blocks, and shows how the building blocks fit

together. Alignment between information systems [or technology] plans [or planning] is paramount in the organizational context, thus there are several methodologies and planning frameworks that are available in the public domain for the development and implementation of enterprise integration strategy across the enterprise. These approaches however do not directly address the linkages between architectural objectives and organizational objectives.

Linkage framework

This study is about linkages. Reich and Benbasat (1996) documented several studies that focused on identification of and the explanatory nature for linkages between information technology and or systems planning with that of business strategy planning and or the strategy itself.

Table 1 Linkage Construct

Dimension of linkage	Potential Factors Influencing Linkage (Causes)	Linkage (effects)
Intellectual Dimension	**I.** The methodologies for formulation of IT and business mission, objectives and plans and the comprehensives of the planning activities.	**II.** The degree to which the set of IT and business mission, objectives, and plans are internally consistent and externally valid.
Social Dimension	**III.** Choice of actors, timing, decision-making, and communication used in the formulation of mission, objectives, and plans for IT and business.	**IV.** The level of understanding to the business and IT mission, objectives, and plans by IS and business executives.

Source: Reich and Benbasat (1996). Measuring the linkages between Business and Information Technology Objectives. MIS Quarterly, 20 (1), pp. 55-81.

Reich and Benbasat (1996) stated that in the planning domain, there are two dimensions in which linkages occur (Table 1): Intellectual dimension is defined as the content of the information technology and business plans (strategy) are internally consistent and externally valid. Social dimension on the other hand as a construct relates to the communicative aspects of planning and is defined as the information systems and business executives understanding of each other's objectives and plans. These authors developed a research framework for studying linkage (Table 1) to guide their study and it was used by this researcher as the basis for furthering objectives in this study.

Reich and Benbasat (1996) focused their investigation on social dimensional factors relative to business and systems objective linkages but suggested that the model can be applied to other studies focusing on strategy causal factors. This researcher's framework for studying linkage in following the creators' suggestion was applied to business strategy linkage with enterprise integration architecture but focused on organizational and architectural objective aspect of the planning process.

An extensive literature review did not uncover empirical support for strategy - architecture linkage although information technology practitioners believe in the benefits of having an architecture that reflects corporate strategy (Rosser, 1996). In recognizing the important role strategic management plays in defining enterprise integration architecture, the IFIP-IFAC task force incorporation of GERAM [Generalized Enterprise Reference Architecture and Methodology] version 1.6.2 into ISO WD 1570 (*Requirements for Enterprise-Reference Architectures and Methodologies*) standard as a point of reference for enterprise integration architecture planning, development, implementation and maintenance. This standard effort will firmly place architectural

methodologies in a framework by which future architectures will be measured on an objective basis.

GERAM (1998) represents a global effort to standardize a set of reference architectural concepts and methodologies to guide the development and ongoing management of enterprise integration architecture for enterprise integration and modeling efforts. Researchers of public and proprietary architectures have suggested that understanding business strategy is critical for architectural planning (Spewak and Hill, 1992; TOGAF, 1997). However, they have approached this analysis in a superficial way rather than as an entity type (GERAM, 1998) within their respective frameworks and/or methodologies.

In the GERAM (1998) model, a strategic management entity type defined the need for architectural linkage and is the starting point of any enterprise engineering effort. This methodology establish strategy management linkage to the architecture but failed however to demonstrate how such linkage can be achieved and the cause and effect relationships between the two sets of activities. This apparent failure in the model highlighted the need to determine linkage variables to be used to model the enterprise integration architecture for achieving strategy-architecture alignment.

Research questions

The following research questions were derived from this dissertation objective and the linkage framework (Table 1) discussed previously.

1. What are the factors for linking organizational objectives with enterprise integration architecture objectives to achieve enterprise integration?

2. To achieve enterprise integration, how are the factors used in the planning model for linking business strategy with enterprise integration architecture?
3. How do these factors relate to enterprise integration modeling?

A survey instrument for collecting data to answer research questions was developed and piloted among a team of subject matter experts. This instrument contained questions in three broad categories: (1) General background data questions about the responding survey participant; (2) Questions directly related to research questions 1-3 used to perform empirical analysis to answer these questions and (3) Items that trapped data about the survey respondent's planning process. Following is a table (Table 2) detailing a crosswalk between the research questions and items in the survey instrument.

Table 2 Category/Research questions crosswalk to survey items

Category	**Research Questions**	**Survey Questions (Appendix)**
General Background Data	No direct research question.	1, 2, 3 & 4
Research Questions	1. What are the factors for linking organizational objectives with enterprise integration architecture objectives to achieve enterprise integration?	5, 6, 7 & 8
	2. To achieve enterprise integration, how are the factors used in the planning model for linking business strategy with enterprise integration architecture?	5, 6, 8, & 9
	3. How do these factors relate to enterprise integration modeling?	14, 15, 16, 17 & 18
Planning Process	No direct research question. However, unlike item 14 which had a direct relationship to research question 3, item 12 was used as an independent variable to evaluate organizational participation development of enterprise integration architecture.	10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 & 21

Study Context and State of the Art

Nunamaker and Briggs (1996) observed from several studies relating to information and communications technology (ICT), the fundamental change computers have on organizations and society. As organizations continue to deploy information and communications technologies, organizations will structure themselves into different forms of business models and connect business partners in ways never before thought possible thus fostering customer relationships that ensure a greater degree of competitive positioning.

Grover and Goslar (1993) in providing an assessment of information technology impact in the 1990s, concluded that "the impact of information technology (IT) in the 1990s and beyond will be significant" thus "efficient and effective IT will be critical for meeting the challenges of an organization's future prosperity" (p 1). Information technology researchers' interest in phenomenon such as information systems concepts, structures, models and, architectures (ISO/TC184/SC5WG1, 1998) continue to evolve as internal and external dynamics change the landscape of both the underlying technologies, innovations and management strategies for integrating information technologies into the corporate planning framework. There are two broad planning dimensions emerging form the strategy planning literature: (1) business strategy and (2) information technology strategy. Information technology strategy and planning can be further classified into socio-technical and technical approaches (Kling, 1999).

Several empirical studies exist in both domains but socio-technical research has been getting a lot of attention in the literature since information technology is vital for competitive advantage, therefore it has strategic importance for organizations in

achieving enterprise vision (Kling, 1999). Information technologies are socio-technical systems consisting of complex interdependent system comprised of (1) people in various roles and relationships with each other and with other system elements, (2) hardware (computer mainframe, workstations, peripherals, telecom equipment), (3) software (operating systems, utilities and application programs, techniques, management services models, data schema), (4) support services (training, support, help), (5) information structures (contents and contents providers, rules, norms, regulations such as those that authorize people to use systems and information in specific ways, access controls) (Kling, 1999).

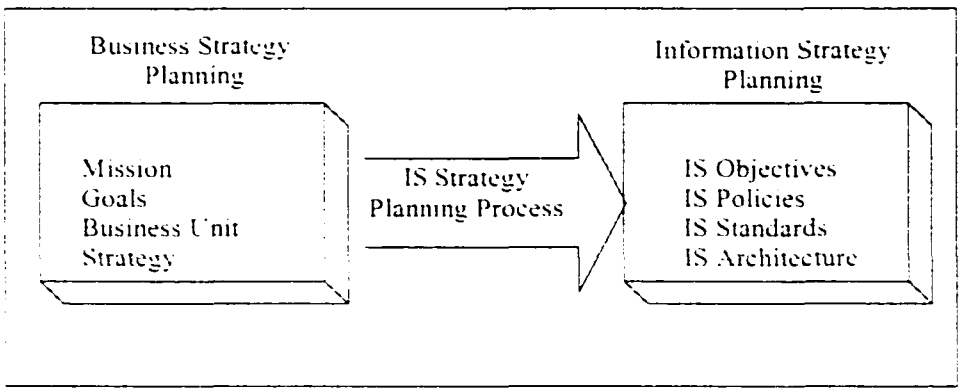
Many socio-technical studies focused on the alignment of information systems and technologies with planning methodology (fit, correspondence, or linkage) and business (organizational) strategy. This produced several frameworks and or planning methodologies that can facilitate different levels of integration between business strategy and information systems strategy (Segars, Grover and Teng, 1998). These studies however take a bottom up approach to information systems planning by focusing on the organization's data needs driven by information engineering methods to define the level of information systems implementation in response to corporate strategy (Walsh, 1992).

Organizations, in their quest to achieve competitive advantage (Q.E.D, 1989; Davenport and Short, 1990; Ageenko 1998), build highly effective organizational structures (King, 1995; Whitman and Gibson, 1996; Hay and Munoz, 1997), and design enterprise integration architectures that can ensure long term competencies, capabilities, and growth (Bernus and Nemes, 1996b). These organizations are exploring enterprise

integration management strategies to drive structural planning activities (Wang, 1997) that leverage information and communications technology innovations.

Enterprise integration architectural development results from performing enterprise engineering. This is a process that is enterprise model driven for achieving enterprise integration (ANSI/NEMA, 1994). It is usually done in concert with the information systems planning process to align the business strategy with the information technology infrastructure implementation (Henderson and Venkatraman, 1991; Pant and Hsu, 1995; King, 1995; Kayworth, Sambamurthy and Chatterjee, 1997; Hay and Munoz, 1997; Segars and Grover, 1998).

Alignment between information systems strategy and business strategy is acknowledged in the theoretical and practical oriented literature (Burn, 1996; Luftman, 1996; Rosser, 1996; Scannell, 1996; Labovitz and Rosansky, 1997; Mirchandani, 1997). Several important studies confirmed a need for alignment along with providing planning frameworks and or methodologies for directing alignment strategies (Burn, 1996; Eardely and Lewis et al., 1996; Reich and Benbasat, 1996; Hamilton, 1997; Mirchandani, 1997). Alignment moves an enterprise towards full integration in it's strategy formulation process (Teo, 1994), and generates a roadmap for achieving enterprise integration (Henderson and Venkatraman, 1991; Schroeder, Congden and Gopinath, 1995; Bemelman and Jarvis, 1996).



Source: Information systems planning guide. IBM guidebook GE20-0527-3

Figure 1 Traditional IS planning model

As enterprise decision makers devise information technology investment, both information systems and business strategy planners approach the planning exercise from one of the following perspectives: (1) impact drivers for competitive advantage purposes or (2) alignment drivers for implementing an information technology infrastructure in concert with business strategy (Burn, 1996). This type of planning is the traditional information systems planning strategy integration model (IBM, 1981). Figure 1 is a graphical representation of this approach as practiced by many information systems organizations.

This alignment approach is insular when making decisions about information systems strategy directions that seek to achieve enterprise integration. The model says nothing about linking business strategy with enterprise integration architecture in the strategy formulation process.

Henderson and Venkatraman (1991) questioned the relative value of the traditional information systems planning model to satisfy information technology-

business strategy links. Traditional planning approaches are reactive since this approach focuses on how to best deploy information systems to achieve organizational objectives (Zviran, 1990). To address what appears to be a separate planning activity from that of information technology strategy developed after formulating a set of business strategies, Henderson and Venkatraman (1991) proposed a Strategic Alignment Model (SAM) as a new and different direction for aligning information technology planning with business strategy. SAM represented a replacement of the traditional alignment concepts therefore fostering a highly integrated strategic management process.

Figure 2 is a graphical representation of SAM. SAM in the words of it creators, defines the range of strategic choices that could be addressed during the strategy management process.

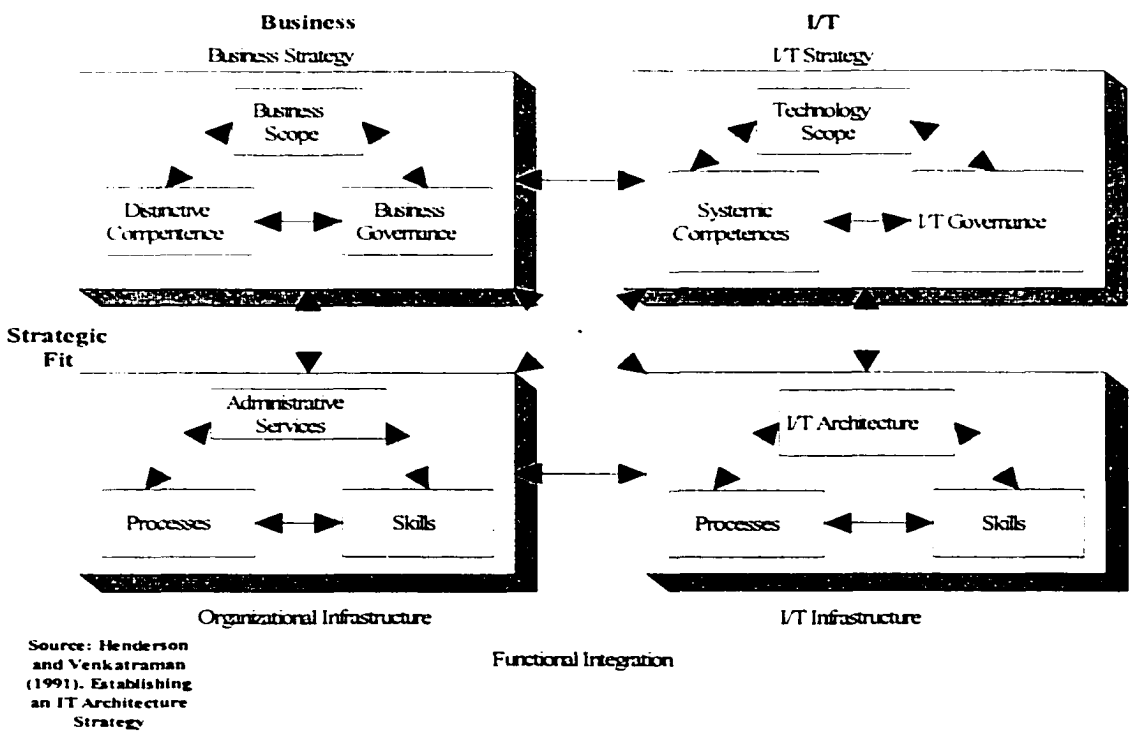


Figure 2 Strategic alignment model (SAM)

Organizations are always looking for ways to exploit opportunities. Information technologies are essential components when formulating corporate business strategy for competitive advantage and integration of intra and or inter enterprise processes. This model defines the range of strategic choices that have potential during the strategic management process (process by which this is done is not considered in this model); focus is on the content of the strategic plans.

Two dimensions were identified: Strategic fit is choices that both position the firm in the external market place as well as how best to structure internal arrangements of the firm to execute the positioning strategy -- this is the business strategy. Functional integration requires an external and market positioning perspectives as well as internal infrastructure perspectives. In using the model, four perspectives emerges that consider relationships that include both strategic fit and functional integration: (1) Strategy execution, (2) Competitive potential, (3) Service level, and (4) Technology potential, each forming a triangulation. Selection of a technology planning methodology will determine which perspective management will pursue.

It was noted previously that information technology (systems) strategy methodologies comes in two dimensions (impact and alignment), each representing two distinct school of thought on how information systems strategy is formulated in relation to business strategy (Burn, 1996). Strategies falling into the impact dimension category focus on organizational objectives that ensure the firms competitive advantage. Alignment of information technology (systems) with business strategy continues to be of critical importance for information systems executives. Thus in the alignment model, information technology (systems) strategy formulation seeks to "fit" information

technology (systems) infrastructure with business goals. Both dimensions however address evolutionary stages in organizational growth (Teo, 1994).

Organizational evolution moves through stages of growth (Teo, 1994). Stage growth theories explain the manner in which integration of business planning with information technology (systems) planning is accomplished. Teo (1994) demonstrated that full integration could only be achieved by following a definite path starting with (a) administrative integration (b) sequential integration (c) reciprocal integration and (d) full integration. Achieving full integration is the first step for enterprise integration: enterprises having achieved this level of planning alignment, shift there focus to the integrative aspects of business process with that of information and communication technologies (Brancheau and Wetherbe, 1989; Das, Zahra and Warkentin, 1991; Woolfe, 1993; Bemelman and Jarvis, 1996; Butler, 1996; Wang, 1997; Zachman, 1998).

Extending alignment theories to incorporate enterprise integration architecture and the application of enterprise integration modeling for achieving linkages between organizational objectives and architectural objectives is the focus of this study. This extension will facilitate linkage between business strategy (organizational objectives) and enterprise integration architecture (architectural objectives) in the strategy formulation and planning process. The focus of this researcher was to analyze the nature of linkage that will link organizational objectives resulting from the integration of business strategy and enterprise integration goals, and enterprise integration architecture objectives resulting from the enterprise integration modeling activity.

Relevance and Significance

The integration of the enterprise from a business process and information systems perspective is fundamental to achieving competitive advantage, developing new products, managing change and reducing time to market impacts on products and services (Bloom, 1997). Enterprise integration architecture is a viable approach to achieving these and other strategic objectives as well as mitigating investment risks associated with the acquisition of information technology (Bernus, Nemes, and Williams, 1996a).

If enterprise integration is to be useful to the decision-maker, enterprise processes must be developed around models that are relevant to enterprise goals, operational environment, organizational structure and business models, along with predictive metrics that provide performance indicators for the decision maker to determine the effects of enterprise integration on business strategy (Working Group 1 [WGI], 1992; Working Group 2 [WGII], 1992; Working Group 3 [WGIII], 1992). Establishing empirical support for enterprise integration architecture-business strategy planning integration accomplishes acceptance of enterprise integration as a corporate strategy, confirms enterprise integration modeling as a valid planning tool for strategic business engineering and defines a linkage construct for enterprise integration architecture objectives and organizational objectives.

As companies extend their reach globally, it is critical that they form strategic alliances with partners that ensure their competitive advantage. These partners are distributed throughout the world and are using information base enterprise applications in their own environments.

Many are still operating at the systems integration level from an inter-organizational systems perspective. In such an instance, there is no strategic fit and functional integration, thus enterprise integration provides a solution to this problem (Bloom, 1997).

Bemelman and Jarvis (1996) argued that there is a disjoint between enterprise integration efforts and strategy formulation process before implementing changes resulting from enterprise integration, business process re-engineering (improvement), and other management actions in relation to corporate integrative strategy initiatives. They also noted that current reference architectures found in the enterprise integration and enterprise modeling literature does not directly address strategic planning processes or incorporate strategic planning. Additionally, these architectures do not demonstrate linkages with organizational objectives although architectural methodologies recognized the importance of linkage as a critical factor for achieving inter-enterprise and intra-enterprise integration.

Enterprise integration is a strategy (Vernadat, 1996). In this context business strategy formulation must be integrated with enterprise integration goals, enterprise models developed that incorporate integrated strategic actions, and translation of such actions into requirements for designing, building, and maintaining enterprise integration architecture.

There are two types of enterprise architectures commonly found in organizations that implement integrated information technology (systems) to support the organization strategies. Type I architecture focus on systems and application integration while type II architectures include type I elements in addition to business integration concerns, aspects

of people, information and technology resources, thus forming enterprise integration architecture (Bernus, Nemes, and Williams, 1996a).

Development of a linkage construct that identifies interrelationships between organizational objective and architectural objectives that support enterprise integration and modeling will extend Zviran's (1990) contingency model beyond correspondence between organizational and systems objectives. The extended model will include variables that link organizational and architectural objectives thus moving the planning dimensions beyond type I architecture to type II architecture.

Strategic role of enterprise integration

Figure 3 depicts the strategic role of enterprise integration in relation to business strategy formulation (Hollocks, Goranson, Shorter and Vernadat, 1997).

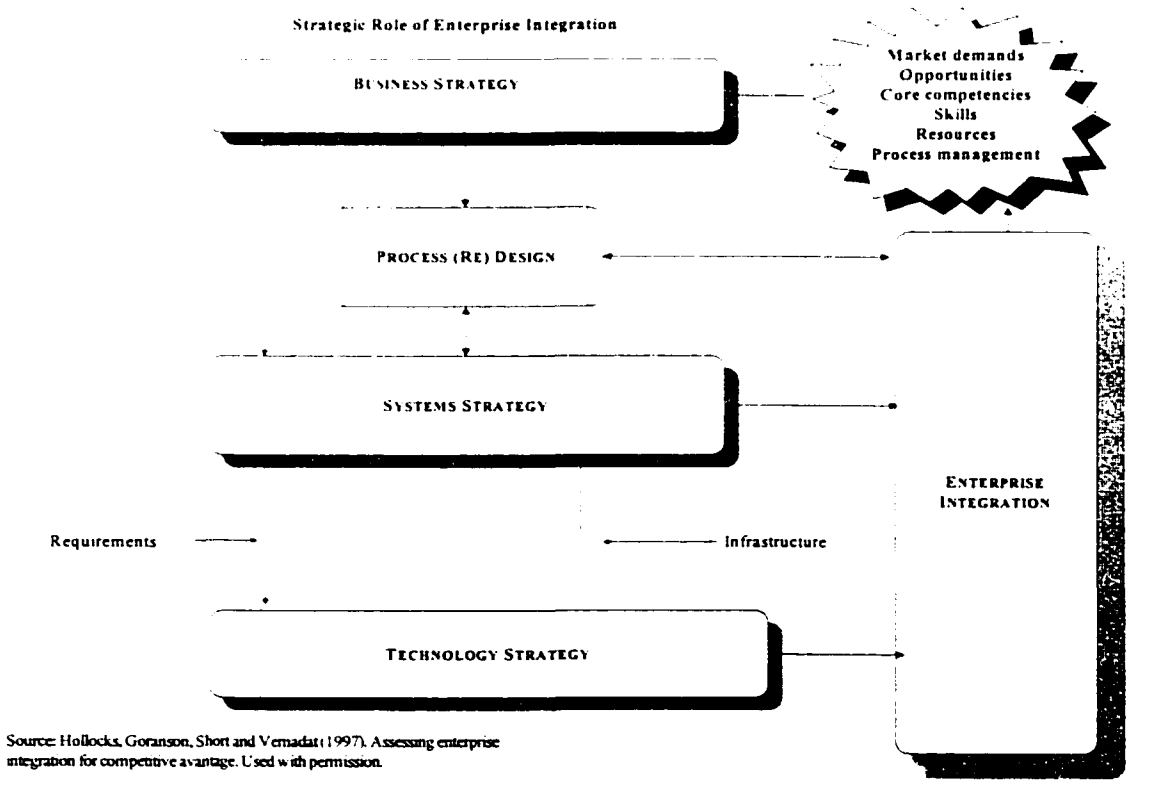


Figure 3 Strategic role of enterprise integration

This model also shows how process re-designs and information systems strategy aligns with technology strategy along with their relationships with infrastructure and requirements for information technology strategy development and is an effective assessment tool for enterprise integration strategic thinking. These authors believe that IS/IT strategy should relate to goals and strategy of an enterprise.

The model (Figure 3) accomplishes this by placing enterprise integration within the context of strategic planning and therefore a tool for focusing attention on opportunities for the business and IS/IT is a pivotal strategy formulation component (Hollocks et al., 1997 p. 98). Business strategy determination is the starting point for opportunity search, understanding market demands on the enterprise, specifying core competencies, and skills for implementing organizational objectives. Strategy is then developed using the appropriate, relevant framework or tools that in turn may inter-relate to the re-engineering of business process (Hollocks et al., 1997).

Information systems strategy, on the other hand, identifies requirements for information technology, i.e. how the system will be delivered. An added benefit accruing to the enterprise is the creation of an infrastructure that is both a facilitator and constraint on future systems and business development thus a repeating cycle of continuous review and improvement is integrated into enterprise operation processes (Hollocks et al., 1997).

Enterprise integration in this perspective is a corporate strategy rather than an activity that connect several computers for data integration (Petrie, 1992) thus achieving process intra- and inter-operability by optimizing any system consisting of people, machines and information in response to enterprise goals (Hollocks et al, 1997). Enterprise integration architecture captures the essence of enterprise integration

objectives. Enterprise integration modeling provides the methodology and tools with which to perform an enterprise analysis of the corporate vision, mission, strategy, and objective being pursued by corporate management (Whitman and Gibson, 1996).

Barriers and Issues

Enterprise integration architecture and modeling is an emerging field of study derived from theories for integrating manufacturing processes and the underlying computer systems that support end-to-end factory automation (Hsu, 1996; IMTR, 1999a; IMTR, 1999b). Published accounts of case studies and corporate research focused on computer-integrated-manufacturing (CIM) integration issues in isolation from that of the larger corporate integration objectives (Bernus, Nemes and Williams, 1996a).

As many corporations implement emerging technologies such as Internet and Intranet, distributed computer systems, and extend the reach of their corporate relationships to include supply chain partners, there is a need to integrate internal business functions horizontally while vertically integrating management levels for decision-making coordination and integration (Vernadat, 1996). These managerial strategies continue to receive intense research focus but results to date failed to articulate such thinking within a strategy - architecture linkage model.

Such thinking has not been formulated because solutions for enterprise integration is not well understood (Goranson, 1992; Kosanke, 1997). The state of the art claims to provide solutions for many of the requirements for enterprise integration while at the same time there are competing solutions to integrate aspects of the enterprise (Kosanke, 1997).

Petrie (1992) in exploring the enterprise integration problem space suggested that enterprise integration acceptance by corporate decision-makers as a business strategy, remains a challenge for the enterprise integration and enterprise integration modeling research community. Current enterprise integration architecture development approaches result in enterprise integration objectives becoming "islands of solution" (Goranson, 1992), and "islands of automation and information" (Vernadat, 1996) with no linkages to the larger corporate strategic management framework (Bemelmen and Jarvis, 1996).

Planning considerations for enterprise integration is generally approached from an information systems implementation perspective or as an information technology implementation activity at the operational level (Petrie, 1992). Enterprise integration objectives represent business strategies that "...encompass the entire chain of value adding activities" (Bernus, Nemes and Williams, 1996a, p.2) and therefore a critical element in the business strategy process.

Implementation of a full-scale integration project is a monumental task because of its multifaceted activities entailing several variables enterprise planning variables (Vernadat, 1996). Published accounts of business process re-engineering (BPR), computer-integrate-manufacturing (CIM), systems integration and systems re-engineering, while having some measure of success, have proven to be disappointing from an enterprise life-cycle perspective because of its incomplete treatment of the enterprise needs as a whole (ISOTC184, 1997).

Organizational change strategies such as BPR, CIM, and enterprise modeling recognized the importance of organizational objectives but failed to demonstrate linkages between the underlying enterprise integration architecture. It is possibly that no visible

investment payoff for pursuing integration goals would be achieved because of poor coordination with human resources capabilities, organizational change that are culturally problematic in it's implantation, and incorrect application of process improvement techniques (Weston, 1997).

Research efforts, while recognizing the importance of strategy prioritization within the enterprise integration framework, continues to focus attention on aspects relating to resolving conflicting solutions and terminology surrounding enterprise integration technical issues. Weston (1997) highlighted the need to link business drives and enterprise integration requirements but noted a disconnection between the conceptualization of business opportunities and the specification, realization and development of enterprise systems. Results so far reflected autonomous isolation of information technology systems and human resources organization structures that cannot provide dependable information about the alignment of business goals and systems operation, and investments in new systems and integration of systems is difficult to cost justify, thus may prove costly and ineffective (Weston, 1997).

There is no shortage of frameworks, tools, and methodologies for carrying out strategic planning including those that address information technology forecasting and information systems planning (Walsh, 1992). These methodologies however do not address enterprise integration directly as a corporate strategy, thus enterprise integration goals are not considered within the larger planning system nor is enterprise integration modeling contemplated at the business function level as a means for defining the enterprise life cycle. Efforts to develop enterprise integration modeling methods while espousing analysis and determination of business strategies as a precursor for

understanding integration links for achieving performance improvements, creation of an agile enterprise through business model and driving enterprise integration architecture design, development and maintenance, has it's set of issues as well (Goranson, 1992; Fox, 1996).

Research conducted by leading authorities in the field have produced promising results to solve the lack of precision in definitions that describe the state-of-the–art. To date, these efforts produced theories relating to modeling language and the development of modeling tools and techniques for analyzing business functions and information systems structures. In addition to theoretical studies, exploration of costs justification models and approaches, experimentation and field trials of various models representations and interpretations continue to add to the body of knowledge thus evolving the concept to a discipline status (Petrie, 1992; Goranson, 1992; Kosanke and Neil, 1997). The wealth of research data and application of theories to practice provided a rich knowledge base from which this researcher can advance a new direction in enterprise integration.

This study is a departure from classical approaches for information technology (systems) congruence with organizational objectives. This study use the term "linkage" as opposed to "alignment" since linkage connote a tight coupling between organizational objectives and the key output from an information systems strategy planning exercise, the enterprise integration architecture. Traditional approaches do not take an enterprise engineering approach that starts with enterprise integration modeling as the planning tool. Enterprise integration modeling was explored as an information technology (systems) planning approach since enterprise integration incorporates modeling methodology and

techniques for the design, development, and maintenance of the enterprise integration architecture.

Enterprise integration modeling concepts continue to evolve (Bernus and Nemes, 1996b). There are several methodologies and supporting modeling languages available to the modeling methodologist (Vernadat, 1996). Because of this diversity, commentators have called for standards (Shorter, 1997), ontology development (Fox and Gruninger, 1997), and formalized framework (Bernus and Nemes, 1997c). These research efforts however were directed to methodological issues and technical solutions and not aspects relating to linkages between organizational objectives and the enterprise integration architecture objectives. The consensus framework (GERAM, 1998) on the other hand, acknowledge the identification of business strategy elements in the enterprise engineering methodologies. The main issue with enterprise integration modeling is that methodologies fail to provide constructs for evaluating links between organizational objectives and enterprise integration architecture objectives. Organizations sought in the past to link organizational processes with overarching vision, mission, strategy and functional activities, a process that is still valid today (Fraser, 1994, 1995).

Technology managers efforts to understand the nature of organizational linkage factors affecting information technology usage for productivity improvements were largely driven by social and physical dimensional factors such an ease of management and physical proximity (National Research Council [NRC], 1997). Implementation of strategic information systems that are aligned with business strategy is an important issues among information systems executives (Eardley and Lewis, 1996; Schroeder, Congden and Gopinata, 1995; Segars and Grover, 1998, 1999) thus the need for a

planning framework that link organizational objectives with the information technology (systems) blueprint.

Enterprise integration efforts measured by integration market volume (Goranson, 1992) along a time dimension (evolution) points to a shift in emphasis from systems integration to enterprise integration with increasing focus on enterprise operations or networks (Kosanke, 1997). This is a holistic planning approach for enterprise life cycle management. Achieving holistic planning cannot be accomplished by using traditional methodologies because of the apparent lack of factors that align enterprise integration architecture with business strategy.

The main thrust of this study was to understand what constitute organizational linkages between the product on an information system planning effort (architecture objectives) and business strategy planning (organizational objectives). This research provided another way to extend alignment (fit, correspondence) theories to business strategy-enterprise integration architecture planning approaches. The model represents a tool with which to analyze connections between enterprise integration goals, enterprise integration modeling, and business strategy and enterprise integration architecture. This tool represents a profile of objectives through which the change process can be planned, managed, and effected.

Summary

Enterprise integration is a strategy rather than a technology solution for achieving horizontal and vertical integration within the organization (Vernadat, 1996). Enterprise integration architecture provides the basis for identifying components that are necessary for achieving infrastructure integration in concert with strategy alignment intentions. The

information systems literature is not short on research data about the importance for aligning business strategy with information technology including several accepted methodologies and frameworks in use by corporate planners.

Achieving full integration (Teo, 1994) continues to be a significant issue to both business unit management and information systems executives and is documented in several research studies and surveys (Brancheau, Janz and Whiterbe, 1996). Many enterprise moves through several stages of organizational transitional paths in an effort to get to full integration (enterprise integration) (Teo, 1996). Information technology continues to evolve as a pivotal resource for competitive advantage, supply chain linkages and internal organizational process re-engineering and improvements (Davenport and Short, 1990). Information technology planning while meeting alignment expectations between business strategy and information systems planning objectives have not moved beyond correspondence between these two planning dimensions (Zviran, 1990) which represent the social linkage aspects of planning (Reich and Benbasat, 1996).

Enterprise integration architecture concentrates on the intellectual aspects of corporate planning. Enterprise integration architecture must reflect the rate of business change and the rate of technology change; it therefore must be internally consistent while externally valid. Business strategy drives the architecture requirements and specification. It is through the enterprise integration architecture information and communication technologies that are critical for business model development and implementation is documented and managed thus eliminating the potential for disconnect between organizational objectives and the enterprise integration architecture objective.

As was noted throughout this Chapter, the literature base did not provide any confirmation regarding linkage construct for organizational objective and the architecture. Development of enterprise integration architecture is supported in the literature however, as the means through which investments in information and communication technologies are effected to provide strategic alignment and information infrastructure integration. This researcher advanced a strategy-architecture linkage construct that link enterprise integration architecture objectives with organizational objectives and therefore a planning profile of variables to be used during the enterprise integration modeling process and architecture development planning activity.

Definition of terms

Alignment: Alignment is the fit between business strategy and information systems strategy and therefore facilitates doing the right things (effectiveness) and doing things right (efficiency). This fit describes the extent to which business and information technology strategies are married to their related infrastructure and processes thus producing a state in which goals and activities of the business are in harmony with information systems that support them. Alignment is accomplished by understanding the relations between business and technology strategy formulation (Chan and Huff, 1993; Henderson and Venkatraman, 1991; Reich and Benbasat, 1996; Scannell, 1996; Burn, 1996; Bulter and Fitzgerald, 1999; Luffman, Papp and Brier, 1999; Woolfe, 1993).

Architecture Objectives: Architecture objectives are statements of what is to be accomplished from the design, development, and implementation of the enterprise integration architecture and provides a set of architectural guidelines for selecting information technology to support the organization's business strategy.

Business Model: Business model defines the business of an organization. It answers: what do we do? This takes the form of describing and defining the factors of the business; a function is defined as a set of actions performed to produce a result in support of business objective (Spewak and Hill, 1992).

Business Objective: Describe the 'why', the long term intention or vision of the enterprise being modeled. It further defines the requirements (business rules) to be modified or designed for the enterprise system (Gustas, n.d.).

Business Process: Describes pieces of enterprise behavior at all levels of decomposition of the functional decomposition except the top and bottom levels. It may have functional parts defined, and must have a behavior part and a structural part. It is employed by one or more Domain Processes and /or Business Processes and it employs one or more Business Processes and/or Enterprise Activities. It is triggered by a parent structure [Domain Process or Business Process] (CIMOSA, 1994).

Business Strategy: A unified set of plans that integrate an organization's major goals, policies, and action sequences into a cohesive whole. These plans are the result of a strategic planning process at the business functions and information technology levels of an enterprise (Fraser, 1994).

Business Strategy Planning: A process for developing a unified set of plans that integrates an organizations major goals, policies, and action sequences into a cohesive whole (Fraser, 1994) done at the business functions and information technology levels of an enterprise. This requires an approach of analyzing situations, generating, and evaluating business opportunities, and thinking about the sequence of actions required to implement business strategies (Fraser, 1994).

Enterprise: A set of interdependent actors, with at least partially overlapping goals, working together for a period of time in order to achieve some form of goals (Christensen and Johnansenm, n.d.).

Enterprise Engineering: The collection of tools and methods which can be used to design and continually maintain an integrated state of the enterprise, that is, to enable the collective co-ordination of all parts of the enterprise to enable it to optimally execute the enterprise mission as established by management (ISOTC 184, 1997).

Enterprise Integration Goals: The literature list several goals for pursuing enterprise integration Higher quality goods (Goranson, 1992; Williams, 1996; Fraser, 1994); decrease unit costs (Goranson, 1992: Williams, 1996; Fraser, 1994); improved products support (Goranson, 1992); product/process cycle time reduction (Goranson, 1992; Williams, 1996; Fraser, 1994); improved customer satisfaction (Bernus, Nemes and Williams, 1996; Fraser, 1994); increased profits (Williams, 1996; Fraser, 1994); increased staff satisfaction (Bernus, Nemes and Williams, 1996; Fraser, 1994); make better decision under uncertainty (Bernus, Nemes and Williams, 1996; Fraser, 1994); manage competitive activity (Bernus, Nemes and Williams, 1996; Fraser, 1994); track political legislation (Fraser, 1994); track economic trends (Fraser, 1994); track technology advances (Fraser, 1994); track social influences (Fraser, 1994); track industry structural changes (Fraser, 1994).

Enterprise Integration Architecture: A framework that captures functions, descriptions or behaviors of types of systems and their associated structures or frameworks for developing a device, system or project for carrying out information integration programs for an enterprise (Bernus, P. and Nemes, L., 1996).

Enterprise Integration: A process by which an enterprise is transformed into an agile and adaptable business system, capable of acting purposefully and coherently as a whole in the interest of its current and strategic business goals in an optimized manner (Bernus, Nemes and Williams, 1996c).

Enterprise Integration modeling: Methods and types of information technology tool sets and approaches for analysis, design, development, and evaluation of information systems technology solution for solving business process and systems integration problem (Rhodd, 1996). The basic idea is to first integrate the models of department applications, and use the model integration to guide the application integration, instead of doing the integration directly (Petrie, 1992). Modeling Concepts important for use with enterprise reference architecture development are (Bernus, Nemes and Williams, 1996):

- Verification of completeness and consistency for all described functions and objects (business processes, data, materials and resources including tools and fixtures) at any detailing level
- Simulation of the enterprise model at any detailing level
- Easy and fast change of the model in case of changing business processes, methods or tools

- The use of model to initiate, monitor and control the execution of the enterprises daily operation
- Repeated resource allocation during the execution of business processes to enable better and more flexible load distribution on the enterprises resources
- Model generation for existing enterprise as well as for enterprises to be built

Enterprise models: Enterprise model is a model of what the enterprise intends to accomplish and how it operates. It identifies the basic elements and their decomposition to any necessary degree. It specifies the information requirements of these elements. It provides the information needed to define the requirements for integrated information systems. It is used to improve the effectiveness and efficiency of the enterprise (Fraser, 1994; Vernadat, 1996; Whitman, 1996).

Enterprise Objective: Enterprise objectives are specific statements of the desired future condition or change of a goal. It includes measurable results to be accomplished within a specific time limit for an enterprise to succeed in its mission.

Models: A structured representation of physical objects, concepts, or a system that helps organize, clarify and unify knowledge; containing a system of rules, data, and inferences presented as a formal logical description of a system of objects and their state of affairs, or interactive behavior; that will facilitate analysis, experimentation, simulation, or comprehension (ICMIT, 1992).

Organizational Linkage: Variables used for measuring (a) adherence to requirements for widely-recognized strategic business planning process and (b) adherence to requirements for widely-recognized procedures for communication of strategic business planning (Calhoun, K. and Lederer, A., 1990). It is the degrees to which the IT missions, objectives, and plans support and are supported by the business mission, objectives, and plans (Reich and Benbasat, 1996). Linkage can be either tightly or loosely achieved depending on three characteristics representing dimensions: Content linkage (effect); Timing linkage (cause); Organizational linkage (cause) (Reich and Benbasat, 1996).

Strategic Alignment: Strategic alignment describes the state in which goals and activities of the business are in harmony with information systems that support them (Woolfe, 1993).

Chapter 2

Literature Review

Overview

This chapter contains a review of the literature related to topics and major studies that are significant for formulating this research and analysis strategy. Figure 4 represents the literature base used by this researcher to analyze relevant theories and the state-of-the-art for this investigation. Linking business strategy and enterprise integration architecture represents a different approach for aligning organizational objectives with the strategic intent of the information systems function. The business and information strategy planning literature did not provide any direct evidence of this, and therefore this researcher had to develop a literature map to guide knowledge acquisition for this study focus.

The identification, selection, and placement of the components of the Literature Review Map in Figure 4 were structured around the idea that specific organizational objectives that are associated with enterprise integration architecture objectives provide a profile of relationship variables. These variables are important for linking the architecture with business strategy and therefore they make full integration is possible. As a starting point, research on linkages and alignment of information systems planning (Reich and Benbasat, 1996; Henderson and Venkatraman, 1991) and information systems objectives (Zviran, 1990) provided a conceptual frame for understanding planning theories and alignment constructs in relation to business and information systems strategy process. Teo (1994) defined full integration as the integration of business and information

systems planning that aligns the contents of theses plans and that both information systems management and business unit management understand the contents of these plans for competitive advantage purposes.

Enterprise integration architecture is an information systems planning decision output but is developed within the enterprise integration planning process. In addition, enterprise integration is an enterprise model driven business development and structuring techniques that is relatively new to organizations for enterprise integration. These two managerial activities have their root in computer-integrated manufacturing (CIM), but as contemporary research has demonstrated, integration of the manufacturing enterprise in isolation produces sub-optimal solutions for the organization (Petrie, 1992). Therefore, business strategy and enterprise processes in conjunction with information technology must be integrated through of enterprise models (Goranson, 1992; Pertrie, 1992; Vernadat, 1996).

Enterprise integration and enterprise modeling represents a new and evolving thinking for linking business processes with information technology that is an enterprise engineering process (ISO/TC184/SC5WG1, 1998). Enterprise engineering encompasses techniques and method for analyzing and understanding the organizational models, processes, and tools for the design and ongoing maintenance of an integrated enterprise (Whitman, 1998). Knowledge acquisition for these related but distinctive subject areas started with the development of a keyword list consisting of terms such as business modeling, the enterprise, enterprise modeling, information engineering, enterprise planning, data modeling, systems planning, BPR, enterprise architecture, integration architecture, systems integration, and IT planning. The researcher to identify relevant

literature sources used these search terms. Many valuable concepts were uncovered; however, two items consisting of all encompassing research by leading authors provided detailed knowledge (Petrie, 1992; Kosanke, 1997) with which to develop Figure 4.

The literature was analyzed for related literature sources to further fine tune the literature map (Figure 4), define the theoretical baseline, and develop the research strategy. In addition, this literature base provided the foundation for the development of the conceptual planning framework (Figure 5) discussed in chapter III that helped with the formulation of the linkage construct for this study.

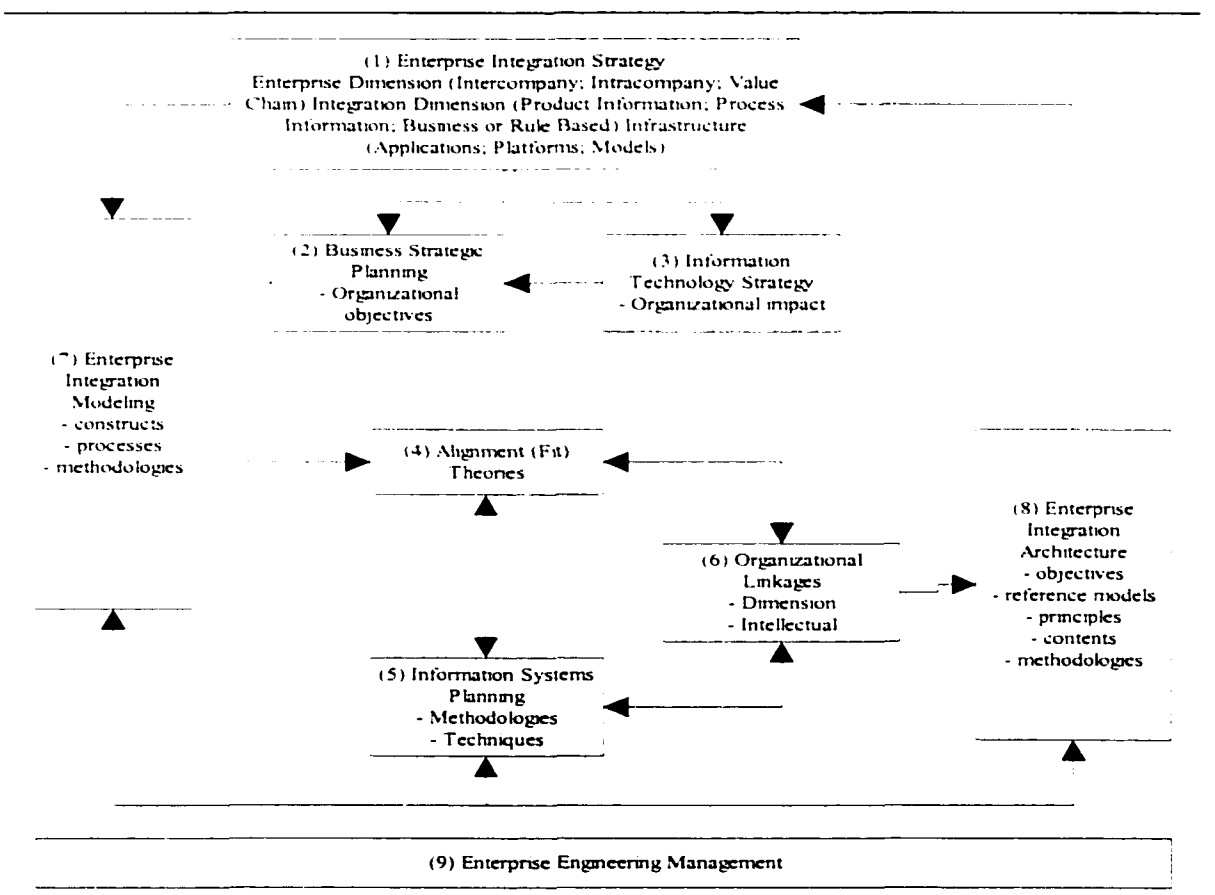


Figure 4 Literature review map

Enterprise integration strategy can be analyzed on three dimensions: (1) The enterprise, (2) integration, and (3) the infrastructure. The strategic role of enterprise integration in relation to business strategy was investigated to determine the integrative impact on organizational objectives for achieving full integration (Teo, 1994). Information technology strategy is considered as a mediator (Eardely, 1996; Dvorak, 1997; Hamilton, 1997; Kayworth, 1997; Meador, no date) for leveraging information technology for competitive advantage within the strategy formulation framework (Goodman and Lawless, 1994).

In any enterprise integration activity, information technology is an important mechanism for linking business processes and eliminating islands of computing, automation, integration, and information. Enterprise integration strategy will then be determined by the nature and types of information technology strategy an enterprise can assimilate into its business strategy formulation thinking; organizational impact of information technology was the focus of analysis in this instance.

Alignment theories along with the nature of organizational linkage were explored for relationships between organizational objectives and architectural objectives. Information systems planning was then reviewed for understanding how alignment is accomplished between business strategy and information systems planning, and what relationships exist within the planning framework for strategy linkage with the enterprise integration architecture development.

Enterprise integration modeling is directly related to enterprise integration and is the process used for managing enterprise integration architecture management (Petrie, 1992; Goranson, 1992; Bernus and Nemes; 1996; Vernadat, 1996; Kalakota and

Whinston, 1993). Enterprise integration modeling was reviewed for planning theories that is directly associated with enterprise integration and enterprise integration architecture. Enterprise integration architecture techniques were presented with the focus on objectives that are germane to enterprise integration strategy. A discussion about enterprise engineering closed the analysis for laying out the theoretical foundation for this investigation. Literature map components are discussed in the following discussion. The numbers to the right of each item refers to the components in the map.

Enterprise Integration Strategy (1)

An enterprise can be defined as a set of interdependent actors, with at least partially overlapping goals, working together for a period to achieve some of their goals (Christensen and Johnansenm, n.d.). Such coordination between goals require a framework that links "the networks of business processes which forms the product value chain [and] the networks of business processes which encompass the decision-making and management functions of the enterprise" (Bernus and Nemes, 1966, p.6).

Enterprise Integration Concepts

The goal of enterprise integration is the implementation of full integration solutions (Teo, 1994; Vernadat, 1996; Goranson, 1992) and computer-based tools that facilitate coordination of work and information flow across organizational boundaries (Vernadat, 1996). This goal not only reflects operational management action but also is process based in that there must be a defined organizational strategy that supports enterprise integration management.

Kalakota and Whinston (1993) in their analysis of the state of the art stated that enterprise integration refers to the integration of data, organizational communications

(between different levels of analysis - individuals, groups or organizations) and business processes across parochial boundaries, such as functions or product lines to aid in promoting organizational goals. Goals such as reducing time to market, improving service and quality, reducing risks and costs and increased market share to name a few; this desiderata suggest shared goals among organizational participants.

Goranson (1992) in his analysis of the state of the art provided this overarching goal for pursuing enterprise integration:

> The goal of EI (Enterprise Integration) is to provide for model transportability across applications, which in turn are portable across platforms enterprise-wide. Enterprise integration successes come about when information from currently differing models ability to be arbitrarily assembled for any ad hoc combination of applications, to run across heterogeneous platforms, and the scope for all (models, applications, and platforms) will be enterprise-wide. (p. 104)

Sheridan (1994) stated that a major challenge facing many companies is the integration of business strategy with information technology that raises such questions as: How to establish tighter internal information systems structure linkages across functional boundaries to give employee at all levels rapid access to the data they need; how to develop the information infrastructure required to participate fully in the emerging era of electronic commerce; how to design an information systems backbone that is flexible enough to evolve as the needs of the business changes.

Kalakota and Whinston (1993), in looking at the problem space, identified five types of enterprise integration approaches according to the level of analysis undertaken by the enterprise engineering methodologist: These are:

> Individual computing -- focus on task cooperation using technologies such as Document-Oriented Interface; Open-Doc; other massage passing techniques that use Inter-application connectivity (IAC) (p.3)

Intra-workgroup integration -- Group-Ware or "workgroup computing" (electronic mail, conference, bulletin boards, calendars, document storage and retrieval, p.3)

Intra-functional integration -- supports the coordination of workflow using a multi-tired architecture based on the client server methodology (it is not a technology) to integrate different workgroup systems implemented on minicomputer and mainframes architectures thus preserving investments in legacy systems while making better use of competitive information locked in "island of automation". Technologies supporting this type of integration are SQL database software, network operating systems, and distributed office-automation solutions. (p.3)

Inter-functional integration -- deals with systems integration of various functional areas such as accounting, marketing etc., thus facilitating the sharing of data to accomplish organizational goals. LAN to WAN connectivity in a multi-vendor environment in addition program-to-program communication and interaction across boundaries -- distributed applications. (p.3)

Inter-enterprise integration -- here systems integration is the approach for connecting various interacting organization (suppliers, subcontractors, etc.) enabling data sharing to achieve specific organizational goals and service exchanges. (p.3)

The term enterprise integration is an umbrella concept that is consistently applied to any managerial action that seeks to tie together several information technology types and business processes at either the internal and or the external levels of any organization. This tie-in of processes and information systems require a fundamental change in the organization's business and management philosophy.

An effective and seamless enterprise integration program requires organizations to revisit how existing organizational processes are configured, assembled, and operated. Enterprise integration is a comprehensive organizational transformation strategy in that it is both organizational and technical in its implementation (Bernus and Nemes, 1996b; Bernus, Nemes and Williams, 1996a; Kalakota and Whinston, 1993; Vernadat, 1996).

Comprehensive organizational transformation requires understanding and methodological diagnosing underlying processes to assess how current work is performed and identify gaps between actual and desired work dynamics, and identify areas for improvements (Kalakota and Whinston, 1993). From a technical perspective, enterprise integration challenges are: (1) Developing a new genre of computational tools to help in organizational diagnosis, representation and re-engineering of workflow (Kalakota and Whinston, 1993); (2) Software development using the object-oriented message passing and event driven paradigm (Kalakota and Whinston, 1993); (3) Installing different types of networks and ensuring inter-connectivity and interoperability (Kalakota and Whinston, 1993); and, (4) Building generic, reusable, configurable software component tool-kits (Kalakota and Whinston, 1993).

Enterprise integration is a process in which an enterprise is transformed into an agile and adaptable business model capable of acting purposefully and coherently as a whole in the interest of its current and strategic business goals in an optimized manner (Bernus, Nemes, and Williams, 1996c). It focuses on improving the coordination among interacting organizations, individuals, and systems by improving the task-level interactions among people, departments, services, and companies; it cannot be achieved simply by connecting computers (Petrie, 1992).

Application of enterprise integration planning within the strategic management framework insures that strategic implications of advancing and converging information technologies that are closely linked with business goals and information systems goals. The process of enterprise integration must not only address information technological issues but must be comprehensively applied to capture and describe business processes,

organizational strategies, organizational structures, levels of resources, goals and constraints of the enterprise. In addition, the enterprise integration process must also provide business process requirements specification, facilitate identification of solution options, simulate through modeling alternative designs and implementation paths at the strategic, tactical, and operational levels (Bernus, Nemes and Williams, 1996c) during the strategy formulation process.

This is achieved through enterprise integration modeling and is embedded in the enterprise integration architecture. The underlying premise therefore is that enterprise integration will improve performance of the organization because of better use of resources with fewer mistakes, is more responsive to changing demands and opportunities, facilities quality products design and customization for small groups of customers (Petrie, 1992).

Improved organizational performance is a function of (1) a common enterprise integration infrastructure that shares applications and information across functions of the enterprise, regardless of whether those functions are under the same management. In this instance, reusability and portability will be applied across time as well as organizational boundaries thus ensuring business value of enterprise integration; (2) lower infrastructure product costs as the suppliers' base (and internal organizational units) relay less on niche infrastructure products due to the development of common infrastructure products. This will allow for the formation of integrated partnerships that include small businesses to participate in the large industrial base by bringing innovations to the "mega-enterprise"; (3) utilization of the enterprise-wide infrastructure to apply business engineering principles as common technical basis is formulated thus enterprise metrics, systems

engineering and enterprise modeling methodologies to optimize the enterprise (Goranson, 1992, p.102).

Sheridan (1994) commented that the impetus for an organization pursuit of enterprise integration can be traced to factors such as advances in personal computers power and networking technologies thus the desktop becoming the window into the enterprise. He also noted a shift away from the mainframe-computing model to distributed client server techniques and the formation of interactive business structures thus cross-functional management style including concurrent engineering in the product development cycle.

In a 1982 study, Barrett and Konsynski (1982) introduced the concept of inter-organizational information systems into in the systems literature. These authors (Barrett and Konsynski, 1982) in this study defined inter-organizational systems as involving resource sharing between two or more organizations. This notion results in information sharing that cross-organizational boundary and benefits all participants with differing interest and characteristics.

Inter-organizational systems represented earlier thinking for archiving enterprise integration. Efforts to integrate external relationships for competitive advantage, cost reductions, productivity improvements, and product strategy reasons resulted in several levels of participation by supply chain partners. Enterprise integration by Barrett and Konsynski (1982) classification involved (a) remote Input/Output (level one), (b) application processing nodes (level 2), (c) multi-participants exchange nodes (level 3), (d) network control nodes (level 4), and (e) fully integrated network nodes (level 5).

There continues to be intense research into the underlying conceptual foundations for enterprise integration and modeling, either as an integrated study or as a stand-alone study but with the view of levering these concepts for the definition and theoretical formulation of both. With recent advances in information and communications technologies, corporate planners and information technology executives recognizing the strategic importance of enterprise integration as a critical methodology for archiving organizational objective are integrating enterprise integration goals in the strategic planning framework.

Fox (1996) in his 40-month progress report on enterprise integration initiatives provided an account of partnership activities between the enterprise integration laboratory (EIL) at the Toronto University and several Canadian organizations. This report detailed many pilot projects that advanced and refined theories relative to organizational ontology, manufacturing – shop floor integration technologies and methodologies, development of various tools that can be used to model and execute enterprise integration and have developed graduate level courses for this evolving engineering subject area.

Hsu's (1996) approach focused on information models and data technologies as the means to achieving enterprise integration. His work also developed several joint research projects with business in the manufacturing sector. His approach developed a meta-database technology and a case tool to design an integrated enterprise. His thesis presented the use of information models to implement information integration across the extended enterprise. In this sense as he stated, "enterprise integration is about using IT (information technology) to achieve dynamics of resources through information and information systems". (p 3)

Implicit in this methodological approach is the use of an information architecture that encapsulates enterprise strategic thinking and is managed by the enterprise metadata. This metadata represents an extended notion of the traditional definition associated with this form of data management technology to include (1) global data models, (2) contextual knowledge and process models, (3) software, hardware, and network resources models, and (4) information users and organization models.

As organizations look for ways to improve aspects of their business processes they are rethinking the manner in which they utilize information technology and methodologies used for deploying information systems to support their various and differing business models. Enterprise integration given the basic purpose for pursuing this business-engineering endeavor is the development of solutions and computer-based tools that facilitate coordination of work and the information flow across organizational boundaries (Vernadat, 1996). The strategic importance of enterprise integration is projected by its evolutionary path from systems integration (systems networks) to enterprise integration (enterprise networks), following a migration path that included application integration (application networks) and business integration (process networks) in between (Kosanke, 1997). This evolution is supported by Teo (1994) stage growth theory for achieving full integration in the strategy planning process.

Information technologies is no longer a supportive organizational resource but instead have moved into the realm of strategic resource for the continuation of corporate life (Dvorak, Holen, Mark and Meehan, 1997). Hollocks, Goranson, Shorter, and Vernadat (1997) proposed that enterprise integration could be viewed as a strategic planning tool to focus attention on opportunities for the business competitive advantage,

strategic information systems portfolio development, and ongoing information technology strategy formulation

Enterprise integration must be considered within the context of the strategic planning process along with business strategy development. The desire to pursue enterprise integration is an outgrowth from appropriate, relevant frameworks or tools, and may relate to re-engineering process but will in turn drive the information systems strategy (Hollocks et al, 1997).

Enterprise Integration Process

Strategy formulation and implementation is based on a distinctive planning methodology (Salmela, Lederer, and Reponen, 2000). Enterprise integration as a strategy is systematic in its approach consisting of the following five stages (Hollocks et al, 1997 p.99):

- Identify the Benefits Profile of the business that is the "hot buttons" of the business potential for enterprise integration.
- Analyze the existing enterprise integration Capability Profile of the business.
- Assess and select which capability improvements are appropriate for the business within the Benefits Profile.
- Plan those integration changes, employing models and standards as appropriate.
- Implement (and monitor) the changes.

The above process provided several matrixes from which enterprise integration and the appropriate information technology can be defined and identified. Enterprise

integration models can then be developed using enterprise modeling techniques to direct the linkages between the planning outcomes and the enterprise integration architecture.

Enterprise Dimension

A working definition of an enterprise was provided previously. Implicit in this definition is the cross functioning of several organizational unit that are either internal and or external to the enterprise of interest. Organizational units are not the only interplay implicit in this notion but also value-chain relationships that are necessary for products and services process streams. The enterprise dimension therefore is about the organizational relationships and the informational contents of the relationships that establish the particular business model (Kalakota and Whinston, 1993 p. 4).

Integration Dimension

Integration dimension in this instance is concerned with the informational flows within the target (focus of attention) for integration. This can either be product, process business models or rules governing the operational aspects of the business model thus integrating the decision making process of the enterprise (Kalakota and Whinston, 1993 p. 4).

Infrastructure Dimension

Infrastructure integration is much more than systems integration which the connection of information systems for rudimentary data passing between one or more systems. Infrastructure integration is about interoperability across applications and heterogeneous systems using open systems standards and technologies. In this instance, integration is accomplished using enterprise models that allow for inter-process and or intra-process of transactions without the need to reconfigure the underlying business processes (Kalakota and Whinston, 1993 p. 4).

Enterprise Integration Strategic Role

Enterprise integration is more than a technology solution for information sharing and connecting various systems using data communication network. Kalakota and Whinston (1993) observed that corporate goals such as reducing time to market, improving service and quality, reducing risk and costs, and increased market share can only be achieved through an integrated strategy planning process that incorporate enterprise integration in the strategy formulation process. They contend that enterprise integration refers to integration of data, organizational communications (between different levels of analysis - individuals, groups or organizations) and business processes across parochial boundaries such as functions or products lines to aid in promoting organizational goals noted previously.

Hollocks et al (1997) suggested that enterprise integration is a strategic planning tool for analyzing business opportunities and aligning information technology and systems with business strategy. Analysis of opportunities is a constant in organizational life in response to business drivers that decision makers must consider as they formulate business strategies. Gonzales (1997) developed an assessment tool and methodology based on the Perdue Enterprise Reference Architecture (PERA) and the Generalized Enterprise Reference Architecture and Methodology (GERAM) models to conduct a case study research in Mexican small manufacturing enterprise to identify the impacts of enterprise integration concepts introduction into these enterprise. A polar graph was used to perform the analysis along three perspectives: (1) Strategic Planning; (2) technology planning and integration; and (3) implementation. This case study confirmed the important role enterprise integration plays in advancing an organization's ability to achieve competitive advantage.

Business Strategy Planning (2)

A strategy is a unified set of plans that integrate an organization's major goals, policies, and action sequences into a cohesive whole (Fraser, 1994). These plans are the result of a strategic planning process at the business functions and information technology levels of an enterprise. Implicit in the notion of strategic planning is a strategic management framework consisting of tools, techniques, and decision-making models for formulating strategy, implementation, and management thereof (Fraser, 1994).

In an organizational context and to a larger extent the business environment, enterprise management must deal with complex and dynamic nature of internal and external environment that have some bearing on the business process and the underlying information technology that supports the enterprise ability to achieve its goals. This requires an "approach of analyzing situations, generating and evaluating business opportunities, and thinking about the sequence of actions required to implement business strategies" (Fraser, 1994, p. 30) in a systematic way. The formulation of business strategy provides the basis for developing the framework for analysis and modeling the business environment for strategic information systems planning (SISP) and selection of technology to satisfy the business objectives.

Strategy formulation cannot occur in a vacuum but must be guided by a set of principles and structure within the organizational context. Bryson (1998) stated that strategic planning is a "disciplined effort to produce fundamental decisions and action that shape and guide what an organization (or other entity) is, what it does, and why it does it." (p. 5) Planning for strategic actions and decisions require broad scale

information gathering and exploration of alternatives with an emphasis on future implications of present decisions thus facilitating communication, participation, accommodation of divergent interest and values, and foster orderly decision making and successful implementation (Bryson, 1998).

Strategy planning is a mature discipline. Corporate planners have many frameworks and approaches for defining strategic direction in concert with the organization mission. Table 3 list some examples of planning frameworks/approaches found in practice. Selection and use of any of these planning frameworks/approaches is contingent on the planner's training, experience, and planning purpose.

Table 3 Example of Planning Frameworks/Approaches

Planning Purpose	**Frameworks/Approaches**
Business strategy	Harvard Policy Model; Strategic Planning Systems; Stakeholder Management; Content Approach/Portfolio Methods; Competitive Analysis (Bryson, 1988); Portor's Competitive Advantage or Value Chain Analysis (Goldsmith, 1991).
Information systems planning	Business Systems Planning (Lederer and Sethi, 1988; IBM, 1981); Information Engineering, (Lederer and Sethi, 1988; Goldsmith, 1991); Rockhart's Critical Success Factors (Lederer and Sethi, 1988; Goldsmith, 1991); Extended Hierarchical Framework for Analysis of Information Technology Planning Activities (Hamlton, 1997); Strategy Set Transformation (Lederer and Sethi, 1988; Zviran, 1990); Derivation of Information Systems Strategy from Organizational Plan (Zviran, 1990); Method/1 (Lederer and Sethi, 1991); Business Information Analysis and Integration Technique (Lederer and Sethi, 1991); Nolan Norton Methodology (Lederer and Sethi, 1991); Customer Resource Life Cycle (Lederer and Sethi, 1991).
Information technology evaluation	Adaptive Rationality Model) (Goodman and Lawless, 1994); Portfolio Management (Lederer and Sethi, 1988; Das, Zahra and Warkentin, 1991); End/Means Analysis (Lederer and Sethi, 1988; Das, Zahra and Warkentin, 1991); Technology Driven MIS Planning (Des, Zahra and Warkentin, 1991).

Table 3 cont'd

Alignment	Strategic Alignment Model (Butler and Fitzgerald, 1999); End/Means Analysis (Lederer and Sethi, 1988; Das, Zahra and Warkentin, 1991).
Information Strategy	Guidelines for Developing an Information Strategy (JISC, 1996); Business Information Characterization Study (Lederer and Sethi, 1988; Das, Zahra and Warkentin, 1991); Information Quality Analysis (Lederer and Sethi, 1991).

These public planning methods and other anecdotal private approaches have contributed to the richness of planning ideas for the development of information technology strategy and alignment of information systems plans with business strategy. A recent set of ideas entering the planning literature is enterprise engineering. This approach is a life-cycle methodology for enterprise modeling and integration of business processes in concert with information systems to support business strategic action. The primes is that generic models of the organization and its various processes represents the organization's overarching objective and therefore a strategy planning methodology in addition to it's capabilities to manage change and ongoing operations (Liles and Persley, 1996).

The use of models in this context accomplishes several things: it provides a dynamic model of the organization; it combines the strategic knowledge in the planning statement, aids managers in the process of strategic planning by enabling evaluation and strategy selection for the enterprise. Information coming from the modeling exercise supports a "...integration role in the organization in the sense of acting as a communication channel between the [enterprise] stockholders" (Fraser, 1994, p. 31). Fraser (1994) further asserted that models helps to provide insights into the options which

an organization has for change by considering both internal and external factors influencing the organization's ability to improve business performance. It is critical that as planners consider the impact of business drivers on internal processes they understand the current state and simulate proposed change through models to meet new and evolving business processes.

Information Technology Strategy (3)

Evolution and transformation of business processes into new and or emerging models cannot be accomplished solely on business strategy directives. Goodman and Lawless (1994) suggested that IT influence the firm's ability to respond to market forces thus IT strategy is a critical aspect of business strategy framework.

Groenfeldt (1997) position is that organizations need to have a technology oriented CEO (Chief Executive Officer) and a business oriented CIO (Chief Information Officer) supported by a committee structure to ensure integration of business and technology strategy. This type of arrangement will allow for discussions around issues such as (1) how is technology changing the business; (2) how good is the information technology staff and infrastructure; (3) levels of information technology expertise among general managers; (4) what information technology is required to support the business and where to obtain the necessary resources. This managerial approach can further enhance the organization's effort to develop an integrated strategy that will prepare the enterprise to leverage information technology for strategic reasons.

Schroeder (1995) empirical study of the linkages between competitive strategy and manufacturing information technology focused on the nature of strategy-technology linkages; the process by which the two are aligned; the business drivers influencing this

alignment; and the consequences for not adopting appropriate technology at the right time. Because of this investigation, Schroeder (1995) advanced five prepositions that form the elements of a dynamic strategy-technology model. It is the author's thesis that application of this model will allow a firm to align (link) business strategy with information technology strategy, thus a process for integration of strategy.

Meador (n.d.) advanced the idea of a strategy alignment methodology for integrating both competitive strategy and information systems planning. Meador (n.d.) used knowledge gained from strategy planning work done with two hundred international organizations over a twenty-year period. The proposal is to imbed this strategy alignment methodology into the normal business strategy planning process thus correcting the failures of other planning approaches that failed to incorporate information technology as critical change agent instead of reacting to competitive strategy after it has been defined.

Information technology must be proactively used to achieve a tight coupling of business processes and information systems across the enterprise and therefore incorporating information technology benefits into the strategic thinking process. This integration will improve the enterprise use of technology by: (1) considering evolving/changing information technology environment as lever to change either competitive strategy or the underlying business processes or infrastructure; (2) identifying best practices for a particular set of business processes within or without the industry thus the competitive environment and strategy can be defined in terms that help in determining opportunities to use information technology; and (3) formulation of a meta-architecture that provides a framework for future information technology use, thus

consideration of emerging technologies that is likely to be important to the enterprise's competitive strategy.

Business strategies are corporate management's collective actions for positioning a firm in a defined market. Information technology acts is the catalyst for moving business strategy from concepts to reality and it is vital for information technology strategy formulation to be integrated within the strategy management framework (Klouwenberg, Koot, Alphons and Schaik, 1995). This integration is accomplished through the application of alignment methodologies as the enterprise moves to full integration (Teo, 1994).

Alignment Theories (4)

Information systems alignment is defined as a fit between business strategy and information systems strategy (Chan and Huff, 1993; Henderson and Venkatraman, 1991; Reich and Benbasat, 1996; Scannell, 1996; Burn, 1996; Butler and Fitzgerald, 1999) thus facilitating doing the right things (effectiveness) and doing things right (efficiency) (Luffman, Papp and Brier, 1999). Butler and Fitzgerald (1999) stated that strategic fit describes the extent to which business and information technology strategies are married to their related infrastructure and processes. A similar perspective was offered by (Burn, 1996) who stated that alignment examines the relations between business and information systems strategy formulation. Woolfe (1993) in looking at issues regarding information technology use for competitive advantage, characterized strategic alignment as the state in which the goals and activities of the business are in harmony with information systems that support them.

Conceptualizations of this theoretical construct has seen several other terms applied to it's definition; terms such as correspondence, linkage and fit can be found in the literature but the fundamental meaning and application are in line with the above definitions. Additionally, alignment studies have focused on the planning aspects of either information systems or information technology relationships with competitive strategy, business strategy planning, and business process re-engineering. The importance of alignment cannot be understated since information technology and the resulting information systems represent critical elements of an organization's ability to survive.

Elevation of information technology from a peripheral status to the center of business strategy formulation thus playing a pivotal role in organizational transformation suggest that information systems have a strategic role in attaining corporate survival (Butler and Fitzgerald, 1999). Organizational transformation through the use of information technology cannot be accomplished without intervention mechanisms that align these mutually exclusive organizational processes, each with its own set of theories and methodologies. Henderson and Venkatraman (1991) strategic alignment model discussed previously is one of many mechanisms for accomplishing alignment at the planning level.

Alignment between business strategy and information systems planning is a major management issue for both business unit's managers and information systems executives. In a study conducted by Luftman, Papp and Brier (1995) alignment surfaced as one of the major organizational issue facing information systems executive. As the rapid pace of information and communications technology continues, it is most likely that organizational objectives can become disconnected with the information systems

strategies and subsequent systems operations thus a mal-alignment with the overarching corporate strategy. Alignment of information systems plans and business strategy continues to be elusive in attaining full integration (Teo, 1994) and remains an important research agenda.

Finding a solution to this critical aspect of strategy planning linkage has received substantial coverage in the research literature (Lederer and Sethi, 1988; Hufngel, 1987; Bowman and Davis; 1983; Lederer and Mendelow, 1989; Chan and Huff, 1993) with several prescriptions for achieving this alignment or description of methods employed by corporate planners to integrate both planning processes. It is interesting to note that some study results while arguing for integration between information systems objective and business strategies, noted the difficulties faced by information systems executives in attaining this type of alignment.

Lederer and Mendelow (1989) explored issues surrounding the lack of coordination between business strategies and information systems plans. This study focused on reasons why coordination is a challenging task and to discover what actions information systems managers employ to seek alignment. In constructing the study, these authors operationalized coordination as having three dimensions - content, timing, and personnel. Content represents consistency between information systems plan and business plan where the information systems plan is incorporated into the business plan with both plans including the relevant portion of each other, thus "reciprocal integration" (Teo, 1994).

Timing considers the sequence in which these plans are developed thus, development of information systems plans before business plans formulation would

impede coordination and therefore limiting an organization's ability to exploit information technology for business strategic reasons because of the "sequential integration" nature of the plans (Teo, 1994; Gottschalk and Solli-Saether, 2001). The converse is true for business plans development. Organizational participants are the developers of these plans thus the potential for alignment between the plans by participation of both IS and business managers in the planning process is more likely to promote the development of an integrated plan.

Coordination difficulties and actions to overcome these difficulties observed from the data by Lederer and Mendelow (1989) were unclear or unstable business mission, objective, and priorities; lack of communication; absence of information systems management from business process; unrealistic expectations and lack of sophisticated user managers. The management actions suggested to mitigate these difficulties were to encourage business manager's participation in information systems planning; rely on business management planning process; establish an information systems plan; IT managers participation in business management planning process. They concluded that successful coordination (actions of information systems executives) could be attained if top management mandates the coordination between both plans.

Calhoun and Lederer (1990) who investigated the relationships of strategic business plan quality and the degree of communication of the business plan to information systems management conducted further exploration of the topic. Motivation for this study (like others) was based on self-reporting by information systems management regarding their failure to align strategic information systems objectives with business strategic plans. These authors suggested that mal-alignment is influenced by

(1) stable IS plan to limit uncertainty caused by environmental changes and (2) information systems executives failure to identify top objectives thus a disconnect between the information systems function and corporate goals. Results from this study suggested that the quality of the communication of the business plan to information executive is a key feature for alignment of information systems plan. Quality communications with information systems executive ensure knowledge about the business plan foster a greater chance of alignment and not the quality of the business plan in of itself.

As more organizations recognize the critical role strategic information systems play in competitive strategy, information systems executives are looking for the information technology connections that would ensure that information systems objectives are derived from organizational objectives (Grestein, 1987; Zviran, 1990). Zviran (1990) in conducting his study of relationships between organizational and information systems objectives, observed that much as been said about the need for alignment but the information systems literature provides no empirical evidence to support alignment between information systems planning and business strategy planning. In an earlier study, this was also noted by (Grestein, 1987) who proposed a 'technology/strategy matrix' tool as the means for effecting the 'technology connection'.

Zviran (1990) on the other hand empirically tested the relationships between organizational and information systems objective to determine the necessary linkages and operationalized the alignment between theses two strategy processes. Zviran's (1990) study produced a set of 'contingency profiles' thus providing a normative approach for linking these objectives during a strategy formulation process.

Information Systems Planning (5)

Integrative planning for and use of information technology forecasting methodology is not widely practiced and organizations suffers from a reaction to overselling and hype, and a lack of understanding by senior management of the technology connection with corporate strategy (Goldsmith, 1991). Goldsmith (1991) asserted that there is a variety of 'formal methodologies' for information systems planning, none of which provides alignment with business planning. The same author (Goldsmith, 1991) stated that:

> [A]s information strategy planning has become more common, it is has become clear that information systems strategies need to be developed in the same process and at the same time as the business strategy if competitive advantage is to be secured from information technology systems. (p.67)

Goldsmith (1991) provided an account of lessons learned from a case study of his organization's effort to apply the above idea. He (Goldsmith, 1991) combined information engineering planning framework with Portor's five forces approaches to form an integrated strategic planning methodology thus allowing for the development of information systems strategy along with business strategy development. To accomplish this planning, the use of workshops provided a valuable mechanism for involving management and creating effective information technology strategies. Workshop participants were in a good position to make business-based information technology decisions. That in terms of options for strategic support and moved the discussions away from a information technology focus to what information is important to support the business strategy.

Scannell (1996) observed that strategic alignment process builds an organizational structure and internal processes that reflect both the organization's strategy and the

information technology capability chosen to develop information systems in concert with business strategy. It is the view of Scannell (1996) that strategy formulation must incorporate business strategy and information technology strategy that is supported by the organizational infrastructure and the information systems infrastructure as was the case of Federal Express Corporation that formed the basis for this observation.

Eardely, Lewis, Avison, and Powel (1996) selected from the literature base, several reported cases that were characterized as 'strategic systems' for competitive advantage. Porter's model of five forces of industry competition analysis (ICA) was the framework of choice to examine some of the 'classical' example of competitive systems. Eardely et al (1996) concluded from research data that it is possible to determine some measure of linkage between systems development and competitive strategy thus the ability to understand the nature of competitive information systems.

Analysis of these case studies indicated that strategic information technology applications do fit into ICA, in terms of defining strategic moves, identifying strategic potential, and suggesting information technology mechanisms that may be developed and incorporated into business systems to achieve this potential. Linkage requires a true alliance between technology development and competitive strategy rather than a serendipitous action (Eardely et al, 1996). No proof was found that suggested a company is capable of conceiving a strategy and linking in the development of an information technology application as an integral part of that strategy (Eardely et al, 1996).

Alignment as a strategic intent focus on the linkages between information technology planning and business formulation strategy. Analysis of case studies while indicating some form of linkage did not provide conclusive proof that outcome as

asserted by theses organizations were directly linked to the implemented architecture when the business strategy was formulated. This "serendipitous" connection represents many of the architectural development process for many organizations.

Research into strategy-information technology and or systems planning alignment provides a theoretical base from which discussions regarding organizational and architectural objectives can proceed. The literature indicates that (1) both information systems executives and business managers do develop strategic plans during normal course of their managerial obligations and within a management planning framework, (2) these plans while espousing some form of alignment, failed to achieve 'real linkages', and (3) there are no direct models that link the enterprise integration architecture with business strategy.

Organizational Linkage (6)

"An organizational linkage occurs when the outputs from one organizational subsystem is combined with outputs of another subsystem into broader outputs" (National Research Council [NRC] 1994, p. 162]). This definition while directly related to studies regarding the effects of information technology as an intervention on organizational productivity, can be applied to the rationale for enterprise integration architecture for two reasons: 1) business processes, individuals (corporate actors), decisions making infrastructure and strategic management framework are subsystem of the enterprise. These subsystems provide outputs that determine enterprise actions and 2) enterprise integration architecture as a product of information technology planning reflects the combined organizational thinking for enterprise integration goals and business strategy. Organizational linkage in this instance represents variables for analysis

and understanding the connections or relations that associate enterprise integration architecture and business strategy planning within a management system (Calhoun and Lederer, 1990; Reich and Benbasat, 1996).

NRC (1994) considered such connections or relations (linkage) as a structural phenomenon referring to the joining of two or more objects and can be described in terms of multiple dimensions in an organizational context. Linkages can vary in terms of technological, organizational, and social objects that join two or more people or organizational units by machines or technological programs or routines, organizational procedures or social norms or customs. Directionality or organizational space linkage types are horizontal, vertical, or diagonal. Complexity is the number of links in any organizational unit thus the more links in an organization, the more complex the environment. Linkage condition can also reflect a degree of interdependence in organizational systems where objects are either tightly linked or loosely coupled.

Calhoun and Lederer (1990) operationalized linkage in the information system planning arena as variables used for measuring (a) adherence to requirements for widely recognized strategic business planning process and (b) adherence to requirements for widely recognized procedures for communication of strategic business plan. This study found that the missing link between business strategy and information system plan was the lack of communication of the business strategic plan details to information system managers -- 'the weak link". Enterprise integration while implicit in business strategy is viewed as a technology solution by existing approaches. The implication of 'the weak link' suggests no connection or relation between business strategy and enterprise integration architecture in which enterprise integration goals are embodied.

Reich and Benbasat (1996) in their linkage study commented on the lack of consistency in describing what information technology plans should be linked to, thus a research approach that included the broadest possible set of linkage constructs between the information systems function and the business. They operationalized linkage as "...the degree to which the information technology mission, objectives, and plans support and are supported by the business mission, objectives, and plans". (p.56) In this definition, they defined 'objectives' as goals and strategies of an organizational unit.

This study focused on the social dimension [intellectual dimension is the other] (Table 1) of the linkage framework, defined as "...the level of mutual understanding of and commitment to the business and information technology mission, objectives, and plans by organizational members." (p.58) Support for the communicative linkage factor was validated and two measures were identified for performing a "linkage audit" in order to access the level and types of linkage within an the organizational planning phase. Planning for enterprise integration is not an isolated strategy formulation activity. It requires congruence within the management system; congruence being a shared vision by business strategy planners and the enterprise architect during enterprise integration architecture development program.

Linkage therefore can be viewed as the ability to trace architectural artifacts back to formal and informal goals and vision of the enterprise. Enterprise integration architecture when constructed for the sole purpose of full integration shows how to build a system to meet user requirements including intangible needs implicit in the value chain. It becomes the decision making tool of the enterprise architect by which ad hoc and implicit decision making are formalized for the determination and identification of

technology choices, allocations of functions or performance improvements, and guidance for selecting appropriate information technology for enterprise-wide transformation.

Competitive strategy literature advanced the theory that an enterprise's ability to increase market share and or retain product dominance is contingent on some measure of information technology use and it is necessary to align the information technology choices with organizational objectives. Alignment of the strategy planning process as was noted previously, paint a 'rich picture' of methods and techniques for evaluating linkage in relations to social dimensional factors in the planning framework (Reich and Benbasat, 1996; Butler and Fitzgerald, 1999).

A general observation from the literature on alignment techniques however, points to the lack of a connection of the top-level view of the business directly to information technology details of the business structure. Connecting the top-level view require enterprise integration models that captures the intellectual dimensional factors (Reich and Benbasat, 1996) implicit in both information technology strategy and business strategy. This connection provides seamless integration of all business model structures and relates process workflow processes sequences to the information technology tools that support them. Enterprise integration model in this instance provides a mechanism through which enterprise integration architecture is aligned with business strategy.

It was the intent of this researcher to gain an understanding of organizational linkage constructs and how it is applied to business strategy planning in order to achieve enterprise integration, thus linking business strategy with enterprise integration architecture. Reich and Benbasat (1996) cited several studies that addressed linkage issues between information systems (technology) plans and business strategy; none of the

cited studies however provided any insight relative to linking enterprise integration architecture with business strategy which was the focus of this research. In order to develop a view point for organizational linkage, Reich and Benbasat (1996) study provided the theoretical foundation for defining (a) the linkage construct and (b) research framework for this study.

Enterprise Integration Modeling (7)

Enterprise integration modeling is primarily concerned with assessing various aspects of the enterprise business process in order to better understand, restructure, or design enterprise operations (ANSI/NEMA, 1994; Christensen and Johnansenm, n. d) to respond environmental imperatives. It is the basis for business process re-engineering (BPR) and the first step to achieving enterprise integration (Bernus and Nemes, n. d; Fraser, 1994). The application of enterprise integration modeling in business and information technology architectures strategy formulation process focus on the types of information technology tool sets and approaches available to the enterprise architect for the design of business models, information models and information technology reference models (GERAM, 1998; Fraser, 1994).

As an analytical tool it offers much promise for eliciting model integration and simulating aspects of an enterprise often time overlooked by business planners and information systems management due to issues regarding the level of business strategy – information systems planning. Alignment between these two planning activities continues evade information systems executives (Brancheau et al, 1996). As a new and evolving subject area, enterprise integration modeling is a multi-disciplined approach for solving problems relating to "island of information", "island of automation", "island of

computing", and "island of solutions" in addition to exploring organizational changes in a control manner (Goranson, 1992; Petrie, 1992; Bernus and Nemes, 1996b; Vernadat, 1996; GERAM, 1998). Petrie (1992) in his commentary, stated that enterprise integration modeling as a methodology, basic idea is first to integrate the models of the departments applications, and use the model integration to guide the application integration, instead of doing the integration directly.

Enterprise integration objectives cannot be planned for in isolation since it relies on enterprise engineering methodologies to be effective (Vernadat, 1996). Enterprise engineering consist of techniques to plan and operate the day to day business of an enterprise using engineering disciplines and methods by building enterprise integration models composed of complete (or parts of it) business processes of the enterprise (CIMOSA, 1994). Bernus, Nemes, and Morris (n.d.) suggested, "enterprise engineering is based on the belief that an enterprise "...can be designed or improved in an orderly fashion thus giving a better overall result than an ad hoc organization and design". (p.1) There are several nomenclature associated with this management technique; for this research the term enterprise integration modeling will be used instead of enterprise model (Petrie, 1992; Whitman and Gibson, 1996;Whitman, 1998), dynamic model (van Meel, 1996) or any other term found in the literature that is conceptually related. This choice is a personal preference and does not alter the fundamental meaning and ideas associated with other terms noted.

Working Definition

The Enterprise State of the Art Survey (Ent/DE/1/1.0, 1994) report part 1 -- 'Business Perspective for Enterprise Modeling', stated "enterprise modeling is widely

used as a catch-all title to describe the activity of modeling any pertinent aspect of an organizations structure and operation in order to improve selected measures of the organizations performance." (p 3) One of the latest management techniques many business organizations are embracing is a business process re-engineering and or improvement task. Another enterprise analytical methodology finding it way into the management planning and rationalization process is enterprise engineering which is a model driven approach to enterprise analysis and business models development (Working Group [WGIII], 1992; Vernadat, 1996; Whitman and Gibson, 1996; ISOTC 184, 1997; Whitman, 1998). van Meel and Wsol (1996) used the term business engineering to express similar concepts and methodology applied to an action research project that modeled several organizations wherein they designed an instrument for doing model simulation.

Enterprise integration modeling, "...encompasses most aspects of classical operations research, process optimization, human resource allocation, organizational design, business process re-engineering ...which are not new to organization as these activities and actions have been done ... for as long as they [*managers*] have appreciated the need to improve business performance" (Fraser, 1994, p. 3). If this is the case, then what is driving this interest in enterprise integration modeling and enterprise integration? Several phenomena come to mind, the need to manage change, "... due to reduced time to make the change ...the breath and the depth of the organization which is affected by the need to change, thus ... the need to focus on the enterprise as a whole, or at least on a larger set of interacting components within the organization -- taking a more 'total systems' approach" (Fraser, 1994, p. 3).

Enterprise integration models serve several purposes: (1) To express the design or redesign of the information and material flow of the enterprise; (2) to achieve common understanding of the enterprise by participants (management, workers etc.); (3) to control the enterprise based on the model (Bernus, Nemes & Morris, n.d.), thus enterprise integration modeling focuses on what the enterprise intends to accomplish and how it operates, identification of basic elements and their decomposition to any degree necessary, specifying the information requirements of these elements, provides the information needed to define the requirements for integrated information systems, and to improve the effectiveness and efficiency of the enterprise (ABSI/NEMA, 1994).

van Meel and Wsol (1999) use the term dynamic modeling to express their approach for the design of business models and analysis of change options. These authors characterize dynamic modeling as a structured approach to analyzing and diagnosing organizational problems and are formal, executable, comprehensible representations of primary business processes of the organization. Although these modeling experts use the term business engineering and dynamic modeling, the concepts are no different from those for enterprise integration modeling.

Enterprise integration modeling methodologies as an organizational design and planning tool continue to attract considerable interest as a research area in the recent years. This interest is evident from research studies (Petrie, 1992; Bernus & Nemes, 1996b; Bernus, Nemes & Williams, 1996c; Christensen and Johnansenm, n.d; Fraser, 1994; Hsu, 1996), reference architectures (Bernus, Nemes & Williams, 1996c) and reported business success stories (Christensen and Johnansenm n.d.). Christensen and Johnansenm (n.d.) in looking at common practices and perspectives provided a historical

sketch of the technology as it moves from 'information systems development' via 'business process re-engineering' to 'enterprise integration' and taking it further to the concept of a 'virtual corporation'.

Inherent general features of an enterprise integration models as defined in the enterprise integration architecture emphasize the purpose for which enterprise models are built thus different types of information at different levels of detail for analysis; reflect different aspects of business objectives, work processes, products, and organization of humans and resources; exist in the minds of humans or in computers (conceptualization); and is domain independent (Christensen and Johnansenm no date, n.d.). The enterprise integration architecture therefore is a framework that encapsulates enterprise modeling methodologies thus representing a departure from the mechanistic information system design principles that results in a less mechanical design of human-executed business processes through co-ordination of management actions, people, information systems, processes and roles (Bernus & Nemes, 1996b).

Whitman (1998) posit that models are 'living representation of an enterprise', thus enterprise integration models is an abstract representation of reality. This representation requires a modeler to determine which aspect of the real system is of interest and which system elements are to be modeled. Whitman's (1998) understanding of enterprise integration model is in line with other definitions mentioned previously. He further stated that (in quoting Presley, 1997) enterprise integration models are symbolic representation of the enterprise and the things that it deals with. It [model] contains representations of individual facts, objects, and relationships that occur within the enterprise.

Given the foregoing working definitions and the evolving nature of this untapped managerial technique for engineering an enterprise for integration purposes, it necessary to formulate a working definition for this research that reflect the fundamental concepts and principles associated with this engineering paradigm and to put this approach in the context of this study. Enterprise integration modeling represents a planning tool for linking organizational objectives with enterprise integration architecture objective. Linking these two planning outcomes is a different approach for achieving full integration as in Teo (1994), performing enterprise analysis (Petrie, 1992), and managing an enterprise through it life-cycle (Bernus and Nemes, 1996b).

Enterprise integration modeling is a collection of tools and methods to design and continually maintain an integrated state of the enterprise, that is, to enable the collective co-ordination of all parts of the enterprise to enable it to execute the enterprise mission as establish by management. Enterprise integration modeling in this framework is the linkage mechanism for integrating organizational objectives with the enterprise integration architecture objective. Enterprise integration models represent various management and control processes as well as services and production processes, resources, organizational and product sub-models of the enterprise that will define the scope, depth, and elements of the enterprise integration architecture. An enterprise integration model is an expression of what the enterprise intends to accomplish and how it operates.

Framework for Enterprise Integration Modeling

Enterprise integration modeling is receiving much interest in both the academic and practice-oriented community. There are several pivotal works contained in

referenced technical publications that provide theory and methodology, and reference models along with discussions regarding the state-of-the-art (Petrie. 1992; Kosanke and Neil, 1997). Bloom (1997) in describing U.S industry efforts to develop techniques and standards needed to support enterprise integration, highlighted several major programs and activities that incorporate enterprise integration modeling concepts as the basis for enterprise integration. United States is not alone in this type of endeavor. There are several European programs in progress, many with successful implementation and publication of reference frameworks and case studies (Vernadat, 1996).

The significance of this concept for enterprise analysis for life cycle management, enterprise integration and formulation of an enterprise integration architecture is recognized by the International Standards Organization (ISO) through the International Federation of Automatic Control/International Federation for Information Processing (IFAC/IFIP) task force proposed adaptation of the Generalized Enterprise Reference Architecture and Methodology (GERAM) framework as an annex to ISO WD15704 (Requirements for enterprise reference architecture and methodologies) standard.

Enterprise integration modeling enable the handling and managing of complex real world issues commonly found in organizations and is conceptually sound as a management technique for enterprise engineering since the theoretical underpinning is supported by systems theory (Braune, Hofmann, Jochem, Konig, Lutz-Kunish, and Pirron, 1995). These commentators (Braune, et al 1995) in reviewing the literature on the methodological aspects of enterprise integration modeling, noted that the various methodologies emphasize different aspects of systems theory but the three mostly used aspects of this theory are: (1) The structural aspect which focus on the interdependencies

among elements within a systems thus providing an explanation of why a systems (whole) exhibit properties that are from it's parts (elements); (2) the behavioral aspect that defines the variables and their functional or other relationships; and (3) the hierarchical aspect which is the principle that elements in of themselves can be regarded as a systems (sub-system) or can be an element of another system (super-system).

Application of systems theory to modeling concepts and specifically those noted previously allow for the directionality of analysis in that lower level analysis provides detailed descriptions of the system under consideration and how it achieves its purpose. Moving to a higher level will provide an understanding of the role of the system within its environment. The use of systems theory in enterprise integration modeling methodologies put the state-of- the-art in the context of formalized planning for organizational understanding and development.

Organizations models are continually evolving in response to business drivers in the external environment. Business drivers by nature pose different types of uncertainty in the planning process for competitive advantage and or for strategic information systems developmental planning program. Critical elements in any of these planning exercise is the enterprise ability to respond to customers changing needs, optimization of supplier's value chain, and reducing time to market for products and services. Information technology as a critical element consumes an enormous amount of financial resources thus it must be analyzed in the same light as that for business strategy. Information technology strategy analysis must focus on gaining an understanding of the technology marketplace from a demand and supply perspective (Goodman and Lawless,

1994). Taken together these two approaches, while operating in two distinct external environments are tightly linked for achieving enterprise integration goals.

Enterprise Integration Architecture (8)

Enterprise integration architecture development can be viewed from the following concept: Every business has an inherent architecture that orchestrates how work is structured and performed and the integrated model can produce an architecture based enterprise roadmap into detailed work structures.

Zachman (1987) is perhaps the first commentator to recognize the importance of information systems architecture (ISA). He developed a framework first proposed in 1987 and later extended in 1992 as a means for developing and or documenting enterprise-wide information systems architecture. This seminal research provided the fundamental basis for future approaches for thinking about architectural design for information systems development. Since developing this framework, many terms have been attributed to the process of developing architectures. Zachman (1987) defined his framework as a simple, logical structure of descriptive representations for identifying models that are the basis of the enterprises design and building the enterprise systems.

In this research, the term 'enterprise integration architecture' is used to denote a broader concept and methodology for the design and implementation of architectures. It is necessary therefore to provide a working definition for the term "enterprise." An enterprise can be defined as a set of interdependent actors, with at least partially overlapping goals, working together for a period in order to achieve some of their stated goals (Christensen and Johnansenm, n.d.). Such coordination between goals require a framework that link "the networks of business processes which form the product value

chain [and] the networks of business processes which encompass the decisional and management functions of the enterprise" (Bernus and Nemes, 1996b, p. 6).

To design an enterprise and manage it through their life-cycle, fundamental principles of design, methodologies based on these principles and supporting tools (Bernus and Nemes, 1996b) form the basis for an enterprise integration architecture, that capture functions, descriptions, or behaviors of types of systems and their associated structures or frameworks (Bernus and Nemes, 1996b). Thus, enterprise integration architecture forms the basis for the development of a device, system or project for carrying out an information integration program for an enterprise (Bernus and Nemes, 1996b).

There are two types of architectures connected with enterprise engineering that deals with enterprise integration: The structural arrangement (design) of the physical system such as the computer control system part of an overall enterprise integration system *(systems or computer integration is generally considered vendors solution)* and can become major sub-unit of the second type. This is TYPE 1 architecture. The structural arrangement (organization) of the development and implementation of a project or program such as manufacturing or enterprise integration or other enterprise development program. This is TYPE 2 architecture -- Enterprise Reference Architecture that addresses the complete life-cycle methodologies for engineering the enterprise (Bernus, Nemes and Williams, 1996a).

Developing a architecture is one of the many key issues facing information technology executives (Rosser, 1996; Brancheau, Janz et al, 1996). Information technology expenditures continue to grow as more investments are made to meet

demands by business managers on information systems organizations to provide business applications and technology infrastructures that will ensure competitive advantage while optimizing business processes. In addition to internal architectural developmental programs, many vendors are proposing frameworks of their own as a means to insure market dominance for their products and or services (Stevenson, n.d.).

Bemelman and Jarvis (1996) observed from the literature and field research that existing reference architectures say nothing about strategy formulation or provided any information regarding linking architectural components to business strategy. To illustrate their point, these authors applied a simplified change process model to analyze reference architectures such as (1) GERAM (Generalized Enterprise Reference Architecture and Methodology), (2) CIM-OSA (Computer Integrated Manufacturing-Open Systems Architecture), (3) GRAI-GIM (Graphs with Results and Activities Interrelated-GRAI Integrated Methodology), and (4) PERA (Purdue Enterprise Reference Architecture).

Their analysis summary suggested that GERAM spans products, enterprises, enterprise integration, and strategic enterprise management with emphasis on the enterprise and enterprise integration. CIM-OSA makes the assumption that enterprise management in initiating the project, defined the goals and objectives for the project and that the scope of the project have been established prior to project start thus strategy is not directly addressed in this methodology. GRAI-GIM is production systems indicators focused thus linkage to organizational objectives is not considered. PERA is more direct in recognizing the importance for determining organizational goals, objectives and critical success factors (aspects of Rockhart's work on CSF [Critical Success Factors] is

an integral part) but view this from a process interface perspective when developing the master plan.

Enterprise Engineering Management (9)

Enterprise engineering management process is that body of knowledge, principles, and practices having to do with the analysis, design, implementation, and operation of an enterprise (Whitman, 1998). This definition is similar to that of Vernadat (1996) who stated that it is the art of understanding, defining, specifying, analyzing, and implementing business processes for the entire enterprise life cycle, so that the enterprise can achieve its objectives, be cost effective, and be more competitive in its market environment.

Enterprise engineering as a process management technique continue to evolve and is becoming a critical organizational planning tool for business model development and process optimization. Unlike other management techniques of this nature (BPR I, TQM), enterprise engineering methodology was incorporated into ISO standards for enterprise reference architectures and methodologies. The ISO in its standard defined enterprise engineering as:

> "[T]he collection of tools and methods which can be used to design and continually maintain an integrated state of the enterprise, that is, to enable the collective co-ordination of all parts of the enterprise to enable it to optimally execute the enterprise mission as established by management" (ISO/TC184/SC5WG1, 1998 p.3).

A management technique needs to have a methodology to support acceptance as a viable tool for its intended purpose. Enterprise engineering is a methodological approach for enterprise analysis as was noted previously. This methodology is documented in the GERAM (1998) framework and is one of the elements of this researcher's linkage

framework. The GERAM (1998) methodology describes the processes of enterprise integration and is applicable to any enterprise regardless of the industry involved. GERAM (1998) defined the methodology purpose as the method for helping users in the process of engineering an enterprise for enterprise integration whether such project is to revitalize the enterprise or management of change. It further stated that enterprise-engineering methodology might be described in terms of process models or descriptions with detailed instructions for each type of activity of the integration process.

GERAM (1998) methodology consists of three aspects of organizational life. First, human factors that define the phases/steps to be followed when engineering the integration project along with the manner in which organizational participants collaborate in the project. The second aspect relates to project management structures to design and implement the integration elements in an efficient manner. Finally, the third aspect is the economics that allow for decomposition of the strategic objectives into sub-objectives of each function and specification of the technical solution thus a technical-economic evaluation of the integration project.

Perkins (1997) in describing this concept stated that enterprise engineering provided both a road map and a vehicle for an enterprise journey into the future. This futuristic view is supported by the enterprise engineering life-cycle that is multi-phased in its approach with the view of coordinating strategic, operation, and organizational demands. This life-cycle approach follows the methodology presented previously but is fine tuned to elicit the enterprise mission and identify external business drivers. This approach enables the architect to perform a SWOT (strength, weakness, opportunity, threats) analysis, link objective with strategy, develop both strategic and operational

plans, effect design to integrate function to meet goals and objective, implement information systems to support the desired change, put in place performance metrics, and re-evaluate changed processes over time.

Relationships between enterprise integration and modeling and enterprise integration architecture with enterprise engineering management are documented in the literature (Bernus, Nemes and Morris, 1996; Liles and Presley, 1996; Perkins, 1997). The strategic importance for large-scale entities integration design effort was confirmed by a co-opting team of designers, analyst, and managers who applied one of the many generic life-cycle models available for enterprise engineering (Bernus et al, 1996; Perkins, 1997; Liles and Presley, 1996) with a high level of success.

Vernadat (1996) in his summary of the concepts devised an enterprise engineering methodology that is similar to others noted previously. His methodology provided a set of enterprise engineering principles for performing the enterprise analysis. This approach consists of the following phases:

1. Enterprise engineering environment (EEE) that incorporate strategic master planning. Here mission definition is the focus of attention that forms the basis for the next element within the EEE. Requirement definition is then pursued during which business process modeling/re-engineering is done along with consistency checks to assure that there is correspondence between the strategic master plan and business models. The process then moves into what is termed a formal business process definition per domain as the means for design specification. Design specification is accomplished through systems analysis and model simulation/animation and Petri Net models. This allows for performance evaluation and database design. The enterprise architect then focuses on the detailed systems specification aspects in preparation for the implementation description development. Implementation description is concerned with the physical system layout design, computer network and database configuration, and formal description/validation and certification of the previous steps. (p.465)
2. System installation is the next phase and is concerned with decisions around build or buy and test. (p.465)

3. The third and final phase is enterprise operation environment. This is where the enterprise architect executes the overall plan to implement the integrating infrastructure. (p.465)

The use of enterprise engineering management methodology for strategic business engineering (vanMeel, Wsol and Henk, 1996) ensures that enterprise life-cycle phases become an integral part of both business and technology strategy formulation process. In toady's competitive environment, organizations must incorporate enterprise integration as a pivotal strategy in the strategy process; this requires a framework such as (GERAM, 1998) and this researcher's proposed model (see Chapter 3 for details of this model Enterprise Integration Architecture Planning and Methodology Framework and Methodology (EIAPM/M)) developed for this study. Application of the enterprise engineering framework on a continual basis facilitate engineering in a systematic manner, the development and ongoing improvements of enterprise systems and processes due to the ability to provide methods for business process definition, cost-based analysis, logistics, process design, resource selection, or design layout including workflow management, information system design and organizational structure (Vernadat, 1996).

Summary

Enterprise engineering is a methodological approach for strategic business engineering. Enterprise integration is the focus of this methodology and is accomplished first by developing enterprise integration models that in turn drive the development of the enterprise integration architecture. However, the literature did not provide any direct insights into what constitutes architectural objective and a linkage construct that would enable alignment between the enterprise integration architecture and organizational objective. On the other hand, there was sufficient data culled from the literature that advanced the development and definition of a linkage model that was empirically tested.

Business strategist as they seek ways to differentiate products and or services for competitive advantage, extend their business models to include external business partners in an effort to minimize impacts associated with supply chain uncertainties. Theses strategist recognized the importance of information technology as an enabler and change agent thus alignment of business strategy and information systems strategy is in their thinking a vital strategy content issue.

The purpose for carrying out an enterprise-engineering program is the integration of the enterprise functions and information technology infrastructure. Commentators on the subject approached this strategy from several perspectives (Petrie, 1992; Bernus and Nemes, 1996b; Bemelman and Jarvis, 1966; Bernus, Nemes and Williams, 1996a; Fox, 1996; Gonzales and Molina, 1997; Goranson, 1992; Hsu, 1996) but they all agree on the benefits a firm can realize by it's application. To achieve an integrated enterprise it is necessary to develop enterprise integration models of the enterprise as the basis for defining and selecting information technology that enables the organization to reach its strategic potential.

Enterprise integration modeling allows for the development of an enterprise integration architecture (Bernus, Nemes, and Williams, 1996a) that provides key decision makers with a roadmap for carrying out an information integration program that seeks to align business strategy with information systems strategy. While the literature acknowledged the importance of this diagnostic technique, it is not widely used as panning tool due to a lack of understanding by corporate planners and information systems executives regarding it's value for structuring areas of concern that help to clarify the thinking about the area under consideration and aid in defining the structure,

logic and behavior. Additionally, models can operate as a problem-solving process for analyzing different options and provide solution for the area under consideration (Fraser, 1994)

The benefits are clear. Research findings provided empirical support for an organization's adaptation of this diagnostic technique for enterprise integration and architecture development and maintenance (Bernus, Nemes, and Williams, 1996a). What is not evident from the literature is the connection between enterprise integration models and modeling as a planning tool for linking organizational objectives with architectural objective or how models as diagnostic tool assist both information systems and business planners with business engineering task.

Enterprise integration architecture represents the blueprint of an organization's information integration strategy. The architecture defines those components (current and future) the enterprise consider vital for it's infrastructure. The infrastructure is self-supporting but must be linked to the fundamental purpose for the enterprise's existence.

Support for pursuing development of enterprise integration architecture is documented in the research and practice-oriented literature. Its importance can be attributed to increased spending on information technology and the continuing search by information systems executives for frameworks and methodologies that advance their efforts in developing an architecture that is linked to business strategy. While enterprise integration architecture is the basis on which enterprises implement enterprise integration strategy, the literature did not provide any empirical support for linking architectural components to business strategy (Bemelman and Jarvis, 1996).

Chapter 3

Conceptual Model and Research Methodology

Overview

This chapter is organized into four sections. The first section provides a detailed explanation of the enterprise integration architecture-planning model and methodology for this research. Section 2 outlines the research methodology employed and in section three, aspects of the instrument development, validation approach, and factors that impact the outcome of this study are delineated and expected results outlined. Section four, provides closure for this chapter in the form of a summary.

Conceptual Planning Model and Methodology

The Model

Debates regarding the pros and cons for developing enterprise integration architecture and the need for implementing enterprise integration strategies are commonplace among business planners and information technology executives due to the changing information technology market place (Brown, 2001; Rabin, 2001). This debate is centered on funding the evolution of information technology infrastructure since information technology executives must justify prior and future infrastructure investments on a value-added basis, a difficult task given that benefits are generally indirect, intangible, and long-term in nature (Zmud, 1997 March). Information technology capital costs it is estimated, consumes a substantial portion of corporate spending (Strassmann and Bienkowski, 2000) and some commentators (Brancheau, Janz and Wetherbe, 1996) believe expenditures will continue to rise as more enterprises seek

to leverage information technology for competitive reasons (Butler, 1996; Cash et al., 1994; Davenport and Short, 1990; Tapscott, 2001).

Formulating an information technology strategy that is linked to business strategy continues to be of paramount importance to line executives and information technology executives as well (Strassmann and Bienkowski, 2000). Business executives need demonstrable proof that the infrastructure will support current operations and have the ability to support future business strategy in ways that ensure competitive advantage (Numamaker, Jay and Briggs, 1996; Strassmann and Bienkowski, 2000).

Conventional approaches for aligning information technology with business strategy provide a high-quality framework for business strategy-information systems planning integration (Goodman and Lawless, 1994; Henderson and Venkatraman, 1991; Teo, 1994; Zviran, 1990) at the social and intellectual dimensions level (Reich and Benbasat, 1996). These models however fall short of providing the means and tactics for evolving business models (Bennett and Hedlund, 2001), evolving information technologies, standards, and suppliers' architectural models, many of which while advocating "open systems" are in fact ensuring suppliers' competitive edge (Goranson, 1992).

What is necessary are new ways of thinking and a methodology for guiding enterprise integration strategic goals and the identification of integrating technologies that are tightly coupled with the enterprise strategy. Enterprise integration architecture provides this structure (Bernus, Nemes, and Williams, 1996a). To ensure that information technology investments support strategic and operational initiatives, there must be a linkage between strategy and the architecture (Strassmann and Bienkowski, 2000). This

linkage can be accomplished by coupling organizational objectives with enterprise integration architectural objectives.

To achieve this new way of thinking and planning, this researcher proposed an Enterprise Integration Architecture Planning Model and Methodology (EIAPM/M). This model is a "holding place" for facilitating the development of enterprise integration architecture. It (EIAPM/M) is a collection of concepts, methods, and tools for performing enterprise engineering for enterprise integration purposes. The associated methodology delineates how to use this model during an enterprise integration architectural development project. This model is principally concerned with designing an enterprise integration architecture that incorporates organizational and architectural objectives thus a planning profile of variables for linking these two sets of objectives.

Model description

Enterprise integration and modeling is an enterprise engineering management activity (Liles and Persley, 1996). Enterprise engineering is defined by the Working Group III of the 1992 International Conference on Enterprise Integration Modeling and Technology (ICEIMT) as a Business Modeling (B-Modeling) process for modeling the business for enterprise integration purposes. It is composed of two major activities (WGIII, 1992): (1) Ontology Engineering and (2) Model Engineering. Deliverables from these activities are (a) generic ontology, (b) business domain specific ontology, and (c) business models.

Whitman (1998) provided this definition for enterprise engineering: "Enterprise engineering is defined as that body of knowledge, principles, and practices having to do

with the analysis, design, implementation, and operation of an enterprise" (p. 10)

Another expert in the field, Vernadat (1996) provided this definition:

> "Enterprise engineering is the art of understanding, defining, specifying, analyzing, and implementing business processes for the entire enterprise life-cycle, so that an enterprise can achieve its objectives, be cost-effective, and be more competitive in its market environment". (p. 30)

In keeping with definitions already detailed above, the International Standards Organization Technical Committee on *Industrial Automation Systems and Integration*, Sub-committee on *Architecture and Communication*, Working Group on *Modeling and Architecture* provided this definition in it's standard dated August - 28, 1997 titled Requirements for Enterprise Reference Architectures and Methodologies (ISO/TC184/SC5WG1, 1998):

> "The collection of tools and methods which can be used to design and continually maintain an integrated state of the enterprise, that is, to enable the collective co-ordination of all parts of the enterprise to enable it to optimally execute the enterprise mission as established by management". (p 9)

With the issuance of ISO/DIS 15704 (Requirements for Enterprise Reference Architectures and Methodologies) standard (ISO/TC184/SCWG1, 1998), enterprise engineering was fine grained to reflect a body of knowledge that was developed from intensive research and experimentation and field-testing by several investigators in the field of enterprise integration architecture and modeling and enterprise engineering. These efforts elevated enterprise engineering methodology to a discipline status (Liles and Persley, 1996) and formal standardization for enterprise integration modeling and architecture development using the GERAM (1998) model (ISO/TC184/SC5WG1, 1998).

Enterprise integration modeling and enterprise integration architecture efforts cannot be pursued in isolation but must be entombed in the strategy planning process as organization move to a more integrated business model. Alignment of information systems planning with that of business strategy provides a proven set of integrated methods for devising information technology solutions (Bulter and Fitzgerald, 1999; Chan and Huff, 1993; Burn, 1996; Henderson and Venkatraman, 1991).

Figure 5 is the conceptual Enterprise Integration Architecture Planning Model and Methodology (EIAPM/M) developed by this researcher as the means by which linkages between organizational objective and architectural objective can be accomplished. The model structure was influenced by Henderson and Venkatraman (1991) strategic alignment model research (Figure 2) along with ideas and concepts found in the information systems planning domain.

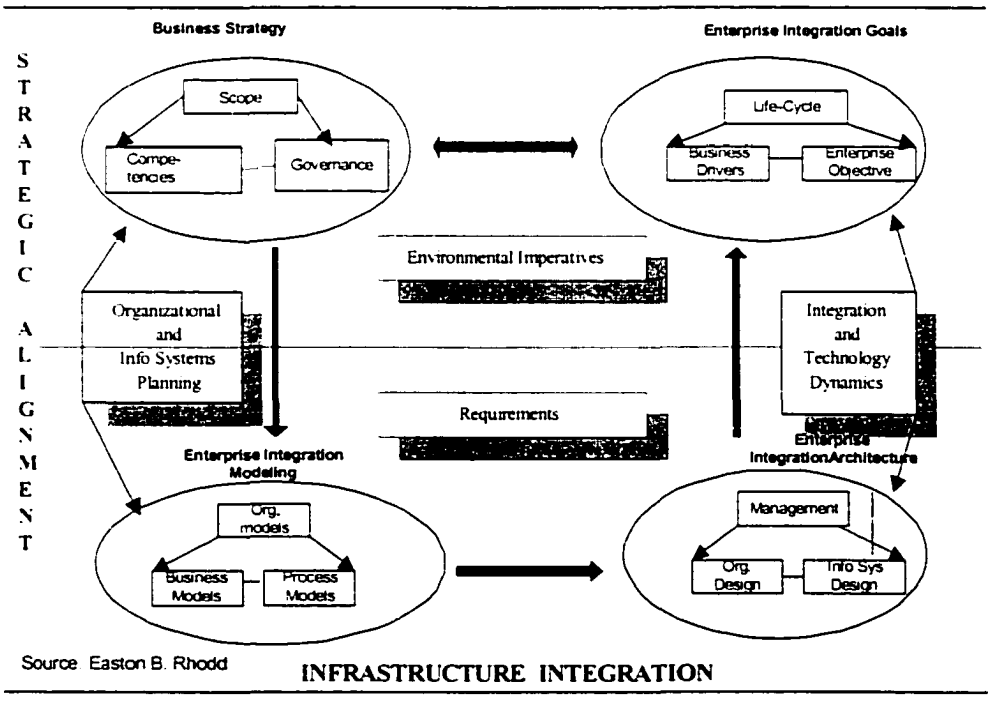


Figure 5 Conceptual planning model

In this model, the following substitutions were made to the SAM (Henderson and Venkatraman, 1991) in order to customize alignment concepts to business strategy and enterprise integration architecture linkage: (1) IT Strategy was replaced with Enterprise Integration Goals; (2) IT Infrastructure was replaced with Enterprise Integration Architecture; and (3) Organizational Infrastructure was replaced with Enterprise Integration modeling. Additional elements in this model (EIAPM/M) that is not found in Henderson and Venkatraman (1991) model includes (a) Organizational and Information Systems Planning, (b) Integration and Technology Dynamics, (c) Organizational Models, Business Models, and Process Models, (d) Life-cycle, Business Drivers, and Enterprise Objective, (e) Management, Organizational Design, and Information Systems Design.

To complete the model for the intended purpose, Environmental Imperatives and Requirements constructs were added since they represent linkage variables. Functional Integration was substituted with Infrastructure Integration and Strategic Fit (Henderson and Venkatraman, 1991) replaced with Strategic Alignment (Woolfe, 1993). Business Strategy along with associated components was retained from the Henderson and Venkatraman (1991) model since it integrates organizational objectives into the planning model. Details of the proposed model and methodology follow.

The model developed in this study incorporates enterprise engineering theories, principles, and concepts in addition to concepts and theories relating to business strategy planning, enterprise integration, enterprise integration modeling, and enterprise integration architecture. It also defines directional interplay among the major elements of the model to achieve linkage between business strategy and enterprise integration architecture.

Organizational and information systems planning are management agenda items that forms a strategic management process through which organizational participant formulate organizational objectives to meet enterprise mission. Likewise, integration and technology dynamics represents integration approaches subject to the level of project scope and analysis (unstructured, structured, and pragmatic) undertaken by the enterprise architect (Brown, 2001).

For this model, the ISO definition (ISO/TC184/SCWG1, 1998) noted previously is the basis for interconnecting the various model components with each other for deriving linkages. ISO definition is the impetus for directing linkages between organizational and architectural objectives. Following is a description of the EIAPM/M components.

Model components description

The model directs integration along two dimensions: Strategic alignment representing vertical integration (Henderson and Venkatraman, 1991; Woolfe, 1993; Vernadat, 1996) of an enterprise decision-making processes and infrastructure integration representing horizontal integration (Vernadat, 1996) of (a) technology for information access and (b) enterprise-wide information independent of the technology that is incorporated into the enterprise integration architecture. Strategic alignment (Woolfe, 1993) and infrastructure integration (Vernadat, 1996) is the context within which enterprise integration occurs over the life-cycle of any enterprise engineering activity as enterprise management pursue organizational and information systems planning, and direct their attention to integration and technology dynamic issues facing the enterprise (Bernus and Nemes, 1996b; Vernadat, 1996).

The purpose of this planning model is to achieve organizational linkages (NRC, 1997) between organizational objectives (Zviran, 1990) and enterprise integration architecture objectives thus a "tight coupling" between the enterprise integration architecture elements in support of business strategy. In this proposed planning model, strategic alignment thinking provides the context for understanding the nature of linkages to achieve alignment between these two set objectives. It (strategic alignment) forms the vertical integration aspects of an enterprise; integration between the various management levels of the enterprise (decision-making integration) thus defining organizational constraints for lower management levels which in turn provide feedback information (performance measures) to the upper levels of management who use this data for strategy re-definition or management of change.

Enterprise integration in this planning model, co-ordinates the enterprise's strategic, tactical, and day-to-day decisions by implementing efficient and timely information flows, and organizational structures that allows for the use of this information in an optimal way to control the manner in which organizations respond to business drivers (Vernadat, 1996). Infrastructure integration is concerned with horizontal integration (Vernadat, 1996). Infrastructure is defined at two distinct but related levels of analysis: On one level, there is information technology infrastructure (ITI) which is the hardware and software, put in place to support access to and use of the information infrastructure. The other level of analysis is concerned with essential information, independent of technology that is required to meet both short and long-term goals of the enterprise. This is the information infrastructure (II) which is all the information that is

considered key to measurement, control, and enterprise-wide management (JISC, 1996; Vernadat, 1996; Isworld, 1998).

Components rationale and descriptions

In Figure 5 (the planning model), several components are included. These components determine the information types and analytical actions the enterprise architect will pursue while formulating linkages for enterprise integration architecture definition. The following rationale and descriptions provide model users with contextual information for understanding the application of this model:

Organizational/information system planning is the decision-making activity corporate planners undertake to determine long-term business and information systems strategies. Long term strategic directions are predicted on evolving business models that extend functions and processes across organizational boundaries (horizontal integration) and decision flows between management levels (vertical integration) (Fraser, 1994; IBM, 1981; Spewak and Hill, 1992).

Integration/technology dynamics are operational business drivers that influence the enterprise ability to deliver on planned strategies. Integration approaches and level of analysis is the focus (Brown, 2001; Kalakota and Whinston, 1993).

Environmental imperatives are factors that force organizational models and or business process change in order to maintain competitive position and or achieve efficiencies and effectiveness in business processes and the application of information technology in the change management process. Environmental imperatives are related to the overall enterprise; factors are either internal or external or a combination of both. Environmental imperative is goal directed in that it identifies business strategies and concerns around

which enterprise integration architecture should be built (Davenport and Short, 1990; Goodman and Lawless, 1994; Tapscott, 2001).

Requirements are specifications for building enterprise models that will direct the design aspects of the enterprise integration architecture. These models are dynamic in that both organizational/information systems planning and integration/technology dynamic receives data from environmental imperative thus both business strategies and enterprise integration goals are evaluated for linkages between strategy and architectures (Bernus and Nemes, 1997; Bernus, Nemes and Williams, 1996a; Fraser, 1994; Fox and Gruninger, 1997; Goranson, 1992).

Strategic Alignment describes the state in which goals and activities of the business are in harmony with information systems that support them (Woolfe, 1993).

Infrastructure Integration is the process of incorporating enterprise integration techniques into the enterprise's strategy definition (Vernadat, 1996). Enterprise modeling methodology is the tool used to model the business processes and the development of (1) business architecture, (2) information architecture, (3) human resources architecture, and (4) information technology architecture (application, hardware, and communications) thus forming enterprise integration architecture (Bernus and Nemes, 1997c; Petrie, 1992).

Business Strategy represents the enterprise unified set of plans that integrate major goals, policies, and action sequences into a cohesive whole (Fraser, 1994; Bryson, 1988). These plans are the result of a strategic planning process at the business function and information technology levels of the enterprise (IBM, 1981). Strategy formulation is influenced by enterprise integration strategy (goals) and not the underlying technologies

available for systems integration (Bernus, Nemes and Williams, 1996a). In this instance, enterprise integration is viewed as a strategy rather than a technology (CIMOSA, 1994). Enterprise Integration Goals facilitates improvement in the task-level interactions among people, departments, services, and companies (Petrie, 1992). Enterprise integration goals represent an enterprise's infrastructure integration solutions and computer-based tools that facilitate levels of integration [physical, application, and business] across the enterprise (Bemelman and Jarvis, 1996; Bloom, 1997). Enterprise integration goals support the business strategy (while business strategy defines the nature and type integration an enterprise will embrace) by way of interaction of both business unit manager and information systems management through underlying decision-making infrastructure (Kalakota and Whinston, 1993). Decisions are based on organizational objectives defined in the strategy making process (Bryson, 1988; Fraser, 1994; Zviran, 1990). Enterprise Integration Modeling is a collection of tools and methods to design and continually maintain an integrated state of the enterprise, that is, to enable the collective co-ordination of all parts of the enterprise to enable it to optimally execute the enterprise mission as established by management (ISO/TC184/SC5WG1, 1998). Enterprise integration modeling in this model is the linkage mechanism for integrating organizational objective with the enterprise integration architecture objectives. Enterprise models represent various management and control processes as well as services and production processes, resources, organizational and product sub-models of the enterprise that will define the scope, depth and elements of the enterprise integration architecture. An enterprise model is an expression of what the enterprise intends to accomplish and how it operates (Bernus and Nemes, 1996b).

Enterprise Integration Architecture is a type 2 architecture (it may contain type 1 architecture that deal with structural arrangement (design) of a physical system for enterprise integration). It (type 2 architecture) describes the structural arrangement (organization) of the development and implementation of an enterprise integration project or program (Bernus and Nemes, 1997c; Bernus, Nemes and Williams, 1996a). Enterprise models represent views from which architectural objective are defined in concert with organizational objectives thus allowing for the definition of policies and guidelines that govern the arrangements of information technology tools along with human resources capabilities (Bernus and Nemes, 1996b; Bernus and Nemes, n.d.). This architecture represents a blueprint of what capabilities the enterprise intends to acquire and how the enterprise will assemble these capabilities for enterprise life-cycle conceptualization, design, development, operation, and dismantling (Bernus, Nemes and Williams, 1996a; GERAM, 1998; Rosser, 1996; Spewak and Hill, 1992; TOGAF, 1998).

Enterprise Integration Architecture Modeling Process

The focal point of EIAPM/M is achieving organizational linkage (NRC, 1997) between strategy and architecture. Enterprise integration modeling is an enterprise-engineering task that is not utilized in the strategy formulation process and for the creation of architectures, but with the pronouncement of ISO/DIS 15704 standard, its use can be expected to be utilized by several organizations and enterprise integration architects as they design and develop enterprise integration architectures. The use of enterprise integration modeling in this model is crucial for achieving linkages between organizational and architectural objectives each of which is derived from the strategy formulation process. The main idea behind this modeling activity is to enhance

enterprise management's ability to predict the impact of environmental imperatives on the enterprise ability to design relevant enterprise integration architectures that support defined business strategy.

Enterprise integration modeling allows corporate planners to map every part of the enterprise to expressed strategic goals. Corporate planners can then simulate and visualize different scenarios of enterprise optimization and assess what needs to be changed and the necessary trade-off to be effected (van Meal and Wsol, 1996). Figure 6 is a graphical representation of the enterprise integration architecture modeling that reflects this researcher's view of enterprise integration modeling for linking organizational and architectural objectives.

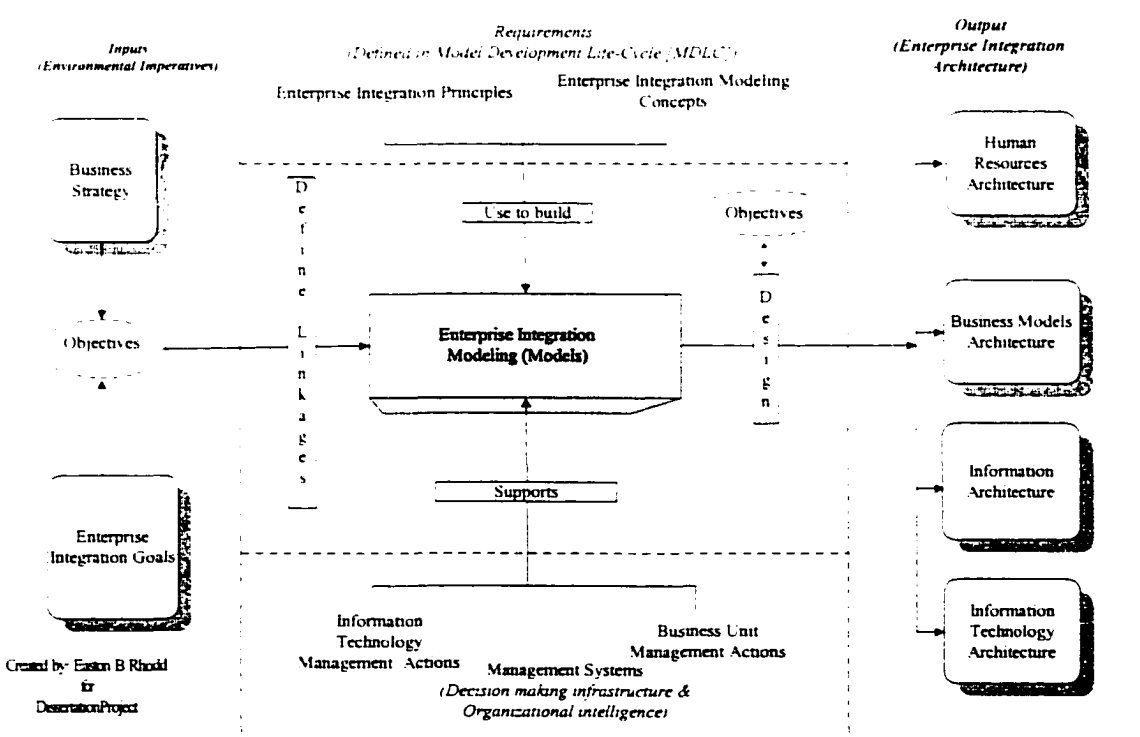


Figure 6 Enterprise integration modeling activity

Description and Explanation

There are five elements (environmental imperative; requirements; management systems; enterprise integration architecture; enterprise integration modeling) in this modeling activity as shown in Figure 6. The element represented by the enterprise integration modeling box is the enterprise modeling process used by the enterprise architect to analyze and construct various enterprise models. Inputs to this element are represented by arrow(s) flowing into the left hand side of the activity box; output(s) are represented by arrows flowing out the right hand side of the activity box; arrow(s) flowing into the top portion of the box represent constraints or controls on the activity; and the final element represented by arrow(s) flowing into the bottom potion of box are the mechanisms (resources) that define the organizational context within which enterprise integration takes place.

Operation

Input side: Environmental imperatives resulting from organizational and information systems planning activities represent linkages that affect enterprise integration architecture development and the quality of information contained in processes used for managing the enterprise activities. Environmental imperative is operationalized as business strategy and enterprise integration goal factors that are critical for formulating mission, strategy, and objectives, and that the planning activities applied are comprehensive for alignment. Organizational objectives are the primary focus of this modeling activity and are the basis for which enterprise integration architecture is develops to support an enterprise strategic thrust thus linking organizational objectives with the enterprise integration architecture objectives.

Constraint or control side: Requirements are governed by GERAM (1998) concepts. GERAM (1998) is an ISO framework that defines a tool-kit of concepts and methodology for designing and maintaining enterprises for their entire life history thus organizing enterprise integration knowledge into a cohesive whole. EIAPM/M is a holding place for application of GERAM (1998) in this modeling activity. The enterprise architect selects those aspects of GERAM (1998) that is important for enterprise model and architecture development. It is therefore necessary for the Modeler to approach the modeling activity in a methodological manner by applying a Model Development Life Cycle (MDLC) methodology (Fraser, 1994a p. 4). The MDLC consist of four stages:

(1) Setting of objectives and scope that includes (a) problem formulation; (b) objectives; (c) constraints/boundaries.
(2) Create the model by doing (d) data/knowledge gathering and analysis; (e) model formulation -- conceptualization of model structure and content, selection of modeling paradigm and language, coding the model in the language; (f) verification and validation.
(3) Use of the model through (g) definition of objective questions that the model will assist in answering; (h) designing model experiments; (i) assign values to variables; (j) analysis of the results.
(4) Maintain the model with respect to: (k) the entity/system that is modeled; (l) the requirements on the model.

Mechanism side: Management systems (who manages, what is managed, and how managing is done) consist of the decision-making infrastructure (tools to convert data to information) and organizational intelligence (value-adding processes) used by organizational actors (management team) for managing the enterprise (NRC, 1997). Information technology management and business strategy management actions are

influenced by process and technology integration dynamics (business drivers) in the external and internal environments. Management actions are derived from scanning operational data to determine actual performance against some pre-determined metrics thus allowing for decisions adjustments that lead to achieving planned strategic goals. Modeling for enterprise integration (application, Interoperability, client/server architecture, information neutralization and semantic unification, functional modeling, process coordination, integration platform, vendor independence (Vernadat, 1996) and technology feasibility (Goodman and Lawless, 1994) in relation to environmental imperatives [input side]) is supported by the management system.

Output side: Enterprise integration architecture development and ongoing maintenance is the object of the enterprise integration modeling activity (GERAM, 1998). Achieving a "tight coupling" between organizational and architectural objectives is the primary focus of the enterprise architect (Liles and Persley, 1996), thus linkages between business strategy and the enterprise integration architecture. The architecture is the product of the strategic planning exercise undertaken by corporate planners (Bernus, Nemes and Williams, 1996a; Bemelman and Jarvis, 1996; Goldsmith, 1991; Hay and Munoz, 1997). The enterprise architect is guided by organizational objectives (Zviran, 1990), architectural design objectives and enterprise integration goals during design of component parts of the enterprise integration architecture. Enterprise integration architecture in this instance is a collection of individual architectures that leverage each other (interdependency) but must be independent enough to be a stand-alone document to facilitate managerial decision-making within those parts of the enterprise it represents.

Enterprise integration architecture given its role in supporting various business strategy is defined as a strategic knowledge repository which define the business models (Spewak and Hill, 1992; Zachman, 1987); the information flows and use to accomplish the enterprise vision, mission, goals, and objectives (Hsu, 1996); the information and communications technologies on a priority basis for supporting the business processes (GERAM, 1998; TOGAF, 1998); knowledge management structure to assemble appropriate levels of human resources to implement corporate strategies (ISO/TC184/SC5WG1, 1998; Shorter, 1997; Petrie, 1992).

Architecture Components Description

Human Resources Architecture: No organization or any enterprise endeavor can exist without the necessary human resources it needs to operate. Human resources combine the necessary skills, knowledge, and abilities within the enterprise. It is the core competencies of any endeavor. Formulating a human resources architecture insures that the basic requirements for personnel are properly defined in relation to strategic, tactical and operational plans; appropriate levels of skills are identified and are balanced in relation to projected needs; training programs are in place to ensure ongoing survival; and define a carefully structured knowledge management program to harness corporate memory and knowledge. This architecture ensures that organizational objectives are properly associated with the right organizational levels and appropriate skills, monitored on a pro-active basis, and reported on in a timely manner; incorporate organizational analysis as an ongoing planning tool; structure the decision-making infrastructure; and use of resource management structure (Demos, Chung and Beck, 2001). Additionally, as the organization evolves this architecture forms the basis for managing organization

change programs. Data for this architecture flow form the "who" part of the enterprise modeling activity.

Business Models Architecture: Organizations are by their very design are complex socio-technical structures comprising of several models of business processes organized around enterprise vision, mission, goals, and objectives. These structures are products of outputs in response to corporate strategy. Business models are knowledge base of what the business is and what information is used to conduct the business. This architecture captures organizational elements such as finance, marketing, manufacturing, etc. without which there could not be an understanding of how the organization operates and could not align information systems to support business operations.

Information Architecture: We operate on and make decisions based on internal and or external information. It is necessary therefore for decision makers and other organizational actors to have the right information at the right time, in the right place, and is accessible subject to rules defined by corporate management. Information architecture provides a structure on which a reliable decision making infrastructure and processes depends. Information architecture therefore identifies, defines, and organizes the business functions, processes, or activities that capture, manipulate, and manage the business information to support the business operation and relationships among that information. All data needed to support business functions should be captured in the information architecture. A starting place for information architecture definition and development is having a clear understanding of the role information plays in the business architecture. This is accomplished by defining a enterprise information strategy (JISC, 1996).

Information Technology Architecture: In the architectural domain, there are two types of architectures: Type I architectures represent the structural arrangement (design) of the physical system such as the computer control system part of an overall enterprise integration system (systems or computer integration is generally considered to be vendor solution) and can become a major sub-unit of the second type. Type II architecture is the structural arrangement (organization) of the development and implementation of a project or program such as manufacturing or enterprise integration or other enterprise development program. Information technology architecture is a type I architecture while the enterprise integration architecture is a type II architecture (Bernus, Nemes and Williams, 1996a).

Information technology architecture (other terms associated with this component are: Technology Architecture; Enterprise Information Technology Architecture; Technical Architecture Framework; Information Infrastructure Model) consist of hardware, software, network and communications elements, standards, policies and procedures, and other computer resources associated with executing information systems services (Spewak and Hill, 1992; TOGAF, 1998; Vernadat, 1996). This architecture is the blueprint for creating enterprise-wide information systems (Spewak and Hill, 1992; TOGAF, 1998). Neither type I nor type II architecture can be defined directly. There must be an information technology/systems plan that reflects dimensions such as scope of objective, time frame for reorganization, levels of resource involvement and flexibility of definition (Bernus, Nemes and Williams, 1996a).

Model operation and execution

EIAPM/M is a collection of concepts, tools, and methodologies existing in the public domain. It is not another "alignment planning methodology", rather it incorporate

any methodology the enterprise architect selects. Its strength is it's ability to accommodate planning tools already in use or newly developed ones. Since design, development, and implementation of architectures that supports business strategy is the purpose, it is crucial to place this model (EIAPM/M) in its context. Enterprise integration architecture is the blueprint for achieving enterprise integration and enterprise integration modeling is the enterprise engineering activity employed to model an enterprise for integration purposes (Bernus, Nemes and William, 1996a; Vernadat, 1996).

EIAPM/M has two main planning themes that are the focus of attention: Strategic alignment and infrastructure integration thus planners will pursue strategy formulation that move the enterprise towards enterprise integration. The model operates on the following premise:

- There exists in the public domain, planning models, methodologies, tools, and techniques that are available for developing business strategy and defining enterprise integration goals (IBM, 1981; Zachman, 1987; Zviran, 1990; TOGAF, 1998; Bernus, Nemes and Williams, 1996a).
- That enterprise integration is a strategic intent rather than a systems integration approach (CIMOSA, 1994).
- There exists within the entity a strategy formulation process (documented or undocumented) and a management system that operates within this process (Bryson, 1988).
- Achieving full integration is the primary intent of corporate planners (Teo, 1994).

This model shows the interrelationships of components that make up the model. To move beyond form, it is necessary to provide some means to apply the model and to derive content that is germane to the activity objectives. The purpose of this planning

model is to achieve linkages between business strategy and the enterprise integration architecture. It is the intent of this approach to accomplish this linkage by identifying organizational objectives in relation to architectural objectives thus a linkage construct that reflects "environmental imperatives" when defining the "requirements" for the development of an enterprise integration architecture during an enterprise engineering exercise.

A strategy-architecture linkage process map (Figure 7) was developed by this researcher for the enterprise architect to use the model (EIAPM/M) for enterprise integration architecture development. Organizational intelligence represents knowledge about the enterprise that exists in either corporate memory or as corporate knowledge (Matsuda, 1988). It is pivotal in driving the strategic planning process, influencing the nature of and types of environmental imperatives to be considered, focusing attention on requirements to link strategy with architecture, and ensuring that an enterprise life-cycle management approach is adapted as the basis for enterprise analysis. Using enterprise integration modeling methodology from (GERAM, 1998), the enterprise architect develops models of the enterprise.

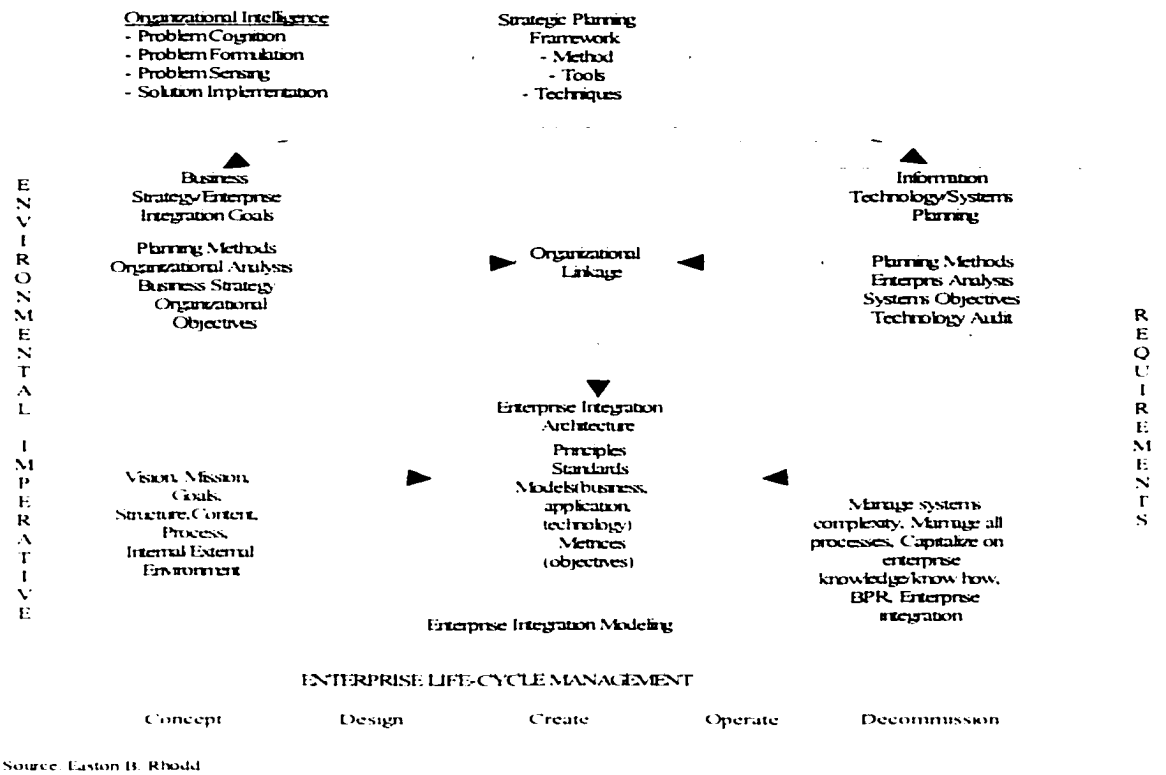


Figure 7 Strategy-Architecture Linkage Process Map

The process map model in Figure 7 is concerned with the informational content within the organization and provides the context for the engineering study. The linking process elicits data that will be used in formulating and developing the enterprise integration models for the design of the enterprise integration architecture.

Organizations are finding that corporate knowledge and memory is vital for continued survival in today's ever changing and dynamic environment (Matsuda, 1988; Ageenko, 1998). Understanding the informational content of value and supply chain partners process models is a critical component of strategy formulation (Demos, Chung and Beck, 2001). Organizational intelligence represents the total knowledge of an enterprise (Matsuda, 1988), the application of which provides strategy planners and

business unit management with a systematic and purposeful set of problem handling actions (Ageenko, 1998).

Model overview

The strategy-architecture process is a life-cycle approach for building the enterprise integration architecture. Organizations act on information that impacts it's ability to reach it's defined goals in the strategy model. This process consists of a strategy-planning model, a set of integrative business strategy and enterprise goals, an information systems plan, and the enterprise integration architecture itself. Organizational linkage construct forms the glue that links these elements thus a direct connection between strategy/enterprise goals.

Enterprise integration modeling as an organizational analysis tool is used to model the business functions and the information systems necessary for supporting the business/enterprise goals. Enterprise integration modeling is the technique used for developing an enterprise integration architecture that in turn defines the information systems technology for enterprise support.

Elements and components description

Developing and implementing an enterprise integration architecture that is linked to business strategy/enterprise integration goals is the purpose of this process map model. What follows is a description of each component and element, and how each drives the development of the enterprise integration architecture.

There are two broad levels of activities and actions corporate and information systems planners and enterprise modeling methodologist perform in developing the architecture. These planners conduct an organizational intelligence study (Matsuda,

1988) to determine environmental imperatives and information technology requirements. Information from the intelligence gathering activity is used within the strategy planning model. Strategy planners when conducting this environmental scan, take an enterprise life-cycle view of the enterprise as they develop and define both business strategy/enterprise strategy and technology strategy. Organizational intelligence, environmental imperative, requirements, and enterprise life-cycle form the outer loop since it represents a cyclical process of strategic problem handling method for evaluating information technology and the resulting information systems within the enterprise (Matsuda, 1988).

Organizational intelligence can be characterized as the collective, intellectual problem handling capability of an organization consisting of problem formulation, problem solving, and solution implementation (Matsuda, 1988). A detailed discussion of this data gathering technique and assessment model is outside the scope of this research, however, the relevance of this model as it relate to the strategy-architecture mapping model will be highlighted for clarity. For a detailed discussion on this topic, readers should read (Matsuda, 1988) work on this topic.

The process of strategy formulation is by definition provides a series of solutions for corporate survival. Corporate survival is greatly impacted by business drivers that determine the nature of and timing of strategy development. In this vain, planners need to approach strategy definition in a methodological manner. All strategy formulation and development approaches inherently follow a defined problem definition and solution process (Matsuda, 1988; Bryson, 1988; Fraser, 1994).

The cyclical process of strategic problem handling (Matsuda, 1988) is one such methodology that is congruent with organizational intelligence technique. This problem solution method, approach the solution horizon in an input - output sequence with each component having a series of purposeful steps for gathering the required data, and specific outcomes. In carrying out the analysis, the enterprise architect who may or may not be involved in the business strategy formulation uses this problems solving technique to discern and evaluate organizational objectives that are pertinent for defining organizational linkages (NRC, 1997) that must be factored into the enterprise modeling exercise.

To develop both business and information systems strategy, there must be a strategic planning model consisting of methods, tools, and techniques that is widely communicated, understood and is consistently applied across the organization by all participants in the strategy formulation process. This strategy-planning model is an outer loop component that takes its informational cues from activities and tasks resulting from organizational intelligence data gathering. As you can see, this model is applicable to both information technology/systems planning and business/enterprise goal formulations.

Turning to the inner loop, enterprise integration modeling methodology provides the analytical and interpretative model; an enterprise architect use this methodology to reduce organizational complexity into phases and therefore, make it simpler for understanding corporate strategy and relations between the components in the inner loop. Enterprise integration modeling describes methods and types of information technology tool sets and approaches for analysis, design, development, and evaluation of information

systems technology solution for solving business process and systems integration problem (GERAM, 1998).

During the modeling exercise, the enterprise architect seeks to verify the completeness and consistency for all described functions and objects (business processes, data, materials, and resources including tools and fixtures) at any detail level. After verification, the architect proceeds to simulate enterprise processes and activities to reflect changes in models due to changing business processes, methods, or tools. These modeling procedures demonstrate to enterprise management how to use these models to initiate, monitor, and control the execution of the enterprise daily operation. Enterprise management can also use the model to allocate resources during the execution of business processes to enable better and more flexible load distribution on the enterprise resources.

Consider the inner loop. There are four components one of which is the linkage construct (or linkage profile) for linking organizational objectives with architectural objectives thus a tight coupling between the business strategy and information technology/systems strategy. Business strategy/enterprise integration goals consist of elements (planning methods, organizational analysis, business strategy, and organizational objectives); it is in this component management consider the enterprise vision, mission, goals, structure, content, process, and assess the internal/external environmental impacts on the organization's ability to compete.

Concomitant with business strategy/enterprise integration goal formulation, information technology/systems planning is initiated. Information systems planners at this juncture utilize an information systems planning methodology to gather information

technology market data, develop a portfolio of internal information systems and projects, identify evolving business models, and assess prior strategy progress. This planning exercise produces a set of information systems objectives (Zviran, 1990) and architectural design objectives that will be linked with organizational objective.

Enterprise integration architecture, the final component can now be developed by the enterprise architect. A key decision tool for this activity is the profile of objectives developed in the linkage component. In this component, architectural principles and standards are identified that will form the basis for further architectural definition along with models that facilitate the identification of a set of metrics to be used to assess the degree of strategy-architecture alignment.

Model conclusion

Enterprise integration is a strategic intent (CIMOSA, 1994), it is not just an information technology and systems solution for linking application, systems and or implementing data access tactics to achieve some form of information sharing (Petrie, 1992). The strategic importance of enterprise integration can be traced to the rapid convergence of computers and telecommunications technologies (the networked organization) that in turn creates new and evolving business models for competitive advantage and extend the reach of both value and supply chain activities as organizations redefine horizontal and vertical business process (Tapscott, 2001). Organizations are transforming their structures at horizontal and vertical levels to achieve full integration that effect process optimization but without sub-optimal impacts on activities and resources that are applied to the process in achieving desired outcomes.

As the level of information technology changes continue to impact business drivers, both corporate planners and information technology/systems planners find it necessary to align both strategies since information technology is considered a strategic resource. Information systems executives have shifted their focus from operational systems to strategic information systems development. The complexity and myriad of solutions available to the information systems executive in meeting strategic objectives are many and can be viewed as chaotic. Environment imperatives coupled with senior corporate decision maker's expectation that information executives justify information technological expenditure and demonstrate how any proposed and or implemented systems demonstrate linkage to organizational objectives, calls for the formal development and implementation of enterprise integration architecture.

Formulation of enterprise integration architecture in of itself is a formidable task that can consume a significant amount of resources if not carefully managed. Otherwise there is a high likelihood of producing an architecture that is not aligned with organizational objectives. Aligning business strategy with information systems strategy is well understood by information systems management but these managers continually fail to show how it contribute to the organization's performance. There are several frameworks and models that have been tested and are in use by several information systems entities (Roberts, Henry, Leete, and Rao, 2001). None of these frameworks and or models however prescribes the relationships with the enterprise integration architecture and the business strategy. Enterprise integration architecture forms the basis for information technology investments, diffusion, and infusion of information systems in concert with strategy direction (Rehberger, 2001). It is a decision making tool used

within the information systems organization but also can aid business unit managers with making informed information technology investment decisions.

Complexity in the information technology environment is not the only issue facing both types of planners (information and business strategist). Evolving business models are also achieving levels of complexity not previously experienced. Therefore, the information systems executives must develop agile internal organizational processes if they are to provide the level of strategic information systems required to support organizational objective. To be agile, approaches for developing information systems must employ enterprise integration modeling techniques. Thus, information systems organizations must adopt an enterprise engineering management methodology into its business process model.

Enterprise integration architecture planning model and methodology (EIAPM/M) is a conceptual approach for linking organizational objective with enterprise integration architecture objective. This model represents a collection of components and elements that when applied to enterprise integration architecture planning process will provide the data needed to achieve linkage between business strategy and the architecture itself. It is flexible in its approach thus it can accommodate existing planning models and architecture development methodology but represents an new way for information systems strategy alignment with business strategy planning and therefore achieving the prospect of full integration.

Research Methodology

Choice of Methodology

Teo (1994) stated that information systems research can be conducted using several research methodologies such as field surveys, case studies, and laboratory experiments. Given the array of choices available to researchers, an appropriate methodology that ensures that research objectives can be attained within the scope of variables involved (Creswell, 1994) is vital in order to obtain valid results (Grover, n.d.). Practical limitations (time and costs) and sample availability are other factors affecting the decision choice taken by the researcher (Teo, 1994; Creswell, 1994; Grover, n.d.).

Creswell (1994) listed five criteria (researchers world view, training and experience of the researcher, researcher's psychological attitude, nature of the problem, and audience for the study) for choosing between a quantitative and qualitative model, and detailed five sets of assumptions (ontological, epistemological, axiological, rhetorical, and methodological) that influence the researcher's choice of research model for effecting the study. In keeping with information systems research traditions (Teo, 1994; ISWN, n.d.; Malhotra, 1993) and specifically studies on alignment (Calhoun and Lederer, 1990; Zviran, 1990; Des, Zahra and Warkentin, 1991; Chan and Huff, 1993; Burn, 1996; Reich and Benbasat, 1996), field survey research seems appropriate.

The use of a survey facilitates for cross-sectional and longitudinal studies using a questionnaire or structured interview for data collection with the intent of generalizing from the sample to a population (Crewell, 1994 in citing [Babbie, 1990]). Grover (n.d.) posit that "relevance" has elevated the importance of field base research in which data are obtained from the business context or social setting in which practice occurs. The choice

of field survey methodology for collecting data in this research will facilitate studying unstructured organizational problems in the information systems area (Grover, n.d.) and allow for statistical testing of the linkage between organizational and architectural objectives across a wide variety of organizations (Teo, 1994; ISWN, n.d.). The purpose of the researcher in this study was to obtain empirical data to confirm (or not confirm) assertions that an enterprise integration architecture must reflect the business drivers that influence the enterprise ability to achieve enterprise integration and leverage information technology for competitive advantage (Brancheau and Wetherbe, 1986; TOGAF, 1998; Luftman and Brier, 1999).

In this study, this researcher determined that there are positive relationships between enterprise integration architecture objectives and organizational objectives, and by so doing, extended information systems planning-business strategy planning alignment or fit theories and practices to the enterprise integration architecture planning process. As stated previously in the goal and problem statement section (see Chapter 1), current IS planning research and traditional planning models failed to addressed factors relative to the architecture-business strategy linkages. Models commonly found in the public domain and approaches documented by way of case studies alluded to some form of linkage between these two set of objectives but is silent on what factors constitute such linkage and how existing planning methods and processes achieve this type of linkage.

In order to achieve the objectives of this study and answer research questions posed in the problem section (see Chapter 1), a critical analysis of the literature was the starting point for defining this study scope and theoretical foundations (McMillan and Schumacher, 1993; Creswell, 1994; Booth, Colomb and Williams, 1995). This identified

a set of variables suitable for developing a linkage construct that was empirically tested by electronic survey method.

To guide the investigation, a research framework was developed (Figure 4) to manage data collection and analysis. In addition, a conceptual enterprise integration architecture planning model (Figure 5) was developed along with a modeling activity process (Figure 6). Furthermore, a strategy-architecture linkage process (Figure 7) was developed as the basis for linking enterprise integration architecture objectives-organizational objectives. These models taken together provided the basis for identifying variables and defining the conceptual framework. Data collection was completed using the survey questionnaire method (Appendix) in keeping with (Zviran, 1990; Teo, 1994; Reich and Benbasat, 1996).

Determination of variables

A review of the literature provided a baseline for an analytical framework, put the research in a theoretical context, and provided the researcher with an understanding of what knowledge existed that is pertinent for achieving research goals and objectives. In performing this review, facts were assembled for research plan development and definition of variables for testing in the data analysis phase of this research.

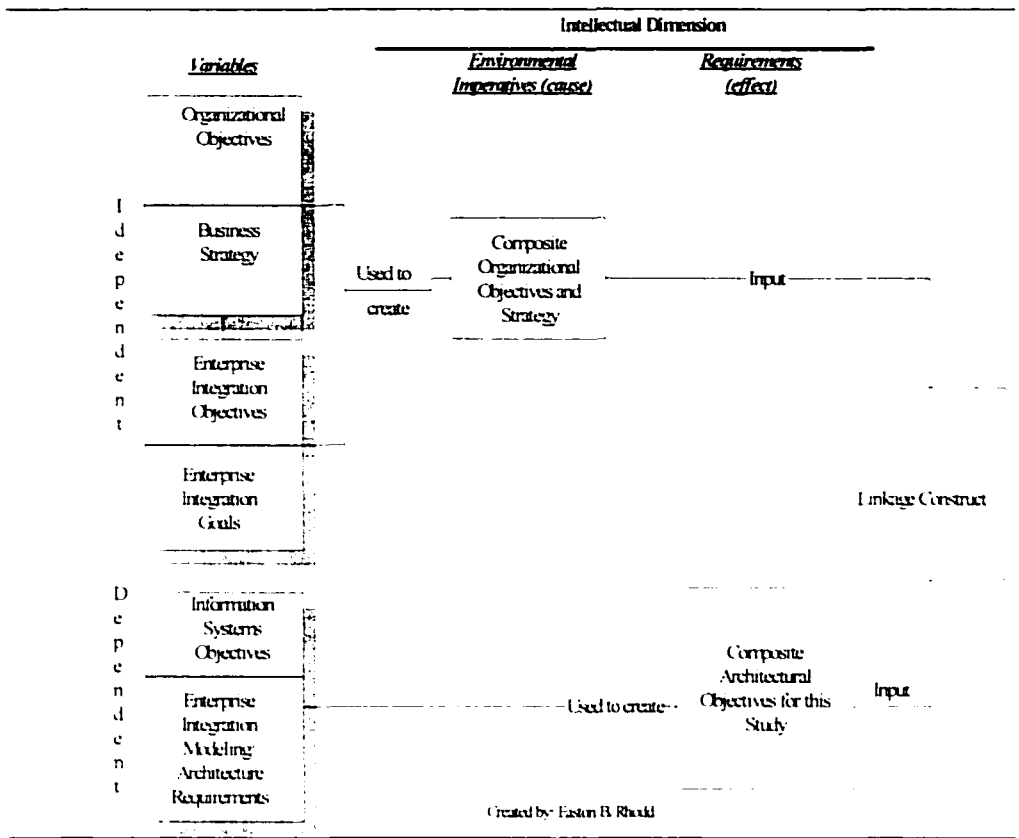


Figure 8 Variables identification map

Figure 8 displays model for the current research showing variables derived from an analysis of the literature. This formed the final linkage construct for testing during the survey phase. This model documented the process used by this researcher to develop the variables used in the linkage model (Figure 9) and was the basis for constructing the survey instrument. The diagram defined for this study the typology in relationship to the research questions and Operationalization of the variables for the linkage construct in Figure 9.

Research questions for this study were presented in Chapter 1 but are restated here for the reader's convenience: (1) What are the factors for linking organizational objectives with enterprise integration architecture objectives to achieve enterprise integration? (2) To achieve enterprise integration, how are the factors used in the

planning model for linking business strategy with enterprise integration architecture? (3) How do these factors relate to enterprise integration modeling?

Independent Factors

Organizational Objectives

	Control and Reduce Costs	Increase Revenue	* Improve Administrative Efficiency	Improve Service	Supply Products and Services on Time	Gain Competitive Advantage	Improve Quality	Increase Organizational Productivity
Dependent Factors								
Architectural Objectives								
Provide Timely Information								
* Standards								
Costs								
Quality								
Flexibility								
* Interoperability								
Share Information								
Environment								
Redundancy Management								
* 80/20 Solution								
Manage IT Risks								
* Education and Training								
Communication between IS and Business Unit								
Integrated Data								
Model Base Decision Support								
Model of Inter or Intra Enterprise operation								
Select/Employ Technology to Support Business								
Right Information in the Right Place								
Cycle Time								
Monitoring Management System								

Note: Items labeled (*) dropped after reliability analysis - see Results chapter for discussion

Created by Easton B. Rhodd

Figure 9 Linkage Constructs

Table 4 Adaptation (with permission) of Reich and Benbasat (1996) linkage construct.

Dimension	Independent variables (Cause)	Dependent variables (Effect) [Linkage]
Intellectual	I. Environmental Imperatives Business strategy and enterprise integration goal factors that are critical for formulating business mission, objectives, and plans and that the planning activities are comprehensive.	II. Requirements Enterprise integration modeling and enterprise integration architecture concepts and principles are specification for evaluating internal consistency and external validity of environmental imperatives.

This investigation focused on the intellectual dimensional aspects of the linkage construct shown in Table 4. The survey questions were designed to seek answers to research questions: Research question [1] was designed to determine business strategy and enterprise integration linkage factors. These factors are inputs for strategy planning activity, when taken together is operationalized as "environmental imperatives". Research questions [2 & 3] were designed determine how linkage factors relate to enterprise modeling and enterprise integration architecture development. These factors are inputs for enterprise integration modeling and enterprise integration architecture activity and are operationalized as "requirements" for enterprise integration modeling and enterprise integration architecture development.

Environmental imperatives represent independent variables comprised of organizational objectives from the Zviran (1990) study. These variables were empirically tested for alignment with information systems objectives. In that study, variables represented a profile of planning actions for information systems-business strategy

linkage. A comparison of enterprise integration objectives (Goranson, 1992; Williams, 1996; Fraser, 1994; Bernus, Names and Williams, 1996a) and business strategy from the enterprise integration literature (Fraser, 1994; Goranson, 1992; Williams, 1996; Petrie, 1992; Bernus and Nemes, 1996b; Fox, 1996; Mahmood and Soon, 1991) with Zviran's (1990) business strategy variables demonstrated similar conceptual meaning and therefore supportable by organizational objectives. This support confirms the notion that enterprise integration is a strategy rather than a technology solution (CIMOSA, 1994) and therefore an integral part of corporate business strategy formulation.

Requirements represent dependent variables that are architectural objectives. These objectives were derived through extensive review of the theoretical research literature and practice-oriented writings on enterprise integration and modeling, information systems, and enterprise integration architecture. Architectural objectives while implicit in enterprise integration architecture formulation and development were never defined in the literature as a theoretical construct or as a set of planning ideas in contemporary frameworks and or methodologies. Because of this gap in the literature, defining a set of objectives that would represent variables to measure this theoretical construct must be guided by grounded theory (Creswell, 1994; Grover, n.d.) found in the business and information strategy and enterprise engineering domains. In addition, a set of criteria is necessary to assist with the identification of variables and to evaluate the quality of the derived objectives for accomplishing the desired research outcome.

Since the primary reason for linking strategy with the architecture is to achieve alignment and therefore organizational effectiveness (Saunders and Jones, 1992) in the use of information technology and systems performance indicators that demonstrated

information technology and systems, contribution to organizational objectives provided a criteria typology for identification of architectural objectives variables. Saunders and Jones (1992) ten dimensions of information systems performance (IS contribution to organizational financial performance; IS operational efficiency; adequacy of systems development practices; Users and Management attitudes; personnel competencies; personnel development; IS planning; quality of information produced by the system; IS impact on strategic direction; integration with related technologies across other organizational units, p.3) provided the criteria for architectural objectives derivation.

Segars and Grover (1998) in framing their theoretical and operational dimension measures of strategic information planning success used the literature extensively to identify various objectives of interest. They also attempted to determine any underlying dimensions that would provide structure for the resulting objectives. These authors in citing (Churchill, 1979) stated that research suggests that extensive literature review and expert opinion provides a sound foundation upon which a theoretical domain (or construct space) of complex variables can be formed. Although Segars and Grover (1998) study focused on information systems planning success, the underlying latent variables are performance indicators since the meaning of "success" suggests that the "process must deliver benefits beyond the resources necessary to sustain it in order to contribute positively to organizational effectiveness" (p.140).

It is interesting to note that in that study the authors identified a similar set of performance indicators with four distinct approaches for assessing the effectiveness of strategic information systems planning. They provided support for using the Saunders

and Jones (1992) indicators noted previously as selection criteria for architectural objectives derivation from the literature.

Architectural Objectives

Derivation followed ideas and methods found in the literature to identify common themes relating to the fundamental purpose, reason, and expectation for an architecture as it relate to building information technology infrastructure in response to business drivers (Teo, 1994; Das, Zahra and Warkentin, 1991; Zviran, 1990; Reich and Benbasat, 1996; Delone and McLean, 1992; Mason, McKenney and Copeland, 1997; Saunders and Jones, 1992; Segars and Grover, 1998). This architectural-organizational objectives model extends alignment theories to include architectural planning and provides the means with which information technology contribution to corporate performance can be measured directly since by linking a specific set of organizational objectives with specific architectural objectives, specification, selection and deployment of information technology solutions are more likely to represent corporate strategic direction, business plans that reflect the impact of technology projects and allow for adaptability to change (Strassmann and Bienkowski, 2000).

This researcher used the ten performance indicators from Saunders and Jones (1992) study as a guide to conduct an extensive review of the literature relating to enterprise integration modeling and architecture, information technology and systems, business strategy, and enterprise engineering. The purpose was to (a) identify to the extent possible, architectural objective; benefits associated with implementing an architecture; goals for the architecture; and (b) practice related ideas relating to the architecture planning process. Variables in addition to meeting one or more than one of

the above indicators must conform to Zviran's (1990) definition of an objective, reflect operationalzed term for requirement (Table 4) and represent a set of actions to guide decisions in the formulation of information technology and systems determination for business strategy support. A total of 119 items covering the period 1970-1999 were analyzed for contents meeting the above guidelines yielding 20 architectural objectives worthwhile for this study.

Lists comprising organizational objectives (Zviran, 1990) and architectural objectives were combined to form the linkage construct (Figure 9) for survey questionnaire construction and testing. Experts were asked to assess the relevancy of the items and to add or remove items not representative of the construct. In addition, they were asked to evaluate if the architectural objectives as derived can provide corporate planners with data to assess information technology contribution to organizational effectiveness. These experts included three IS Project Managers all with more than 25 years experience, one Program Manager with several years of information systems requirements definition and use, and one Network Manager with more than 20 years information technology management experience. In general, each of these experts agreed that this set of objectives and linkage construct represented variables that can measure strategy-architecture linkages. This verification approach is similar to one used by Segars and Grover (1998).

The linkage construct (Figure 9) represents a different alignment construct from that commonly found in the empirical literature but is similar to Zviran's (1990) correspondence approach. This correspondence (or linkage) between organizational objectives and information systems strategy is a contingency planning method that

establishes a specific set of information systems strategy with organization objectives. The logic of this correspondence is that for any set of organizational objectives there are specific sets of information systems strategies a firm must pursue if the intent is alignment (Zviran, 1990).

This researcher's approach, while it is intellectual dimensional focused, is only applicable to business and information systems strategy plans and not the architectural definition planning and development which is the focus of this researcher's study. Like the Zviran (1990) study and others of this type that investigated alignment between information systems strategy and business strategy (Henderson and Venkatraman, 1991; Reich and Benbasat, 1996), variable relationships that comprise a linkage construct is necessary for architectural and organizational objectives alignment. The final linkage construct (Figure 9) therefore consists of organizational objectives (Zviran, 1990) and architectural objectives derived from the literature.

Figure 9 represents the linkage construct for this investigation. The survey instrument was constructed to collect data for testing the relationships between these two sets of factors. Survey participants were asked to rate each of these variables using a scalar approach regarding the importance of these variables for linking organizational objectives with architectural objectives for enterprise integration architecture alignment with business strategy; each architectural objectives can be linked to more than one organizational objectives at different levels of association to produce a profile of planning variables to be used during strategy formulation and subsequent enterprise integration architecture development.

Zviran's (1990) study relating to alignment between business strategy and information systems strategy provided a detailed description of organizational objectives variables along with a detailed description of the results of his investigation and the results were discussed in the literature review section of this paper. Writings on enterprise integration architecture support the alignment of the architecture with business strategy. The underlying notion is that such an alignment will result from integrating information systems plans with business strategy and that information technology strategy formulation as a result will facilitate selection of an appropriate integration infrastructure (Zviran, 1990; Rosser, 1996; Strassmann and Bienkowski, 2000; Gottschalk and Solli-Saether, 2001).

In order to accomplish the purpose for conducting this research, it is necessary to define the dependent variables. Since the focus of this investigation was to seek alignment between architectural objectives and organizational objectives as the means through which alignment occurs to establish linkages between the enterprise integration architecture and business strategy, a working definition is required for architectural objectives. Zviran (1990) stated that organizational objectives are measurable statements used by management for achieving a desired state. This definition can be extended to architectural objectives since the objective for developing and implementing the architecture can be viewed as a measurable aim or a target state. In essence, architectural objectives represent a set of measurable actions to guide decisions during the selection and deployment of information systems for business strategy support.

Operationalization of architectural objective follows (Zviran, 1990) approach but as was stated in Chapters 1 and 2, the literature did not provide any direct insight into

what constitutes these objectives, except for clues from which these objectives can be derived for testing during the survey phase of this investigation. These objectives were structured into the construct as dependent variables with organizational objectives forming the independent axis of the construct (Figure 9).

These objectives are not stated as action items as is expected for objectives but instead as statements. This is so since the purpose of this research was to first establish the veracity of these objectives and secondly, to test several hypothesis. Usage of any of these objectives as actionable item must demonstrate a positive relationship with organizational objectives in addition to exhibiting high reliability.

Following are architectural objective statements developed by this researcher (see determination of variables discussion previously) from the literature used in this study:

- **Provide timely information:** This architectural objective is derived from the fundamental purpose for enterprise integration and modeling as is supported in the GERAM (1998) for enterprise analysis and process modeling. The purpose for enterprise integration and the architecture is to allow timely, repeatable, and accurate information flows between enterprise processes. In an operating scenario, this information must be available to some executive, human or machine, responsible for successful operations, so that management may make accurate decisions about operations (ISO/TC184/SC5WG1, 1998; GERAM, 1998).
- **Standards:** Interoperability improvements across applications and business areas as an architectural goal can be achieved through the application of standards. Implementing standard-based platforms and applications will have and use a

common set of services that improve the opportunities for Interoperability (TOGAF, 1998).

- **Costs:** Reduction of life-cycle costs is both an information systems strategy and an architectural goal. Costs management can be viewed from (1) reduced duplication by eliminating or replacing isolated systems with interconnected open systems; (2) reduced software maintenance by use of COTS [commercial-off-the-shelf] products and standardization of development tools and languages; (3) incremental replacement by using common interface to shared infrastructure components thus allowing for phased replacements or upgrade with minimal effort; (4) reduced training by implementing common systems and consistent human interface (TOGAF, 1998; Rehberger, 2001).
- **Quality:** Quality has implications for several aspects of the architectural development process. On one level it relates to the enterprise architectural planning activity, the capabilities of the IS staff to provide efficient and effective IT solutions, and an effective IS organizational process to support delivery of reliable information and communication technologies. From an architectural objective perspective, quality embrace ideas that ensures in addition to items noted previously, data administration and the ability to provide components that support product and process improvements. The architecture must support quality management [design and specification and performance monitoring and assessment functions including continuous improvements] (Spewak and Hill, 1992; Brancheau, Janz and Whiterbe, 1996; TOGAF, 1998; GERAM, 1998; IMTR, 1999a).

- **Flexibility:** The enterprise model [architecture] must be able to respond to changes in organizational direction. Such change is reflected in the business strategy and is measured by specific set of organizational objectives. Architectural contents therefore must incorporate flexibility of all enterprise processes and organizational structures based on enterprise models (Fraser, 1994; Zviran, 1990; Bernus, Names, and Williams, 1996a).
- **Interoperability:** [See discussion on standards above]. Corporate reasons for pursuing enterprise integration can be characterized as adaptation of the 'new information paradigm'. This paradigm espouses principles that seek to connect and combine people, processes, systems, and technologies to ensure that the right people and the right processes have the right information and the right resources at the right time. Information systems or components therefore must have the ability to exchange and use information across dissimilar environments, and the ability of systems to provide and receive services from other systems and to use the services so interchanged to enable them to operate effectively together (IMTR, 1999b; Bernus, Nemes and Williams, 1996a; Bernus and Williams, 1996a; TOGAF, 1998).
- **Sharing of Information:** One enterprise integration principle is the "the principle of information neutralization"; both data and knowledge must be exchanged by various functional entities of the enterprise system. Information sharing as an architectural objective seeks to eliminate specialized formats, detach application oriented data and knowledge from the "legacy" components and place such data and knowledge in a central repository for anytime, anyplace, anyone access, and

transfer information in an agreed upon neutral format (Vernadat, 1996; Bernus, Nemes and Williams, 1996a).

- **Adaptability of Environment:** Ability of the architecture to be adaptable to the continuous change of the information technology environment and the production processes (Bernus, Nemes and Williams, 199a; Vernadat, 1996).
- **Management of Redundancy:** Implementation of an integration infrastructure allow for the communications between systems in the form of information objects using enterprise models thus a common semantic referential. This architectural objective ensures that 'island of computing', island of automation', and 'island of solutions' are not pursued but that common objects are reused where possible (Vernadat, 1996; Goranson, 1992; Vernadat, 1996; Rehberger, 2001).
- **Eighty/Twenty [80/20] Rule:** Anecdotal literatures continually mention the concept that the ideal information technology solution is one where 20% effort should solve 80% of the business requirements. This has never been put to the test presumable due to the nebulous nature of this idea. Including this idea as a variable will test it's relevance as an architectural objective in relation to specific set of organizational objectives. The idea here is that minimal architectural components should provide substantial business solutions that will further an enterprise's ability to meet it's overarching strategy.
- **Manage IT Risks:** Information technology is considered necessary for competitive positioning thus planning for IT and architectural components should factor in aspects of risks associated with IT investments. IT risks can be viewed from (1) vendor's exposures to market dynamics, (2) vendor dependence by the

acquiring entity, and (3) lack of human resources capabilities. Architecture therefore must be able to mitigate risks associated with the component selected to align information systems strategy with business strategy. Manage IT risk deals with vendor independence, portability and scalability, security, financial, technical, schedule, regulatory, legal (including intellectual property control), risk evaluation, decision, and management processes relative to internal and external views, allocation of human resources in concert with levels of IT deployment (TOGAF, 1998; Vernadat, 1996; IMTR, 1999a; Bernus, Nemes and Williams, 1996a).

- **Education and Training:** Communications between information systems executive and business executive continue to be a concern to both groups. It is believed that this situation can be improved through the use of an architecture since it is a decision making tool and therefore this blueprint must be able to facilitate educating the business executive about information technology choices and provide the basis for on-going training of information systems personnel in aspects of the business and evolving information technologies (Brancheau and Whiterbe, 1996; TOGAF, 1998).
- **Communication between IS and Business Unit:** Having good business plans and IS plans do not ensure understanding between both these groups but instead linkages between these two plans foster greater understanding. The architecture therefore must be able to translate linkages into architectural components and further the understanding between these two groups (Reich and Benbasat, 1996).
- **Integrated Data:** Integration of data facilitate data sharing across the enterprise thus increasing security of information, improve decision making, allow for a

common services and functions across all applications, improve developmental efficiency, improve users productivity, and use of technology in the most economic manner (TOGAF, 1998; Bernus and Nemes, 1996a).

- **Model Base Decision Support:** Models accomplishes (1) verification of completeness and consistency for all described functions and objects (business process, data, materials and resources including tools and fixtures) at any detailing level; (2) simulation of the enterprise model at any detailing level; (3) fast and easy change of the model in the case of changing business processes, methods, and tools; (4) the use of models to initiate, monitor and control the execution of the enterprise's daily operations; (5) repeated resource allocation during the execution of business processes to enable better and more flexible load distribution on the enterprise' s resources; (6) model generation for existing enterprise as well as for enterprise to be built. Architectural models support of enterprise operation provides (a) model portability and Interoperability by providing an integrating infrastructure across heterogeneous enterprise environments; (b) model driven operational support by providing real time access to the enterprise environment (Bernus, Nemes and Williams, 1996; GERAM, 1998).
- **Model of Inter or Intra Enterprise Operations:** Business management function and production operations integration through the use of automation and process refinements have realized tremendous gains since both functions are more responsive to each other, and decisions made and actions taken reflects the best solution from the standpoint of all enterprise functions and business drivers This type of coupling is further extended to supply chain partners as technologies and

fragmentation of enterprise functions place greater reliance on a more complex web of suppliers, vendors and partners thus the need to manage supply chains relationship. Architectural models allow for "plug and play" across a wide spectrum of relationships (IMTR, 1999a; IMTR, 1999b; Vernadat, 1996).

- **Select/Employ Technology to Support Business:** Mapping future technology against present day best practices to show suitability or desirability of the proposed technology (Bernus, Nemes and Williams, 1996a).
- **Right Information in the Right Place:** Data and information systems must be integrated so that the right information can be used at the right place at the right time, wherever stored in the enterprise and under whatever format. This architectural objective relates to other objectives noted previously [provide timely information; integrated data; share information] (Vernadat, 1996).
- **Cycle Time:** A fundamental purpose for process optimization is to achieve cycle time reductions in the operational process for competitive advantage reasons. This architectural objective relates to the enterprise achieving shorter development cycle time thus a reduction in cost and improvements in customers' responsiveness; improvements in product quality; improvements in resources allocations and needs (Goranson, 1992; Williams, 1996; IMTR, 1999b; Rehberger, 2001).
- **Monitoring Management System:** Strategy planning activities and operations needs management oversight and a governance structure to lead the organization's competitive actions. It therefore necessary to have in place architectural components that foster improved ability to manage knowledge and experiences as

corporate assets; improved access to needed information at point of need; reduced dependencies on specialized expertise; performance data collection and reporting (IMTR, 1999b).

The conceptual planning model and the research model served as maps in moving from theories obtained from the literature searches to achieve this research objectives. Research objectives serve as limitations and delimitation of the investigation and help to operationalized variables for data collection and analysis (Creswell, 1994)

Independent variables, defined for this study as environmental imperatives and dependent variables as requirements (Table 3). Following are the independent and dependent variables used in this study to measure relationships between organizational objectives and architectural objectives along with survey instrument items to trap data used to perform the data analysis:

Independent variables:

1. **Opdvia**: Organizational participation development of enterprise integration architecture. Opdiva was measured by items prefixed 12 in the survey instrument (What is the level of organizational participation in the development of the enterprise integration architecture). A high score indicates more **Opdvia** and a low score means less **Opdvia**.
2. **Ooimprt**: Organizational objective importance for development of IT. **Ooimprt** was measured by items prefixed 6 in the survey instrument (Please rate the importance of organizational objectives for development of IT). A high score indicates more **Ooimprt** and a low score means less.
3. **Eigimprt**: Enterprise integration importance. **Eigimprt** was measured by items prefixed 9 in the survey instrument (Please rate the relative importance of enterprise integration objectives for business strategy support). A high score indicates more **Eigimprt** and a low score less.

Ooimprt is directly related to research questions 1 and 2. Question 1elicited answers to determine business strategy and enterprise integration linkage factors for planning purposes and question 2 determined how linkage factors related to enterprise modeling and enterprise integration architecture development. **Eigimprt** is related to question 2 that have a planning focus and **Opdvia** which is not directly related to any of the three research questions is planning process focused in that it elicited insights into the intellectual dimension of linkage.

Dependent variables:

1. **Arcobimp**: Importance of architecture objectives. **Arcobimp** was measured by items prefixed 5 in the survey instrument (Please rate the importance of architecture objectives for design, development and management of architecture planning). A high score indicates more **Arcobimp** and a low score means less.
2. **Eiaensr**: Enterprise integration architecture ensures. **Eiaensr** was measured by items prefixed 14 in the survey instrument (Enterprise integration architecture ensures). A high score indicates more **Eiaensr** and a low score means less.
3. **Arcoblnk**: Architectural objective business link. **Arcoblnk** was measured by items prefixed 7 in the survey instrument (Which architectural objectives are appropriate for linking architectural and organizational objectives to achieve alignment between business and technology strategy). A high score indicates more **Arcoblnk** and a low score means less.
4. **Arcobapp**: Organizational objectives are appropriate. **Arcobapp** was measured by items prefixed 8 in the survey instrument (Which organizational objective influence enterprise integration strategy). A high score indicates more **Arcobpp** and a low score means less.

Arcobimp, **Arcoblnk** and **Arcobapp** relate to questions I and 2 that addressed business strategy and enterprise integration linkage and how linkage was achieved for enterprise integration architecture development. **Eiaener** relates to question 3 that trapped enterprise modeling linkage and planning process involvement.

Hypotheses

Three research questions were advanced in the goal and problem section of Chapter 1. In addition, these questions were cross-walked to survey instrument items to elicit answers to these questions for empirical analysis. These questions were reformulated to produce the following set of hypotheses:

Hypotheses 1: Organizational participation development of enterprise integration architecture (**Opdvia**), organizational objective importance for developing IT (**Ooimprt**), and enterprise integration importance (**Eigimprt**) will be significant predicators of the importance of architectural objectives (**Arcobimp**).

1a. The relationship between organizational participation development of enterprise integration architecture (**Opdvia**) and importance of architectural objectives (**Arcobimp**) will be positive.

1b. The relationship between organizational importance for development of IT (**Ooimprt**) and importance of architectural objectives (**Arcobimp**) will be positive.

1c. The relationship between enterprise integration importance (**Eigimprt**) and importance of architectural objectives (**Arcobimp**) will be positive.

Hypotheses 2: Organizational participation development of enterprise integration architecture (**Opdvia**), organizational objective importance for developing IT (**Ooimprt**), and enterprise integration importance (**Eigimprt**) will be significant predicators of the benefits associated with enterprise integration architecture (**Eiaensr**) for information technology management.

2a. Relationship between organizational participation development of enterprise integration architecture (**Opdvia**) and the benefits associated with enterprise integration architecture (**Eiaensr**) for information technology management will be positive.

2b. Relationship between organizational importance for development of IT (**Ooimprt**) and the benefits associated with enterprise integration architecture (**Eiaensr**) for information technology management will be positive.

2c. Relationship between enterprise integration importance (**Eigimprt**) and the benefits associated with enterprise integration architecture (**Eiaensr**) for information technology management will be positive.

Hypotheses 3: Organizational participation development of enterprise integration architecture (**Opdvia**), organizational objective importance for developing IT (**Ooimprt**), and enterprise integration importance (**Eigimprt**) will be significant predicators of enterprise integration architecture objective (**Arcoblnk**) for alignment of business and technology strategy.

3a. Relationship between organizational participation development of enterprise integration architecture (**Opdvia**) and enterprise integration architecture objectives (**Arcoblnk**) for alignment will be positive.

3b. Relationship between organizational importance for development of IT (**Ooimprt**) and enterprise integration architecture objectives (**Arcoblnk**) for alignment will be positive.

3c. Relationship between enterprise integration importance (**Eigimprt**) and enterprise integration architecture objectives (**Arcoblnk**) for alignment will be positive.

Hypotheses 4: Organizational participation development of enterprise integration architecture (**Opdvia**), organizational objective importance for developing IT (**Ooimprt**), and enterprise integration importance (**Eigimprt**) will be significant predicators of organizational objectives (**Arcobapp**) for enterprise integration strategy.

4a. Relationship between organizational participation development of enterprise integration architecture (**Opdvia**) and organizational objectives (**Arcobapp**) will be positive.

4b. Relationship between organizational importance for development of IT (**Ooimprt**) and organizational objectives (**Arcobapp**) will be positive.

4c. Relationship between enterprise integration importance (**Eigimprt**) and organizational objectives (**Arcobapp**) will be positive.

Instrument Development

Data collection was performed with field survey methods using a questionnaire instrument. The survey instrument was delivered over the Internet using web enabled e-mail (Sheehan and Hoy, 1999) to participants of (1) ICEIMT@tools.org (2) Architecture Plus list (3) Opentech_architecture web conference (4) ItmWeb: Worldwide IT forum [CIO and IT executive corner] (5) Enterprise-wide IT Architecture forum (6) alt.org.data-proc-mgmt discussion list (7) comp.infosystems newsgroup (8) comp.inforsystems.www.database newsgroup (9) ISWorld list whose purpose is collaboration on topics (enterprise modeling, information systems and technology, enterprise architecture) relating to this investigation. It was expected that this population would have first hand knowledge of the subject matter under investigation and could contribute to the theory development of this domain. Selection of the Internet population for this study was based on this researcher's active participation in these lists. It is a customary practice among list members to conduct this type of survey since one of the main purposes of these groups is to further knowledge in it's domain area. It is the established protocol to announce intent to conduct a survey and request participation from members. This protocol was followed by this researcher thus eliminating concerns around "spamming".

Instrumentation for this research was constructed along the lines used by (Totland, 1993; Teo, 1994; Reich and Benbasat, 1996; Zviran, 1990; Bernus, Nemes and Williams, 1996) for their study on alignment, strategy, architecture, and modeling and (Totland, 1993; Sheehan and Hoy, 1999; ISWN, n.d.) for automated survey delivery approaches using the Internet. Survey questions therefore were designed around (1)

research questions detailed in the problem section, and (2) linkage construct (Figure 9) that list both independent and dependent factors identified from the literature for this investigation.

Instrument Structure

Survey instrument (see the Appendix) structure design was restricted to aspects of data that are directly related to measuring relationships between the objective variables outlined in (Figure 9) with the exception of a few questions that sought to capture general environmental and organizational characteristics for sample frame descriptive purposes. In addition, issues relating to confidentiality, time to complete and the use of the Internet were carefully integrated into the design and development of the questionnaire. Instrument structure included the following elements:

> **Environmental data and characteristics of the organization:** The questions in this category [items 1-3] were designed to obtain information regarding the type, size, and background information about the respondent (Zviran, 1990; Teo, 1994; Reich and Benbasat, 1996).
>
> **Domain of Inquiry:** Questions in this section of the survey instrument directly addressed the goals and objectives of this investigation [items 4-21]. These questions therefore were designed to elicit responses to the following set of goals: (1) To determine factors for linking business strategy with enterprise integration architecture to achieve enterprise integration; (2) To establish relationships between linkage factors and the planning model for enterprise integration objectives; (3) To identify how linkage factors relate to enterprise integration modeling.

The objectives for conducting this survey were: (a) To test aspects of the conceptual model for enterprise integration and business strategy planning linkage for internal and external validity; (b) To propose an enterprise integration architecture-

planning model that can be applied to business strategy planning-enterprise integration architecture alignment.

Proper instrumentation is a precursor to executing a high-quality field study (ISWN, n.d.; Creswell, 1994). It was therefore necessary to follow good design principles to ensure content validity (Rungtusanatham, 1998) of the survey instrument. Following are the specific actions applied to the development of the questionnaire development:

1. The purpose and objectives of the survey were clearly stated.
2. The type of people (population) for participation in the survey was identified.
3. The source (list) of potential survey participants was obtained.
4. The units of analysis were determined.
5. The IS literature relating to instruments was reviewed. This focused on similar investigations for design and construction approach and methodology.
6. The literature base for the methodology was reviewed along with experiences relative to Internet survey research. This included particular structural and implementation issues and solutions including specific steps for design.
7. An automated survey tool was selected to interface with the Internet (e-mail and Web enabled including HTML e-mail capability) and to export of data to SPSS statistical software package for robust data analysis and reporting. The automated tool was used to develop a demonstration instrument to test its design capabilities and to learn its features. In addition design ideas and scale structures were tested.
8. Questions were developed and fine tuned for the questionnaire based on the research questions and the research model.

9. Unique terms were defined for questions in the questionnaire.
10. The instrument was submitted to an ad hoc committee of subject matter experts for construct and content validity review and recommendations incorporated into redesign of the instrument.
11. The survey strategies to handle accidental or intentional duplications were defined and issues around "spamming", confidentiality and authenticity of the survey were addressed in accordance with the evaluation check list after (Teo, 1994; Grover, no date, Sheehan and Hoy, 1999).

Development of this survey instrument required careful consideration of the purpose and objectives for carrying out the research (Creswell, 1994; ISWN, n.d.; Grover, n.d.). Good design ensures that items to be measured will reflect the intended constructs thus contributing to the theory base and development of new knowledge (Grover, n.d.; Dennis and Valacich, 2001). Grover (n.d.) discussed the importance of measurement, emphasized the importance of defining the "unit of analysis" clearly at the outset of the instrumentation to limit the potential for bias. In selecting the survey population, the researcher must be guided by the respondent's ability to represent the unit of analysis in terms of the degree of knowledge about the construct under investigation (Grover, n.d.; Malhotra, 1993).

The use of survey instrument therefore is the means by which key informants provide data about the unit of analysis for determining the value or level of a particular attribute that link theoretical constructs with empirical research and is the manner in which constructs are rendered researchable (Malhotra, 1993). Careful reading and analysis of the literature provided a rich set of data for verifying instrument structure, item creation, and methodology; prior related studies identified pitfalls and strategies to mitigate such pitfalls are generally provided.

This researcher's mode of data collection was the Internet; the target population was restricted to individuals who participated in discussions and activities related to this research and were presumed to have knowledge about the domain under investigation. ISWN (n.d.) noted the increase use of the Internet (automation) for survey purposes but cautioned researchers to exercise "due care" to ensure that results are the same as what could be expected from a "traditional paper and pencil" approach.

Other writers (Totland, 1993; Kehoe and Pitkow, 1996; Comley, n.d.; Smith, 1997; Sheehan and Hoy, 1999) advocated that this mode of data collection is proving to be highly desirable and can provide good results. Kehoe and Pitkow, 1996; Comley, n.d.; Smith, 1997; Sheehan and Hoy, 1999) found no difference in survey data quality when validated with that normally observed using the traditional methods. Although there have been much success with this mode, there are disadvantages and execution problems associated with this method.

Comley (n.d.) and Sheehan and Hoy (1999) in an account regarding their use of the Internet for data collection noted a lack of precision in defining the survey population due to e-mail address quality, restriction imposed by Internet Services Providers (ISP) and the search engines supported by these organizations (Internet Service Providers), each configured differently to suite the site's operating mode, and the possibility of multiple e-mail address by the same individual for which there is no verification method that would limit this type of duplication. Comley (no date) noted that response quality is difficult to quantify because it depends on the amount of effort and thought devoted by the key informant in responding to the survey.

Kehoe and Pitkow (1996) discussed a methodology (used by the Georgia Institute of Technology) for distributed electronic surveys and posit that this form of surveying is still new and is evolving and therefore results obtained must be interpreted conservatively. Two problems observed by these authors were (1) self-selection and (2) sampling. A decision not to participate may reflect some systemic judgment by a segment of the population causing them to be excluded from the results; this is not very different from the traditional method. Sampling can either be random or non-random with random sampling offering a better statistically valid estimate about the larger population using various techniques to ensure that the people who respond are representative of the target population (Dennis and Valacich, 2001). Application of non-random sampling on the other hand, limits the generalzeability of survey results.

Sheehan and Hoy (1999) in their study cited the lack of a national directory of e-mail address as a limiting factor thus posing a problem of obtaining names with which to define the sample frame. Issues such as anonymity and confidentiality (the use 'reply' function) is a concern to potential participants along with intrusion which does not fit into the "Internet culture" and therefore could elicit negative reaction to the survey including mistrust.

While there are disadvantages associated with type data collection, these author (Sheehan and Hoy, 1999; Comley, n.d.; Smith, 1997; Coomber, 1997; Kehoe and Pitkow, 1996) see many benefits in using the Internet and E-mail for data collection. All commented on the cost effectiveness of this mode: short response cycle, the use of log file to address validity issues, ability to control duplicate responses and non-responses, and ease and flexibility of responding. Additional benefit from this researcher's

perspective is the integration of the automated survey tool with MS outlook and MS Access database, and the tool ability to collect the data in an automated manner and update the database.

Existing survey instruments were analyzed for related questions and design structure. Where items served the needs of this research, they were incorporated along with the items developed specifically for this research. Since the intent was to administer the survey electronically, a software tool (Perseus, 1998 [Survey Solutions for the Web v2.0 with release 1.0 update]) was identified that facilitated the deployment of this type of instrument across the Internet. This tool also has the ability to manage the process including performing statistical analysis of the data, and when necessary export the data to SPSS for rigorous analysis and interpretation.

The product brochure for the Perseus software noted features such as word processor for survey design, automated HTML translation, automatic formatting for e-mail survey, automatic publishing to the web, automatic collection of survey results, automatic creation of server based result file, automatic update to MS Access results database, instant display of results as charts and tables and instant reporting and presentation options on the workstation. As an additional measure, SPSS software version 9 product literature release dated 1999, lists features such as ODBC (Open Database Connectivity) wizard for easy data integration with a wide range of databases; long variables labels in dialogs; full services statistics thus the ability to perform complex statistical procedures; a wide array of charting tools to graphically display data; several output and reporting methods. This tool is widely used by a large number of educational institutions and corporate organizations for complex data analysis (see product literature).

Zviran (1990) used an ad hoc committee comprising of subject matter experts to perform validation of survey instrument. In this study, this researcher used similar technique in the proposal stage to validate the survey instrument. This committee of subject matter experts was given a copy of the survey instrument in a complete form; it was delivered through e-mail with a cover letter requesting their participation but with additional information they would need for validating the survey instrument. The committee of experts was asked to rate the survey instrument on the following criteria:

- The survey instrument conformed to good design.
- The survey was easy to use.
- The survey was easy to understand.
- The survey questions were grouped in the correct sequence.
- The survey items were scaled correctly.
- The survey items related to question/s asked.

Respondents were requested to rank their answers on a scale of 0-5, where 0 indicated a strong disagreement and 5 indicated a strong agreement. In addition, they were encouraged to provide any other comments they feel would improve the quality of the survey instrument. Responses indicated a high degree of acceptance with all criteria receiving a rating of 4 and above. One expert suggested a change in the scale for two of the items and another indicated that he found the use of the Internet approach appealing and relatively easy to use.

Data Collection Method

Survey research methods was used for collecting data on the linkage between enterprise integration architecture objectives and organizational objectives (Zviran, 1990;

Teo, 1994; Reich and Benbasat, 1996). Specifically, the survey method was used in two ways: As a means of collecting the data and as analysis techniques for data interpretation. The specific actions were:

a) Prepared announcement of intent to conduct survey to online participants and post it.

b) Developed cover letter information to be included with survey instrument. This cover letter provided confidentiality assurance along with the number of questions in the survey and estimated time to complete the survey.

c) Created a file directory on this researcher's Internet Service Provider (ISP) web page directory space to house the survey instrument file.

d) Redesigned this researcher's personal web page to include a "hot spot" for the survey thus giving the survey instrument it unique URL [Uniform Resource Locator].

e) Created a MS Access Database file within the survey tool to accept survey data returned by the mail server; the mail management module included with the survey tool integrates with MS Outlook Mail application that provides the mail transport.

f) Tested survey instrument delivery. This was accomplished by sending the completed questionnaire to ad hoc committee in the same manner intended for sample frame. In addition to the cover letter, a letter requesting their evaluation was included and a special section provided in the survey instrument for them to record their comments (this will section will not be included in the final questionnaire).

g) Prepared package for delivery to sample frame and execute survey.

h) Monitored survey progress and closed out data collection after approximately three months of activity.

i) Evaluated data quality, cleaned up data (including removing any trace information to ensure confidentiality) and performed data analysis.

The sample frame was drawn from a population of Internet users who were members of ICEIMT@tools.org; ArchitecturePlus list; opentech_architecture web conference; iTMweb: worldwide IT forum [COT and IT executive corner]; Enterprise-wide IT Architecture forum; alt.org.data-proc-mgmt discussion list; comp.infosystems newsgroup; comp.inforsystems.www.database newsgroup; ISWorld list whose statement of purposes included discussion or collaboration on topics relating to information systems and technology management, business process re-engineering, enterprise modeling and architecture. Following are synopses of these virtual communities:

ICEIMT@tools.org: International Conference on Enterprise Integration Modeling technology (ICEIMT) is the outgrowth from the 1992 conference on the same topic. The forum is not moderated; it provides subscribers with an avenue to post announcements and discuss topics of interest in the area of enterprise integration. Audience is typically involved in R & D, international, and wide range of interdisciplinary skills and interest with strong representation across government, industry, academia, and standards groups. As of November 1, 1999 there are 263 active subscribers (including this researcher who did not participate in the survey).

ArchitecturePlus list: This is a moderated list consisting of several sub list focusing on different aspects of the "Zachman Framework" and the super list that focus on architecture models and standards; membership is restricted to either the super list or any of the sub lists but not both. No data on number of active subscribers were provided (this researcher is an active member of this list but did not participate in the survey).

Opentech_architecture web conference: This conference is a moderated forum of authorized subscribers. The purpose of this conference is to allow those interested in

IT architecture (including systems, data, networks, process flows and/or business architecture) to share concerns and ideas. Active subscribers' number was not determined at the time of survey posting.

ItmWeb: Worldwide IT forum [CIO and IT executive corner]: This forum consists of several discussion groups (moderated and un-moderated). For this study sample frame, the CIO and IT executive corner was of interest. This group focused on IT management topics include people skills, budgeting, ROI, strategic planning, and business relationships. Active subscribers were not determined.

ISWorld Discussion List: This list serves the entire community of information systems researchers and educators as well as doctoral level students. The list focus is information systems and technology related that covers topics such as strategy, modeling, architecture, and aspects of teaching and research. The list consisted of approximately 2260 subscribers from 55 countries at the time of survey posting.

Enterprise-wide IT Architecture Forum: Subscribers to this forum exchange conversations relating to IT architecture planning, development, and management. The group consists of about 200 subscribers at the time of survey posting.

Alt.org.data-proc-mgmt, comp.infosystems, comp.inforsystems.www.database: These are newsgroups focus on various information systems and technology subjects. Subscribers exchange information that includes but is not limited to topics such as methodologies, planning, resources, practical application of IT, and software (public domain). Number of subscribers was not published or could be provided to this researcher at the time of survey posting.

These specific sample frames were selected based on this researcher membership in these virtual communities and the unique informational nature of the study itself. The

data collected required knowledge of the subject matter, thus this population have specialized knowledge in the study area was selected and therefore affording the generalization of results to the general information and technology population. These individuals participate in these collaborative environments because of the specific focus.

Survey instruments were emailed to the survey population listed previously in January of 2001. Because this data collection method was designed to obtain information from virtual communities that did not provide subscription information, a total count of the participants receiving the survey instrument was not determined. A total of 85 responses were returned after three months of activity that included three follow up requests reminding participants to complete the survey if they had not done so already.

Statistical Procedures

Selecting an appropriate measurement method ensures that the data collected measure the intended construct and variables. It is common practice to use or adapt when possible, existing measurement scales since by so doing facilitate reconciliation of new findings with past studies (Segars and Grover, 1999). While this is desirable, there will be instances when this is not possible and therefore the investigator must consult the literature for theoretical context for describing the variables in terms of content and complexity and definition for the variables of interest (Segars and Grover, 1999). With this study, the literature was extensively used to develop items measures for architectural objectives; items measuring organizational objectives from (Zviran, 1990) were incorporated since these were empirically tested and thus meeting the objective of this research.

There are many statistical procedures available to a researcher to assess measurement efficacy (Segars and Grover, 1999). In this study, this researcher identified empirical support for linkages between enterprise integration architecture objectives and organizational objectives. This approach, while in the realms of strategy planning, proposed a linkage between the two sets of actionable statements generally accompanying both information systems strategy plans and business strategy plans. This researcher's thesis went beyond the planning formulation processes often time the subject of research and practice-oriented concerns to extend alignment theory to the means by which information technology actions are implemented to support the organization's strategy and therefore achieving a higher degree of alignment in pursuit of full integration.

These architectural objectives represent global justification for architectural management in support of business strategies. The literature did not provide empirical support for these variables thus their veracity needs to be tested. Architectural objectives are the input to the requirements part of the model. The final linkage construct (Figure 9) represents the testable linkage factors. Zviran's (1990) organizational objectives are the independent variables; architectural objectives are dependent variables that were associated with specific organizational objectives to produce a linkage profile. The logic of this matrix is that for each organizational objective there exist a relationship between a specific set of architectural objectives that will influence the definition of an enterprise integration architecture to achieve alignment with business strategies and therefore minimizing disconnects between the business strategy and information technology investments. Survey participants were asked to (a) select organizational objectives that

are important for architectural development, (b) identify objectives that represents architectural objectives, and (c) select architectural objectives that will support specific organizational objectives.

SPSS was used to import the data from MS Access database that was created by the survey tool to collect survey data. Once the data was converted into a format for SPSS, descriptive statistical data analysis (mean and standard deviation, breakdown of survey responses, variance and covariance, and population statistics) of the survey responses was performed to build response profiles from the data, produce data distribution (frequency and cumulative frequency tables and cross tabulation) and identify any data quality issues. This approach was supported in the information systems planning alignment literature and given the range and scope of variable under consideration. These analytical techniques seem in line with the objectives of this investigation (Zviran, 1990; Teo, 1994; Segars and Grover, 1999).

The linkage construct (Figure 9) consisted of 8 independent variables (organizational objectives) and 20 dependent variables (architectural objectives). The linkage construct assumes there exists some form of relationships between these two sets of objectives in that there can be one or more architectural variable(s) linked to one or more organizational variable(s) to form a profile of planning factors for enterprise integration architecture development. This specification suggests that the linkage construct is linear in it's composition in that it display a form of relationship among variables such that when any two variables are plotted, a straight line results thus a relationship is linear if the effect on a dependent variable due to a change of one unit in

an independent variable is the same for all possible such change (Hair, Anderson, Tathm, and Black, 1995).

Measuring reliability of the instrument ensures accuracy and precision that is free from error measurement (Teo, 1994). Internal consistency methods were performed by the application of Cronbach Alpha statistic to determine if items measuring the same construct correlate highly with each other thus high values of Cronbach alpha indicate high internal consistency of multiply items measuring each construct and therefore high reliability of the individual construct. The use of Cronbach's alpha statistic to estimate reliability yielded a subset of reliable items for each variable, where the items meet or exceed the minimum Cronbach alpha level. An Alpha of 0.5 or greater is generally acceptable (Teo, 1994) however, an alpha of 0.7 was selected for this research.

Four separate multiple regression analysis were performed to test hypotheses, one multiple regression for each dependent variable. The goal was to test if there was any relationship between one or more continuous independent (predicator) variables and a continuous dependent (criterion) variable. This allowed for measurement of the combined influence of Organizational participation development of enterprise integration architecture (**Opdvia**), Organizational objectives importance for development of IT (**Ooimprt**), and Enterprise integration importance (**Eigimprt**) on each dependent variable (Importance of architectural objectives [**Arcobimp**], Enterprise integration architecture ensures [**Eiaensr**], Architectural objectives business link [**Arcoblnk**], and Architectural objectives are appropriate [**Arcobapp**] indicators of strategy-architecture linkage.

Regression analysis was applied after the application of Cronbach alpha analysis to estimate reliability (internal consistency reliability) and to remove weaker items to

produce a subset of reliable items for each variable that met an error measurement of 0.7 and was basis for creating the total scores on each variable in question.

Zviran (1990) used chi-squire (x^2) to test independence between each of the specific information systems objectives and the application of scalar-to-profile (STP) and profile-to-profile (PTP) techniques to find the specific correspondence between organizational objectives and information systems objectives. With STP procedure, relevant groups of information systems objectives are related to specific organizational objective thus allowing for fitting of each organization objectives with the appropriate information systems objectives according to its specific organizational objectives. PTP examined the total profile taking into consideration the interrelationships among the objective within the profile but this procedure requires a large data set to draw any worthwhile generalized conclusions.

Reich and Benbasat (1996) in their linkage study, applied interpretative analysis since their study relied mainly on qualitative data. They however performed statistical analysis on the data after performing data transformation. Correlation analysis procedure was used to test linkage measures. These authors however provided the avenue for future researchers to explore alignment constructs between information systems and business planning using other statistical procedures to develop empirical support for linkage measures.

Teo (1994) investigated the integration of information systems planning with business strategy planning. In this study Teo (1994) sought to determine stages of evolution an organization follow in reaching full integration, full integration being a linkage of the planning processes thus both plans (business and information systems) are

developed concurrently and is supportive of each other. Statistical procedures applied by (Teo, 1994) included content validity to assess the representatives or sample adequacy of the content of the survey instrument, confirmatory factor analysis to test the construct validity of the items comprising each construct along with principal component analysis with varimax rotation to determine if all items measuring the construct cluster together. Further refinement of the data was obtained through the use of factor analysis on individual constructs and the application of joint factor analysis.

Confirmatory factor analysis was applied by (Segars and Grover, 1998) in a study that sought to understand how information systems planning success that included an alignment construct is measured. This method was used to develop profiles of strategic information systems planning of variables for each construct in the profile (Segars and Grover, 1999).

Studies relating to information systems planning and business strategy planning alignment, integration, correspondence, fit, and planning successes were synthesized by (Chan and Huff, 1993) who provided an empirical assessment of the nature and importance of information systems strategic alignment and the impact of alignment on organizational performance. These authors applied analytical techniques such as factor analysis, Cronbach's alpha calculations, inter-rater reliability analysis, partial least square analysis on various alignment models for empirical support of their model.

Use of survey research design methods provided an appropriate method for measuring linkage variables since it is expected that the data will represent relevant practice oriented information on the topic, therefore results should be generalizeable to the population (Creswell, 1994). As discussed in the goal section, a review of current

research literature did not provide any empirical support for enterprise integration architecture-business strategy linkage although many organizations claim to have developed or have implemented enterprise integration architecture. It is expected that this research findings will extend current alignment theories to be useful in enterprise engineering for information technology (systems) planning and implementation in support of business strategy. This was accomplished by testing architectural support for organizational objective.

Summary

The conceptual planning model for advancing linkages between organizational objectives and architectural objectives when implanting enterprise integration strategy and modeling the enterprise for leveraging information technologies through the enterprise integration architecture provided the context in which enterprise integration architectural objectives and organizational objectives linkages can be achieved. This model consists of planning components to guide the enterprise architect during the enterprise integration modeling tasks necessary for strategy-architecture links based on a contingency profile of organizational and architectural objectives.

Business strategy and information systems planning frameworks and methodologies while espousing the importance of aligning the strategic actions formulated within these two planning events is silent on what and how architectural components relate to the organization's strategic thrust. Organizational objectives are supported in the empirical literature and are understood by both information systems and business planners. What are missing are architectural objectives that represent

measurable statements for the design, development, and implementation of the enterprise integration architecture.

A set of architectural objectives were derived from the literature using criteria discussed previously in this chapter. These objectives are the dependent variables and organizational objectives represent the independent variables for this investigation, when taken together, they form a contingency profile of planning factors for linking the architecture with business strategy and therefore full integration is possible.

Linking these two planning variables represents a different approach for information systems strategy and business strategy alignment and therefore use of existing data would not provide empirical support for research questions posed previously. To collect the data needed to test the linkage construct, a survey instrument was developed and tested, and was administered over the Internet using the email format.

Data collected from the sample frame were analyzed first to summarize the data to gain detailed understanding of the respondents and second to test the research model. Primary statistical techniques were discussed in this chapter. Finding empirical support for the linkage construct was realized from the data collected thus advancing alignment theories to aspects of the architectural development process and therefore a direct tie-in with the information technology infrastructure.

Chapter 4

Results

Three research questions were stated in Chapter 1 of this dissertation. These questions were developed around two themes: (1) Enterprise integration modeling as a planning tool for defining information technology and systems strategy to achieve enterprise integration, and (2) enterprise integration architecture planning, development, implementation, and ongoing maintenance in support of business strategy that is linked to the architecture. These two themes were then structured into a research model that draws on alignment theory as a baseline along with business and information systems strategy linkage factors. The purpose of this type of investigation is to extend alignment theory to enterprise integration architecture formulation.

Enterprise integration architecture is a vital decision-making tool for information systems organizations (Bernus, Nemes and Williams, 1996a; King, 1995; Rosser, 1996). Empirical support for enterprise integration architecture is non-existent in the literature and the state-of-the-art provides no insight regarding what constitute architectural objectives and to what extent the architecture as implemented is congruent with enterprise strategy direction. In this study, this researcher provided a new perspective and planning factors to link architectural objectives with organizational objectives and therefore alignment of architectural artifacts with business strategy.

To establish this type of linkage, several architectural objectives were derived from the literature. These objectives together form dependent variables representing

requirements for enterprise integration architecture development. Organizational objectives on the other hand representing independent variables had empirical support (Zviran, 1990) and therefore provided a testable set of variables that were used to model the final linkage construct detailed in Chapter 3. Application of the final linkage construct during any enterprise integration architecture development process provides a profile of planning factors for linking architectural artifacts to business strategy and by so doing:

- Facilitate the implementation and use of information technology to improve enterprise operations.
- Enable and encourage up-front investment in infrastructure components.
- Support the use of new methodologies, techniques, and tools for constructing and maintaining enterprise business applications.
- Ensure a centralized management structure and therefore (a) facilitate economics of scale in acquisition of resources and services, (b) increase reliability of operations and predictability of outcomes, (c) help in defining roles and responsibilities, and accountability for outcome, and (d) make data accessible and enable the exchange of information among value and supply chain participants.
- Create an IT vendor neutral environment; mitigate technology risks associated with market dynamics.
- Encourage a stable infrastructure that is configurable as business needs dictates.

The findings presented in this chapter reflect outcomes for the goals and objectives outlined in Chapter 1. Three research questions detailed in Chapter 3 provided the foundation for the design of the survey instrument for data collection and were used to structure both dependent and independent variables for this study. Table 5 details how

these questions correspond to each dependent and independent variable along with survey item (number in []) used to trap construct measurement.

Table 5 Research Questions and Variables Crosswalk

Research Questions	Dependent Variables	Independent Variables
What are the factors for linking organizational objectives with enterprise integration?	Importance of architectural objectives (**Arcobimp**) [5] Architectural objective business link (**Arcoblnk**) [7] Architectural objectives are appropriate (**Arcobapp**) [8]	Organizational objectives importance for development of IT (**Ooimprt**) [6]
To achieve enterprise integration, how are these factors used in the planning framework for linking business strategy with enterprise integration architecture?	Importance of architectural objectives (**Arcobimp**) [5] Architectural objectives are appropriate (**Arcobapp**) [8]	Organizational objectives importance for development of IT (**Ooimprt**) [6] Enterprise integration importance (**Eigimprt**) [9]
How do these factors relate to enterprise integration modeling?	Enterprise integration architecture ensures (**Eiaensr**) [14]	Organizational participation development of enterprise integration architecture (**Opdvia**) [12]

Analysis

Validation

Data were collected from survey participants who responded to the survey instrument (see the Appendix). This instrument was validated by a panel of "experts" who were asked to rate survey items for construct and content validity. This approach was necessary because this instrument was an inaugural design and therefore it is incumbent on the researcher to ensure that the instrument measures the construct under investigation (Boudereau, Gefen and Straub, 2001). Expert panel ratings indicated a high

degree of acceptance with all criteria receiving a rating of four and above on a scale of 0 – 5, where 0 indicated a strong disagreement and 5 indicated a strong agreement with items construct and content for this investigation. In order to ensure uniformity of scale rating for data analysis, all variables were recoded in such a way that 5 = strongly agree and 1 = strongly disagree, so that a higher score on any item (or scale) indicated a more "positive" attitude.

Reliability

The Cronbach's alpha statistic was used to measure the internal consistency reliability of each scale. The Cronbach's alpha statistic usually ranges between zero and one. Scores closer to one indicate more reliability, scores closer to zero indicate lower reliability; a Cronbach's alpha level of 0.7 or higher is usually desirable (Teo, 1994).

Table 6 summarizes the reliability of constructs for this research. Generally, the reliability of the various constructs is greater than 0.6 thus demonstrating a high degree of precision of the measuring instrument. The original architectural objectives listed in survey item five, consisted of 20 factors for the **Arcobimp** (Importance of architectural objectives) construct.

Two items (standards and 80/20 solution) were deleted since both of these factors correlated poorly therefore deleting these factors improved the alpha to 0.7 the cutoff point. Possible explanations for these two factors showing such a poor correlation could be (1) standards while necessary for building the infrastructure for architectural support of the information systems strategy cannot be measured directly, (2) adopting any standard is more a principle embraced by IT management rather than an objective for the architecture itself, (3) standards provide a framework for managing IT selection and

decommissioning and is therefore a component of the architecture process to the extent it helps to define how the architecture will adopt IT innovations to achieve interoperability which is one the factors in the **Arcobimp** construct.

Table 6 Reliability of Constructs

Construct	N	No. of Items	Cronbach Alpha
Dependent variables			
Arcobimp	85	18	0.70
Arcoblink	85	16	0.70
Arcobapp	82	7	0.72
Eiaensr	85	8	0.71
Independent variables			
Ooimprt	85	8	0.71
Eigimprt	84	12	0.66
Opdvia	82	5	0.74

Key: **Arcobimp** = Importance of architectural objectives
Arcoblink = Architectural objective business link
Arcobapp = Architectural objectives are appropriate
Eiaensr = Enterprise integration architecture ensures
Ooimprt = Organizational objectives importance for development of IT
Eigimprt = Enterprise integration importance
Opdvia = Organizational participation development of enterprise integration architecture

The poor correlation of the 80/20 solution factor demonstrated the nebulous nature of this idea. The notion that in any architectural endeavor, planners (the architect) can devise a plan that focus on 20 % of the problem space to achieve an 80 % solution to the problem is a stretch in the minds of respondents. On the other hand, respondents could have been confused with this factor in relation to how it could be linked to any organizational objective. The specification could be hard to define; it would need to be standardized in such a manner that it holds the same meaning across the board. As a factor, it could increase misunderstanding among IT professionals and the business units and perhaps give a false sense of security to business managers to the extent these

business managers correlate funding strategies with problem space specification. Factors remaining (18 items) however confirmed the architectural objective construct for this research.

This study was about determining architectural objective factors that can be linked to organizational objective factors. Respondents were asked to identify architectural objectives they consider appropriate to achieve linkages with organizational objectives for alignment between business strategy and information technology strategy (survey item 7). The **Arcblink** (Architectural objectives business link) construct represents operationalization of this measure that consisted of the original set of architectural objective factors (20 items); reliability tests indicated four factors (standards [see discussion on **Arcobimp**], interoperability, 80/20 solution [see discussion on **Arcobimp**], and education and training) that did correlate with the overall construct.

Interoperability involves principles about to connecting and combining people, processes, systems, and technologies to ensure that the right people and the right processes have the right information and the right resources at the right time. Given this meaning, respondents may have viewed this factor not as an architectural objective but instead as a principle for information systems strategy formulation. With regards to education and training, on the surface it is an appealing action for improving the communications and understanding between business managers and IS managers, but as was observed from the data, it did not correlate with other factors. Respondents' attitudes on this factor may have been influenced by another factor (communication between IS and business unit) that could accomplish the understanding aspects of the plans for linkage purposes. On the other hand, given the need for tacit and explicit knowledge of

information technologies and the enterprise architecture development process, the architecture can facilitate learning about the underlying information technologies to the extent business unit managers can influence selection for infrastructure implementation is questionable.

The **Arcoblnk** construct, after deleting the four items discussed previously that did not correlate contained 16 factors out of the original 20 factors. These 16 factors represent core architectural objectives that can be linked to organizational objectives for alignment reasons. In addition, since the literature did not provide a set of architectural objectives, this list provides empirical support for architectural objectives and the need to link these objectives to business strategy.

Assessing the strength of organizational objectives for enterprise integration architecture strategy is vital for achieving linkage between the architecture and business strategy. The **Arcobapp** construct (survey item 8) consists of eight original factors (Zviran, 1990) on which reliability analysis were performed. One factor (improve administrative efficiency) failed to correlate and therefore was deleted resulting in a final construct consisting of seven factors that influence enterprise integration architecture strategy. Improve administrative efficiency represents "data processing era" information systems thinking thus respondents attitude to this factor may have been influenced by this idea along with the fact that organizations believe re-engineering provides a better efficiency approach in concert with automation.

Eiaensr construct (survey item 14) consisted of nine factors making up the scale. One factor (integration of current technology) did correlate and was deleted to improve the reliability of the construct. This construct was concerned with the primary reasons for

the enterprise integration architecture. Respondents clearly did not see any merit in having the enterprise integration architecture integrate current technology presumable because architectures reflect information technologies that supports the business direction but must layout a transitional approach to adopting IT that is efficient and effective. Another explanation for this poor correlation could be that architectures should reflect only those technologies that indeed support various business strategies instead of the technology strategies driving the business imperatives. The fundamental purpose of any enterprise integration architecture is to provide a blueprint of the organization's approach for information technology diffusion.

The above amplification of the reliability analysis results focused on the dependent variables. Three scales were used to tap the independent variables. **Ooimprt** (survey item 6) tapped the relative importance of each organizational objective for the development of information technology strategy, the information systems plans and the enterprise integration architecture. These organizational objectives were empirically tested for correspondence with information systems strategy (Zviran, 1990) and were used by this researcher for enterprise integration architecture support. The **Ooimprt** construct demonstrated a high degree of reliability since no factors were deleted thus eight factors make up this construct.

Eigimprt (survey item nine) related to the importance of enterprise integration objectives for business strategy support. This construct consisted of 14 factors, reduced to 12 after reliability analysis. Two factors (improve customer satisfaction and product process cycle time reduction) were deleted due to poor correlation within the scale. While these two factors represent good intentions by corporate management, they are best

thought of as operational actions rather than strategic goals. The final construct, **Opdvia** (survey item 12) related to the level of organizational participation in the development of the enterprise integration architecture. None of the 5 items were deleted since the items met the cutoff for scale reliability. Table 7 summarizes items remaining after reliability analysis for both independent and dependent variables.

Table 7 Variables and Factors after Reliability Analysis

Constructs	Factors	
Dependent Variables		
Importance of Architectural Objectives (**Arcobimp** [18 items])	• Provide timely information • Costs • Quality • Flexibility • Interoperability • Share information • Environment • Redundancy management • Communication between IS and business units	• Model base decision support • Model of inter or intra enterprise operations • Select and employ technology to support business • Right information in the right place • Cycle time reduction • Monitoring management system • Manage IT risks • Education and training • Integrated data
Architectural Objective business link (**Arcoblink** [16 items])	• Provide timely information • Costs • Quality • Flexibility • Share information • Environment • Redundancy management • Communication between IS and business units	• Model base decision support • Model of inter or inta enterprise operations • Select and employ technology to support business • Right information in the right place • Cycle time reduction • Monitoring management system • Manage IT risks • Integrated data

Table 7 cont'd

Architectural Objectives are appropriate (**Arcobapp** [7 items])	• Control and reduce costs • Improve service • Gain competitive advantage	• Increase revenue • Supply products and services on time • Improve quality • Increase organizational productivity
Enterprise Integration Architecture ensures (**Eiaensr** [8 items])	• Make better use of current resources • Improve the quality of systems development process • Integration of the decision making process • Visibility of the integrated nature of the enterprise	• Manage costs associated with developing enterprise wide systems • Contain metrics for exploring economic/technology options • Flexibility in systems configuration and change management • Development of a documented form of the enterprise process
Independent Variables Organizational Objectives importance for development of IT (**Ooimprt** [8 items])	• Control and reduce costs • Improve administrative efficiency • Supply products and services on time	• Increase revenue • Improve service • Gain competitive advantage • Improve quality • Increase organizational productivity
Enterprise Integration importance (**Eigimprt** [12 items])	• Higher quality goods • Increase profits • Better decision under uncertainty • Track political legislation • Track technology advances	• Decrease unit costs • Improve product support • Increased staff satisfaction • Manage competitive activity • Track economic trends • Track social influence • Track industry structural changes
Organizational Participation Development of Enterprise Integration	• CEO • Business Unit Managers	• CIO • Supply Chain Partners • IS Managers

Architecture (**Opdvia** [5 items])

Hypotheses Testing

The statistical methods used to test the research hypotheses are summarized in Table 8. Multiple regression analysis was used since the goal was to measure the combined influence of the independent variables (predictor) on the dependent variable (criterion). For multiple regressions to be appropriate, all variables must be continuous.

Table 8 Summary of Hypotheses Testing

Research Variables	Measures	Analysis
Hypotheses		
Relationship between **Opdvia**, **Ooimprt**, **Eigimprt**, and **Arcobimp** (H1; H1a;H1b;H1c)	Combined influence of the independent variables on the dependent variable	Multiple Regression
Relationship between **Opdvia**, **Ooimprt**, **Eigimprt**, and **Eiaensr** (H2; H2a;H2b;H2c)	Combined influence of the independent variables on the dependent variable	Multiple Regression
Relationship between **Opdvia**, **Ooimprt**, **Eigimprt**, and **Arcoblnk** (H3; H3a;H3b;H3c)	Combined influence of the independent variables on the dependent variable	Multiple Regression
Relationship between **Opdvia**, **Ooimprt**, **Eigimprt**, and **Arcobapp** (H4; H4a;H4b;H4c)	Combined influence of the independent variables on the dependent variable	Multiple Regression

Multiple regressions assume that the relationship between the dependent variable and each of the independent variables is linear. In addition, there is normality in the distributions and that no outliers are having an undue influence on the results. Multiple regressions assume that independent variables are not strongly correlated, a condition

known as multicollinearity (Hair, Tathm and Black, 1995). Each of these assumptions can be assessed by examining simple correlations.

Multiple regression yields a series of statistics to help determine if a given set of predictors is adequate and which predictors have the most impact at predicting the dependent variable. R^2 represents the total proportion of variance accounted for by all of the predictors (0 = none, 1= perfect prediction). Closer to 1 is better. A related statistic, adjusted R^2, has the same interpretation, but it is the R^2 adjusted for bias. As new variables are entered in the multiple regression equation, R^2 can be used to see how well a given set of predictor variables predicts the dependent variable. Multiple regressions also yield "beta weights" for each independent variable, which can be tested for significance. A significant beta weight for a given variable means that the variable is a significant predictor of the dependent variable (Hair, Tathm and Black, 1995).

Importance of Architectural Objectives

Hypotheses 1: Organizational participation development of enterprise integration architecture, organizational objective importance for developing IT, and enterprise integration importance will be significant predicators of the importance architectural objective.

1a. The relationship between organizational participation development of enterprise integration architecture and the importance of architectural objectives will be positive.

1b. The relationship between organizational importance for development of IT and the importance of architectural objectives will be positive.

1c. The relationship between enterprise integration importance and the importance of architectural objectives will be positive.

Multiple regression tests the relationship between importance of architectural objectives (**Arcobimp**) and each of the predictor variables (organizational participation development of E.I.A. [**Opdvia**], organizational objective importance for development of

IT [**Ooimprt**], and enterprise integration importance [**Eigimprt**]).Table 9 shows descriptive statistics and the Pearson r correlation for both set of variables.

Table 9 Descriptive Statistics and Correlations for Importance of Architectural Objectives

Dependent/Independent Variables	Mean	Std. Deviation	N	Pearson r
Importance of architectural objectives (**Arcobimp**)	2.58	0.222	82	1.000
Organizational participation development of EIA (**Opdvia**)	4.25	1.038	82	-0.118
Organizational objective importance for development of IT (**Ooimprt**)	2.59	0.327	82	0.605
Enterprise integration importance (**Eigimprt**)	2.34	0.282	82	0.498

Survey item 5 asked respondents to rate the relative importance of architectural objectives for the design, development, and management of the architecture planning process. Architectural objectives are statements of what is to be accomplished from the design, development, and implementation of the enterprise integration architecture, and provide a set of architectural guidelines for selecting information technology to support the organization's business strategy (TOGAF, 1998). Organizational objectives are specific performance targets, directing the efforts of what are to be accomplished through the organization's business activities (Zviran, 1990).

These architectural objectives as was discussed in Chapter three represent factors that were not subjected to any empirical test since they represented new factors derived from the literature by this researcher. Assessing the importance of these factors was a

critical step in understanding how the various independent variables influenced the dependent variable in this study.

Organizational participation development of EIA (**Opdvia**) demonstrated a mean score significantly greater than all other variables and a negative Pearson r correlation thus organizational participation development of EIA (**Opdvia**) falls outside the typical value for independent variables and therefore a poor predictor of the dependent variable. The other two independent variables demonstrated mean scores and correlation that reflect some differences between them but represent predictors of the dependent variable.

Table 10 Model Fit Summary for Importance of Architectural Objectives

Model Summary Model

	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.677	**0.458**	0.437	0.16722

Multiple Regression Model

		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.845	3	0.615	21.994	**0.000**
	Residual	2.181	78	0.027		
	Total	4.026	81			

Predictors: (Constant), Enterprise integration importance
Organizational participation development of EIA
Organizational objective importance for development of IT

Dependent Variable: Importance of Architectural Objectives

Table 10 shows summary and regression statistics that indicate model fit or how well the data cluster about a straight line along with F test statistic for the fit of the liner model. The R^2 statistic shows the proportion of variance in the dependent variable that was predictable from the independent variables. Approximately 46% of the variance in

the dependent variable was accounted for by the independent variables. About 54% of the variance in the dependent variable was not accounted for by the independent variables. This is moderate model fit for social science/self report data. The F test statistic was significant and is evidence that a straight line is a good fit for the data.

Table 11 presents the un-standardized beta from the regression analysis and the corresponding test of significance, which is in the form of a t test. When the t test for a given un-standardized beta is significant it indicates that the relationship between the dependent variable and the corresponding independent variable was significant. Since the t test for organizational objective importance for development of IT was significant, this means that a significant relationship exists between organizational objective importance for development of IT and importance of architectural objectives (the dependent variable).

Table 11 Importance of Architectural Objectives Coefficients Model

	Non-standardized Coefficients Beta	Std. Error	Standardized Coefficients Beta	t	Sig.
Organizational participation development of EIA	-0.0179	0.018	-0.084	-1.000	0.321
Organizational objective importance for development of IT	0.332	0.061	0.487	5.414	0.000
Enterprise integration importance	0.243	0.071	0.308	3.413	0.001

Note that the un-standardized beta was positive (there was no negative sign), which indicates that a positive relationship exists between organizational objective importance for development of IT and importance of architectural objectives. This means that high scores on organizational objective importance for development of IT go with high scores on importance of architectural objectives. Low scores on organizational objective importance for development of IT go with low scores on the importance of architectural objectives. Since the t test statistic for enterprise integration importance was significant, this means that a significant relationship exists between enterprise integration importance and importance of architectural objectives (the dependent variable).

Note that the un-standardized beta was positive. This implies that a positive relationship exists between enterprise integration importance and importance of architectural objectives. High scores on enterprise integration importance go with high scores on importance of architectural objectives and low scores on one go with low scores on the other. The t-test statistic for organizational participation development of E.I.A. was non-significant. This means that there was no significant relationship between organizational participation development of E.I.A. and importance of architectural objectives the dependent variable.

In summary, hypothesis (H 1) that organizational participation development of E.I.A., organizational objective importance for development of IT, and enterprise integration importance were related to importance of architectural objectives was supported by this data (see the F test from the multiple regression table). Hypothesis (H 1b) that organizational objective importance for development of IT was related to

importance of architectural objectives was supported by this data (see the "sig" column in the coefficients table). The relationship was positive.

Hypothesis (H 1c) that enterprise integration importance was related to importance of architectural objectives was supported by this data (see the "sig" column in the coefficients table). The relationship was positive. Hypothesis (H 1a) that organizational participation development of E.I.A. was related to importance of architectural objectives was not supported by this data (see the "sig" column in the coefficients table).

Enterprise integration architecture ensures

> Hypotheses 2: Organizational participation development of enterprise integration architecture, organizational objective importance for developing IT, and enterprise integration importance will be significant predicators of the benefits associated with enterprise integration architecture for information technology management.
>
> > 2a. The relationship between organizational participation development of enterprise integration architecture and the benefits associated with enterprise integration architecture for information technology management will be positive.
> >
> > 2b. The relationship between organizational importance for development of IT and the benefits associated with enterprise integration architecture for information technology management will be positive.
> >
> > 2c. The relationship between enterprise integration importance and the benefits associated with enterprise integration architecture for information technology management will be positive.

Table 12 shows the descriptive statistics and the Pearson r correlation for both variables. Multiple regression tests the relationship between enterprise integration architecture ensures variable (**Eiaensr**) and each of the predicator variables (organizational participation development of EIA [**Opdvia**], organizational objective

importance for development of IT [**Ooimprt**], and enterprise integration importance [**Eigimprt**]).

Table 12 Descriptive Statistics and Correlations for Enterprise Integration Architecture Ensures Variable

Dependent/Independent Variables	Mean	Std. Deviation	N	Pearson r
Enterprise integration architecture ensures (**Eiaensr**)	4.30	0.522	82	1.000
Organizational participation development of EIA (**Opdvia**)	4.25	1.038	82	-0.090
Organizational objective importance for development of IT (**Ooimprt**)	2.59	0.327	82	0.465
Enterprise integration importance (**Eigimprt**)	2.32	0.282	82	0.485

Survey item 14 asked survey respondents to identify from the nine items making up this scale, factors that would represent the benefits of enterprise integration architecture for IT management. It is common belief among information systems management that enterprise integration architecture will deliver substantial benefits to the organization and therefore allow for an effective and efficient IT management (Bernus, Nemes and Williams, 1996a). Table 12 shows that organizational participation development of EIA (**Opdvia**) mean score was far greater than the other independent variables and the Pearson r correlation indicated a negative score thus a poor predicator of the dependent variable. The other two independent variables demonstrated mean scores that reflect some differences between them but are predicators of the dependent variable.

Table 13 details both summary and regression statistics that indicate a moderate to weak model fit, or how well the data cluster about a straight line and F test statistic for the fit of the liner model. The R^2 statistic shows the proportion of variance in the dependent variable that was predicted from the independent variables. Thirty three percent (33%) of the variance in the dependent variable was accounted for by the independent variables; approximately 67% was not accounted for by the independent variables. The overall test of model fit was significant.

Table 13 Model Fit Summary Enterprise Integration Architecture Ensures

Model Summary Model

	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.575	**0.331**	0.305	0.43481

Multiple Regression Model

		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.288	3	2.429	12.850	**0.000**
	Residual	14.746	78	0.189		
	Total	22.034	81			

Predictors: (Constant), Enterprise integration importance
Organizational participation development of EIA
Organizational objective importance for development of IT

Dependent Variable: Enterprise Integration Architecture ensures

Table 14 presents results from the un-standardized beta from the regression analysis and corresponding test of significance that is in the form of a t test. When the t test for a given un-standardized beta is significant it indicates that the relationship between the dependent variable and corresponding independent variable was significant. Individually the t tests for organizational objective importance for development of IT and

enterprise integration importance were significant predictors while organizational participation development of E.I.A. was not

Table 14 Enterprise Integration Architecture Ensures Variable Coefficients Model

	Un-standardized Coefficients Beta	Std. error	Standardized Coefficients Beta	t	Sig.
Organizational participation development of EIA	-0.028	0.047	-0.056	-0.602	0.549
Organizational objective importance for development of IT	0.525	0.160	0.329	3.290	0.002
Enterprise integration importance	0.659	0.185	0.356	3.553	0.001

Dependent Variable: Enterprise Integration Architecture ensures

In summary, the hypothesis (H 2) that organizational participation development of E.I.A., organizational objective importance for development of IT, and enterprise integration importance were related to enterprise integration architecture ensures was supported by these data (see the F test from the multiple regression table). The hypothesis (H 2b) that organizational objective importance for development of IT was related to enterprise integration architecture ensures was supported by these data (see the "sig" column in the coefficients table). The relationship was positive. The hypothesis (H 2c) that enterprise integration importance was related to enterprise integration architecture ensures was supported by this data (see the "sig" column in the coefficients table). The relationship was positive. The hypothesis (H 2a) that organizational participation

development of E.I.A. was related to enterprise integration architecture ensures was not supported by this data (see the "sig" column in the coefficients table).

Architectural objective business link

> Hypotheses 3: Organizational participation development of enterprise integration architecture, organizational objective importance for developing IT, and enterprise integration importance will be significant predicators of enterprise integration architecture objective for alignment of business and technology strategy.
>
> > 3a. The relationship between organizational participation development of enterprise integration architecture and enterprise integration architecture objective for alignment will be positive.
> >
> > 3b. The relationship between organizational importance for development of IT and enterprise integration architecture objective for alignment will be positive.
> >
> > 3c. The relationship between enterprise integration importance and enterprise integration architecture objective for alignment will be positive.

The following multiple regression analysis tested the relationship between enterprise integration architecture objective business link variable (**Arcoblnk**) and each of the predicator variables (organizational participation development of EIA [**Opdvia**], organizational objective importance for development of IT [**Ooimprt**], and enterprise integration architecture objective (**Arcoblnk**). Table 14 shows the descriptive statistics and the Pearson r correlation for both variables.

Arcoblnk (dependent variable) related to survey item number 7 on the survey instrument. Survey respondents was asked to determine which of the architectural objectives from a list of twenty (20) items they consider appropriate for linking architectural objectives with organizational objectives to achieve alignment between business and technology strategy. A substantial body of research exist that address alignment between business strategies and information systems planning, and strategy

outcomes (Henderson and Venkatraman, 1991). In this study, this researcher's alignment approach was to link organizational objectives resulting from business strategy planning with the method used by information systems management to implement information technology strategy – the architecture. To accomplish this alignment, it is necessary to identify architectural objectives that can be linked with organizational objectives thus a profile of factors for planning purposes.

Table 15 Descriptive Statistics and Correlations for Enterprise Integration Architecture Objective Business Link Variable

Dependent Independent Variables	Mean	Std. Deviation	N	Pearson r
Architecture objective business link (**Arcoblnk**)	2.55	0.2253	82	1.000
Organizational participation development of EIA (**Opdvia**)	4.25	1.0381	82	-0.216
Organizational objective importance for development of IT (**Ooimprt**)	2.59	0.327	82	0.613
Enterprise integration importance (**Eigimprt**)	2.32	0.282	82	0.600

Results of the Mean and Pearson's r statistic (Table 15) show organizational participation development of EIA variable demonstrated a mean score far greater than the two other independent variables, and the Pearson r correlation indicated a negative score thus a poor predicator of the dependent variable. The other two independent variables demonstrated mean scores that reflect some differences between the two but are good predicator of the dependent variable.

Table 16 details summary and regression statistics that indicate a good model fit and how well the data cluster about a straight line and F test statistic for the fit of the liner model. The R^2 statistic shows the proportion of variance in the dependent variable that was predicted from the independent variables. Fifty six percent (56%) of the variance in the dependent variable was accounted for by the independent variables; approximately 44% was not accounted for by the independent variables. The overall test of model fit was significant.

Table 16 Architectural Objective Business Link Model Fit Summary

Model Summary Model

	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.751	**0.564**	0.547	0.15166

Multiple Regression Model

		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.319	3	0.773	33.609	**0.000**
	Residual	1.794	78	0.023		
	Total	4.113	81			

Predictors: (Constant), Enterprise integration importance
Organizational participation development of EIA
Organizational objective importance for development of IT

Dependent Variable: Architectural objectives business link

Table 17 presents the un-standardized beta from the regression analysis and corresponding test of significance, which is in the form of a t test. When the t test for a given un-standardized beta is significant, it indicates that the relationship between the dependent variable and corresponding independent variable was significant. Individually,

all independent variables were significant predicators of the architectural objective business link variable.

Table 17 Architectural Objective Business Link Variable Coefficients Model

	Un-standardized Coefficients Beta	Std. Error	Standardized Coefficients Beta	t	Sig.
Organizational participation development of EIA	-0.037	0.016	-0.174	-2.319	0.023
Organizational objective importance for development of IT	0.311	0.056	0.452	5.592	0.000
Enterprise integration importance	0.333	0.065	0.416	5.141	0.000

Dependent Variable: Architectural objective business link

In summary, the hypothesis (H 3) that organizational participation development of E.I.A., organizational objective importance for development of IT, and enterprise integration importance were related to architectural objective business link was supported by this data (see the F test from the multiple regression table). The hypothesis (H3b) that organizational objective importance for development of IT was related to architectural objective business link was supported by this data (see the "sig" column in the coefficients table). The relationship was positive. The hypothesis (H 3c) that enterprise integration importance was related to architectural objective business link was supported by this data (see the "sig" column in the coefficients table). The relationship was positive. The hypothesis (H 3a) that organizational participation development of E.I.A. was related to architectural objective business link was supported by this data (see the

"sig" column in the coefficients table) but the relationship was negative thus the implication is that high score on one variable go with low score on the other.

Architectural objectives are appropriate

Hypotheses 4: Organizational participation development of enterprise integration architecture, organizational objective importance for developing IT, and enterprise integration importance will be significant predicators of organizational objectives for enterprise integration strategy.

4a. The relationship between organizational participation development of enterprise integration architecture and organizational objectives will be positive.

4b. The relationship between organizational importance for development of IT and organizational objective will be positive.

4c. The relationship between enterprise integration importance and organizational objectives will be positive.

Table 18 Descriptive Statistics and Correlations for Organizational Objective are Appropriate Variable

Dependent/Independent Variables	Mean	Std. Deviation	N	Pearson r
Architectural objective are appropriate (**Arcobapp**)	2.72	0.303	79	1.000
Organizational participation development of EIA (**Opdvia**)	4.21	1.047	79	-0.051
Organizational objective importance for development of IT (**Ooimprt**)	2.59	0.333	79	0.347
Enterprise integration importance (**Eigimprt**)	2.32	0.285	79	0.518

Table 18 shows the results of the descriptive statistical analysis and the Pearson r correlation for both variables. Multiple regression tests the relationship between organizational objectives are appropriate (**Arcobapp**) variable and each of the predicator variables (organizational participation development of EIA [**Opdvia**], organizational

objective importance for development of IT [**Ooimprt**], and enterprise integration importance [**Eigimprt**]).

This dependent variable (**Arcobapp**) related to survey item number 8 on the survey instrument. Survey respondents were asked to determine which of the organizational objectives from a list of eight (8) items they believe influence the formulation of enterprise integration architecture strategy to achieve alignment between business and technology strategy. The purpose of this research was to identify a set of organizational and architectural objectives that can be linked thus forming a profile of variables for enterprise integration architecture planning and development.

Table 19 Architectural Objectives are Appropriate Model Fit Summary

Model Summary Model						
	R	**R Square**	**Adjusted R Square**	**Std. Error of Estimate**		
1	0.543	**0.295**	0.267	0.26023		
Multiple Regression Model						
		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	2.125	3	0.708	10.460	**0.000**
	Residual	5.079	75	0.677		
	Total	7.204	78			

Predictors: (Constant), Enterprise integration importance
Organizational participation development of EIA
Organizational objective importance for development of IT
Dependent Variable: Architectural objectives are appropriate

Results of the Mean and Pearson's r statistical analysis (Table 18) show organizational participation development of EIA variable demonstrated a mean score far greater than the two other independent variables, and the Pearson r correlation indicated a negative score thus indicating a poor predicator of the dependent variable. The other two

independent variables demonstrated mean scores that reflect some differences between the two but are good predicator of the dependent variable. Table 19 list both summary and regression statistics that indicate a relatively weak model fit (about 29percent of the variance was accounted for) however the overall F test of the model fit was significant.

Table 20 Architectural Objectives are Appropriate Variable Coefficients Model

	Non-standardized Coefficients Beta	Std. Error	Standardized Coefficients Beta	t	Sig.
Organizational participation development of EIA	-0.005	0.028	-0.019	-0.193	0.848
Organizational objective importance for development of IT	0.159	0.096	0.174	1.657	0.102
Enterprise integration importance	0.479	0.112	0.451	4.292	0.000

Dependent Variable: Architectural objective are appropriate

Table 20 presents the un-standardized beta from the regression analysis and corresponding test of significance, which is in the form of a t test. When the t test for a given un-standardized beta is significant, it indicates that the relationship between the dependent variable and corresponding independent variable was significant. Individually, organizational objective importance for development of IT and organizational participation development of E.I.A. were not significant predictors of architectural objectives are appropriate; enterprise integration importance was a significant predictor.

In summary, Hypothesis (H4) that organizational participation development of E.I.A., organizational objective importance for development of IT, and enterprise

integration importance were related to architectural objectives are appropriate was supported by this data (see the F test from the multiple regression table). Hypothesis (H4c) that enterprise integration importance was related to architectural objectives are appropriate was supported by this data (see the "sig" column in the coefficients table). The relationship was positive. Hypothesis (H4b) that organizational objective importance for development of IT was related to architectural objectives is appropriate was not supported by these data. Hypothesis (H4a) that organizational participation development of E.I.A. was related to architectural objectives are appropriate was not supported by the data.

Summary

The Cronbach Alpha test was used to eliminate weaker items from the dependent and independent variables thus providing a reliable set of variables for multiple regression analysis. Architectural objectives were validated thus providing empirical support for 18 factors out of an original set of 20 items derived from the literature for this study. These 18 factors therefore represent objectives to be used for enterprise integration architecture planning. Since this study's main thrust was to identify linkage factors, the architectural objectives were further fine-grained to determine from the list of 20 items, factors that represent linkage variables. A total of 16 factors remained after the application Cronbach Alpha test that can be utilized for linking architectural objectives with organizational objective to achieve alignment with business strategy.

Organizational objectives consisted of eight original items. Reliability test produced seven items making up this construct that can be linked with architectural objectives. In essence, these two constructs represents the core linkage construct for

alignment between organizational objectives and architectural objectives. Regarding the primary reasons for developing and implementing enterprise integration architecture, nine items were identified from the literature. A reliability test of these items produced eight factors that made up the Eiaensr construct. These factors therefore represent the underlying rationale for developing and implementing enterprise integration architecture.

The importance of enterprise integration objectives for business strategy support produced 12 factors out of a total of 14 original items. These 12 items therefore are objectives emulating from enterprise integration strategy formulation and are the basis for business strategy integration and enterprise integration modeling.

It is a common belief that participation by organizational participants in the development of enterprise integration architecture is paramount. A reliability test resulted in all five items meeting reliability cutoff thus indicating the level of participants within the organization structure who should influence enterprise integration strategy. Finally, the reliability test of organizational objectives for the development of IT resulted in all original items meeting reliability cutoff. These items had empirical support (Zviran, 1990) thus for this study, these factors support information systems strategy direction to achieve alignment between business strategy and IT planning.

Multiple regression analysis was used to assess the four main research hypotheses and the 12 associated sub-hypotheses. Table 21 summarizes the results. All main hypotheses were supported by the data along with seven sub-hypotheses; five sub-hypotheses were not supported by the data. Organizational participation development of enterprise integration architecture (**Opdvia** [H 1a, H 2a, H3a, H4a]) was not a predicator

of any dependent variable (**Arcobimp, Arcoblnk, Arcobapp, Eiaensr**) although it met the reliability test.

While participation by key decision makers is an important aspect of information technology planning, their participation in the creation of enterprise integration architecture and enterprise integration models is not their primary responsibility. Enterprise integration architecture and modeling are highly technical tasks that require formal training in modeling tools along with tact and explicit knowledge of the process. In addition, creation of enterprise integration architecture is a time consuming task thus a dedicated team is necessary for success. Hypothesis (H 4b [Organizational importance for the development of IT]) relationship with architectural objectives are appropriate was not supported also.

Table 21 Summary of Results

Hypotheses	**Dependent variables**	**Independent variables**	**Results**
H1	Importance of architectural objectives	Organizational participation development of enterprise integration architecture; organizational objective importance for development of IT; enterprise integration importance	Supported
H 1a		Organizational participation development of enterprise integration architecture	Not supported
H 1b		Organizational importance for the development of IT	Supported
H 1c		Enterprise integration importance	Supported
H 2	Enterprise architecture ensures	Organizational participation development of enterprise integration architecture; organizational objective importance for development of IT; enterprise integration importance	Supported

H 2a		Organizational participation development of enterprise integration architecture	Not supported

Table 21 cont'd

H 2b		Organizational importance for the development of IT	Supported
H 2c		Enterprise integration importance	Supported
H 3	Architectural objective business link	Organizational participation development of enterprise integration architecture; organizational objective importance for development of IT; enterprise integration important	Supported
H 3a		Organizational participation development of enterprise integration architecture	Not supported
H 3b		Organizational importance for the development of IT	Supported
H 3c		Enterprise integration importance	Supported
H 4	Architectural objectives are appropriate	Organizational participation development of enterprise integration architecture; organizational objective importance for development of IT; enterprise integration important	Supported
H 4a		Organizational participation development of enterprise integration architecture	Not supported
H 4b		Organizational importance for the development of IT	Not supported
H 4c		Enterprise integration importance	Supported

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Introduction

This chapter includes four sections after the introduction. The conclusions section provides answers to research questions outlined in Chapter 1. The next section includes the implications of the research in this dissertation. The Recommendations section includes suggestions for future research and the next step for the linkage model. The final section of this Chapter provides a summary of the entire dissertation.

Conclusions

Achieving linkages between organizational objectives and architectural objectives were the thrust of this research. There has been considerable material in the IT industry print media relating to alignment between business strategy and information systems planning along with several models and methodologies available for achieving alignment. The literature on the other hand did not provide any insight regarding how alignment between architectural objective and organizational objectives can be achieved.

This study relied on works of Henderson and Venkatraman (1991), Reich and Benbasat (1996), and Zviran (1990). Henderson and Venkatraman (1991) examined information systems strategic alignment with business strategy and proposed a strategic alignment model (SAM) for information systems and business strategy planning integration. Reich and Benbasat (1996) identified social dimensional linkage factors with a linkage framework to assess alignment between the information systems planning and

business strategy planning process. They (Reich and Benbasat, 1996) defined their approach as a form of "linkage audit" that can provide data to planners regarding the degree of alignment attained between information systems strategy and business strategy.

Zviran (1990) investigated the level of correspondence between organizational objectives and information systems objectives thus producing a "contingency profile of planning variables" to effect alignment between business strategy and information systems strategy. The Zviran (1990) contingency profile of planning variables when used during information systems planning would create a linkage between business strategy and information systems strategy and therefore full integration is possible (Teo, 1994).

In Chapter 1, the goals and objectives for this dissertation were delineated with the following research questions arising from the objectives: (1) What are the factors for linking organizational objectives with enterprise integration architecture objectives to achieve enterprise integration? (2) How are these factors used to achieve enterprise integration in the planning framework for linking business strategy with enterprise integration architecture? (3) How do these factors relate to enterprise integration modeling? The following sections include the author's conclusions in response to the research questions.

Linkage Factors

Analysis of the survey results confirmed (1) the importance of architectural objectives (2) produced a set of architectural objectives representing linkage factors and (3) identified organizational objectives (Zviran, 1990) that can be linked to architectural objectives.

Conclusion 1. Architectural objectives are important factors for enterprise integration architecture planning to achieve enterprise integration (Table 9). These architectural objectives and this study represent a new approach for aligning information systems strategy with business strategy where the overarching goal of the organization is enterprise integration. Enterprise integration goals are reflected in the enterprise integration architecture and are the antecedent to full integration (Teo, 1994).

Results of the literature review produced twenty original items making up the majority of architectural objectives variables and the set was subsequently reduced to eighteen items after reliability testing (Table 7 [Arcobimp]). These eighteen items constitute factors for enterprise integration architecture development thus, they are dependent variables for the enterprise integration architecture planning framework.

Conclusion 2. Architectural objectives are important factors for development of information technology (Table 9). The original twenty items making up architectural objectives were reduced to eighteen items (see number 1 above). Survey respondents were asked to identify items from the original twenty architectural objectives that represented linkage variables with that of organizational objectives. The data produced sixteen factors (Table 7 [Arcoblnk]) that can be linked to organizational objectives for alignment reason. The sixteen factors confirmed the relationship between organizational objectives and architectural objective thus when combined with organizational objectives provides a linkage profile for architecture – business strategy alignment in the enterprise integration architecture planning framework.

Conclusion 3. Architectural objectives provide the basis for achieving linkages between organizational objectives for IT in support of enterprise integration (Table 15).

Architectural objectives ensures enterprise integration goals are linked with business strategy with the participation of key decision makers during the determination and assessment of architectural objectives linkages with organizational objectives for enterprise integration architecture development. In this instance, low participation by organizational participants may result in inconsistent links and therefore the enterprise integration architecture may not support the business strategy.

Conclusion 4. The seven organizational objectives are linkage factors in the enterprise integration architecture planning framework and process to achieve enterprise integration (Table 18). Zviran's (1990) eight organizational objectives were incorporated into this study. As was stated throughout this dissertation, the Zviran (1990) objectives were empirically supported for correspondence between business strategy and information systems strategy and were reduced to seven factors after reliability testing (Table 7 [Arcobapp]) for this study that can be linked with the sixteen architectural objectives noted previously (see number 2 above). Organizational objectives represent independent variables or environmental imperative in the planning framework and are determining factors for enterprise integration architecture planning and development.

Organizational objectives as a stand-alone set of factors cannot assist with the development of IT for enterprise integration. Organizational participants in the development of enterprise integration architecture do not determine organizational objectives but instead, determination of organizational objectives results from business strategy formulation and therefore must be in place for any linkage to occur.

Enterprise Integration Architecture Linkage

The second research question builds on the first. This research question is related to how factors are used in the planning framework for business strategy-architecture linkage for enterprise integration purposes (Table 9 and 18).

Conclusion 5. The sixteen factors making up the architectural objective business link variables (Table 7 [Arcoblnk]) represent the requirement specifications or architectural objectives element in the framework. On the other hand, the seven factors making up the architectural objective are appropriate variables (Table 7 [Arcobapp]) represent the environmental imperative elements in the framework. The reader will recall that this researcher for this dissertation (see Chapter 3 for discussion) developed a conceptual planning framework (Enterprise Integration Architecture Planning Framework and Methodology). The framework set the context in which the enterprise architect initiates the architecture project.

The architect uses the framework to develop an understanding of what constitute environmental imperatives and requirement specifications from organizational intelligence data gathered during business strategy planning activity. Environmental imperatives are factors that force organizational models and or business process changes in an effort to maintain a competitive posture and or achieve efficiencies and effectiveness in the business processes and the infusion of information technology in the organizational change management process. These imperatives relate to the enterprise at large thus factors can either be internal or external or a combination of both. Environmental imperatives define the business strategies the architecture must support.

Requirement specifications are enterprise integration model attributes that direct the design aspects of the architecture. These models use environmental imperative data thus facilitating evaluation of business strategies and enterprise integration goals for linkages between business strategies and the architecture.

In the planning process, these architectural objectives (Table 7 [Arcoblnk]) would be linked to this study's seven organizational objectives (Table 7 [Arcobapp]) within the framework. The architect therefore would apply a matrix approach like that in Figure 9 to determine which of the architectural objectives best fit the set of organizational objectives resulting from strategies outlined in the organization's strategic plan. Once the matrix is developed, the architect can then turn to constructing the architecture to support business strategies.

Enterprise Integration Modeling

The final research question focused on enterprise integration modeling in terms of how the factors relate to modeling the enterprise for architecture development (Table 12). The enterprise integration architecture receives input from enterprise integration models.

Conclusion 6. Enterprise integration modeling is an important business engineering activity for aligning business strategies with IT. The use of models ensures that the architecture represents enterprise integration intensions. Use of enterprise integration models rather than active participation by key decision makers during the architecture development process ensures alignment with business strategy after the organizational plan has been developed and ratified.

These models are particular models (business models) of what the organization intends to accomplish and the manner in which management execute business strategies

defined in the organization's plan. Enterprise integration modeling methodology is defined in GERAM (1998). A model of any organization starts with the recognition of a generic model of the enterprise, followed by a search for and understanding of the industry model (partial model) and finally, proposing models that are specific to the enterprise in question (the particular model). Within the planning framework, the architect uses these models to engineer the business processes for enterprise integration.

A scan of the factors in Table 6 highlighted the fundamental purpose for pursuing enterprise integration. In constructing the enterprise integration model, the architect use these factors to determine completeness of the business models for architecture development. These factors therefore are assessment criteria for validating strategy-architecture linkage.

In addition to the direct conclusions presented in conclusions 1 through 6, the data provided some additional conclusions worth mentioning. These are as follows:

Conclusion 7. IT – Business alignment assessment: Organizations with IT invested dollars can use the planning framework and methodology along with the factors identified in this study to conduct a linkage audit (Reich and Benbasat, 1996) to determine the level of alignment if any, realized from past investments in IT. A critical outcome of this type of assessment would be an alignment gap analysis that would provide data for future IT spending decisions.

Conclusion 8. Use of factors for organizational performance measurements indicator: Incorporating these factors into existing performance standards would further enhance decision makers ability to predict and measure in real terms IT contribution to corporate strategy especially if the goal is to achieve enterprise integration.

Conclusion 9. Tracking IT trends: New and evolving approaches for use of IT will continue to impact decisions about IT infusion and diffusion within the enterprise. Selecting and use of these factors would provide a consistent set of criteria for focusing on IT that potentially could impact the organizational plan; it would enable a more structured approach to selecting IT in a cost effective manner thus keeping pace with IT development.

Conclusion 10. Development of enterprise integration architecture that is aligned with business strategy: IS IT alignment is well understood in the practice-oriented world. What is not understood is how this type of alignment translates into IT infrastructure integration that can support the organizational plan. Although there may be alignment between business strategy and information systems strategy, it is conceivable that IT diffusion and infusion is disconnected with the organizational plan thus IT investments that contribute nothing to organizational performance. Use of these factors in the planning framework has the potential to limit this type of exposure and therefore provides a better method for IT expenditure decisions.

In the foregoing sections, interpretations of the data as it relates to the three research questions were delineated. In general, the data provided factors with which linkages can occur for strategy-architecture alignment. A major accomplishment for this study is the confirmation of architectural objectives that can be linked with organizational objectives. Since architecture development is a function of enterprise integration modeling, factors relating to enterprise model completeness were also validated thus enterprise integration modeling was confirmed as a viable tool for describing the

organization's processes and provided critical data for architecture development and therefore the possibility of achieving full integration as in (Teo, 1994).

Implications

The Enterprise Integration Architecture Planning Model and Methodology (EIAPM/M) was developed for advancing alignment between business strategy and the enterprise integration architecture. The planning framework is enterprise integration model driven thus confirming enterprise integration as a strategy as measured by the relationships established by way of the linkage profile. Architectural objectives were validated thus producing a profile of planning variables for designing, developing, and ongoing maintenance of the enterprise integration architecture.

The author improved professional practice by advancing an alternative alignment framework methodology that when applied to information systems planning can enhance key decision makers ability to predict the impact of IT on business strategy and audit IT investments contribution to corporate performance management.

Recommendations

The framework and the linkage construct defined in this study is an alignment approach to integrate the architecture into the strategy formulation and planning arena. It is not commonplace to find any architecture in many organizations and to the extent one is available there is no connection between architectural artifacts and business drivers (Spewak and Hill, 1992; Brancheau, Janz and Wetherbe, 1989). Architecture-business strategy alignment is content focused and therefore represents the intellectual dimension (Reich and Benbasat, 1996) of the planning process.

The profile of planning variables from this study accomplishes (1) validation of architectural objectives and (2) ensures that architectural artifacts are in alignment with business strategy on a continuous basis. The architect having determined the overarching strategy and related organizational objectives, must map the organizational objectives to architectural objectives thus forming a profile of variables that will be used to design the enterprise integration architecture. Further, the architect will use the architecture to select related information technologies and build information systems to support the organization's strategic direction.

In addition, business unit management will be able to understand the role of information technology and systems for competitive positioning and achieve improved communication with the information systems organization. In addition, as business models and IT drivers evolve due to market, regulatory, and customer's actions, architectural components can be adjusted incrementally to accommodate redefined organizational objectives.

Linkages between architectural objectives and organizational objectives at the intellectual dimensional level within the context of information systems and business strategy planning were the objective of this investigation. Several themes (enterprise integration modeling; enterprise integration; alignment) were integrated since these themes are directly related to architecture planning, development, and ongoing maintenance. It was the intent of this researcher to advance a different approach for formulating information technology and systems that is aligned with business strategy. This alignment will help to solve concerns regarding alignment of business systems with corporate integration strategy and allow for incremental adjustments as changes in

strategic direction dictates. There are several aspects worth future investigation to advance theory development in the alignment and architectural domains.

1. This researcher recommends the development of a measurement instrument or research plan to test and or investigate the specific correspondence within the linkage profile. This research identified a set of factors that form a linkage profile but did not specify any form of correspondence as in (Zviran, 1990) study on alignment between organizational objectives and information systems objectives. Repetition of the study using Zviran's (1990) model could further identify the specific set of factors (from the 16 architectural objectives) that are related (correspond) to the seven organizational objectives in this dissertation.

2. Another area worth investigating is to determine what relationships exist between information systems objectives from the Zviran (1990) study and architectural objectives from this dissertation. It is this researcher's belief that linkage data from this dissertation could provide a baseline for this type of analysis.

Summary

Linking architectural objectives with organizational objectives presents a departure from traditional alignment approaches found in the empirical literature and in practice. As was discussed throughout this Chapter and other Chapters of this study, alignment approaches focused on relationships in the planning process – that is a fit between information systems plan and business strategic plan. Another aspect of traditional alignment approach is the high importance placed on the social dimensional factors in the planning process with the intellectual dimensional factors receiving very little attention.

Alignment between architectural objectives and organizational objectives, while not espousing to be better technique does offer a new way of seeking congruence between business strategy and information technology and systems artifacts with an intellectual dimensional focus. This type of linkage however would worthless if it did not provide the means with which to evaluate the value information technology and systems accrue to the firm's strategic performance. As a first step for advancing a different alignment approach, architectural objectives were derived from the literature and a linkage model developed for empirical analysis.

Research that introduces new variables within an existing theoretical framework must be interpreted with caution. While valuable data can be obtained that may answer research questions, research that extend existing theory should be seen as discovery of additional factors that could explain relationships not previously considered in prior studies. This therefore continues the tradition of increasing knowledge in the specific domain area.

In this study, three research questions were presented along with a set of hypotheses that was empirically tested. Answers to these questions were obtained from the data collected from the survey. In addition, the data led the researcher to accept all hypotheses, and therefore represented a different alignment approach between business and information technology strategy. This was accomplished by linking a set of organizational objectives with architectural objectives thus moving closer to full integration.

Appendix

Survey Questionnaire

E-Mail instructions to ad hoc committee of experts requesting survey instrument validation

Dear Business Professional:

I am requesting your participation in a pre-test of my survey instrument that was developed for my dissertation project at Nova Southeastern University, School of Computer and Information Sciences (http://www.scis.nova.edu). The survey questions seek to collect data on aspects of "Linkages between Organizational Objectives and Enterprise Integration Architecture Objectives". In addition, some questions elicit your views on enterprise integration modeling a strategy planning methodology and tool for the design, development and implementation of information systems in support of organizational objectives.

Below I have provided a URL that will launch the survey questionnaire. At the end of the survey you will see a submit button which will return the completed form to me. As you proceed with answering the questions, I ask that you consider the following set of questions for evaluation of the survey design:

[1] The survey instrument conforms to good design elements.
[2] The survey is easy to use.
[3] The survey is easy to understand.
[4] The survey questions are grouped in the correct sequence.
[5] The survey items are scaled correctly.
[6] The survey items relate to question/s asked.

Please rank your answers to the above on a scale of 0 to 5, where 0 indicates a strong disagreement and 5 indicates a strong agreement. In addition, I ask that you provide any other comments you feel will help to improve the quality of the survey instrument. After completing the survey, please return to this e-mail to provide your responses to the above by using the reply feature of your mailer.

Please go the survey page at (http://rhodd.home.netcom.com/~rhodd/eiasurvey3.htm) to complete the survey. You may also access my home page at (http://rhodd.home.netcom.com/~rhodd) for information about my work and links to other related sites.

Thanks for you participation.

Easton B. Rhodd

PS. If you are unable to access the survey page, please send let me know via e-mail: rhodd@ix.netcom.com

Linkages between Enterprise Integration Architecture Objectives and Organizational Objectives

Dear Survey Participant:

My name is Easton B. Rhodd. I am a Ph.D., student at Nova Southeastern University, School of Computer and Information Sciences (http://www.scis.nova.edu) located in Fort Lauderdale, Florida US A. As part of my dissertation project [Enterprise Integration Modeling: Linking Enterprise Integration Architecture with Business Strategy Planning], I am required to conduct a survey of individuals with knowledge about enterprise integration architecture development and ongoing maintenance. The purpose of this survey is to obtain your views on what constitute linkages between organizational and architectural objectives.

I would like to invite you to participate in the survey by providing your views on questions included in the survey instrument. Your answers to this survey will be handled in a confidential manner, and all responses will be reported in the aggregate. You have my assurance that you will not receive any commercial solicitation from me or from your participation in this survey. In addition, any information linking you and or your organization will not be retained once I have collected the data required for analysis.

The survey consists of 21 questions and it estimated to take about 20 minutes to complete.

Because this study is for my dissertation project, I cannot provide you with any monetary incentive to participate. I can however provide you with survey results information. If you require this information, please send e-mail to me at (rhodd@ix.netcom.com) and I will be more than happy to share this information with you.

Thank you for your cooperation.

Easton B. Rhodd (Student)

Survey Instrument

A. Organizational Environment

1. What type of organization do you work for?

- Business firm
- Professional firm/practice
- Self-employed in own business
- Private school, hospital or other private institution
- Local, state or federal government

2. Which of the following best describes your company's primary business?

- Agriculture
- Construction
- Finance, Insurance, Real Estate
- Government
- Health Care
- Manufacturing
- Mining
- Retail
- Services
- Transportation
- Communications
- Utilities
- Wholesale
- Nonprofit
- Other

3. How many people are employed in your entire organization, including all branches, divisions and subsidiaries?

- Less than 10
- 10 - 19
- 20 - 49
- 50 - 99
- 100 - 499
- 500 - 999
- 1,000 - 2,499
- 2,500 - 4,999

○ 5,000 - 9,999

○ 10,000 or more

4. What is your exact job title? What department do you primarily work in?

Job Title

Department

B. The Objectives of the Organization and its Enterprise Integration Architecture (EIA)

Architectural objectives are statements of what is to be accomplished from the design, development and implementation of the enterprise integration architecture (EIA), and provides a set of architectural guidelines for selecting information technology to support the organization's business strategy. Organizational objectives are specific performance targets, directing the efforts of what is to be accomplished through the organization's activities.

5. Please rate the relative importance of each of the following architectural objectives for the design, development and management of the architecture planning process.

	Extremely Important	Somewhat Important	Not At All Important
Provide timely information	○	○	○
Standards	○	○	○
Costs	○	○	○
Quality	○	○	○
Flexibility	○	○	○
Interoperability	○	○	○
Share information	○	○	○
Environment	○	○	○
Redundancy management	○	○	○
80/20 solution	○	○	○
Manage IT risks	○	○	○
Education and training	○	○	○
Communication between IS and business units	○	○	○
Integrated data	○	○	○

Model base decision support	○	○	○
Model of inter or intra enterprise operations	○	○	○
Select and employ technology to support business	○	○	○
Right information in the right place	○	○	○
Cycle time reduction	○	○	○
Monitoring management system	○	○	○

6. Please rate the relative importance of each of the following organizational objectives for the development of information technology strategy, the information systems plans and the enterprise integration architecture.

	Extremely Important	**Somewhat Important**	**Not At All Important**
Control and reduce costs	○	○	○
Increase revenue	○	○	○
Improve administrative efficiency	○	○	○
Improve service	○	○	○
Supply products and services on time	○	○	○
Gain competitive advantage	○	○	○
Improve quality	○	○	○
Increase organizational productivity	○	○	○

7. Which of the following architectural objectives you consider appropriate for linking architectural and organizational objectives to achieve alignment between business and technology strategy

	Most Appropriate	**Appropriate**	**Not Appropriate**
Provide timely information	○	○	○
Standards	○	○	○
Costs	○	○	○
Quality	○	○	○
Flexibility	○	○	○

Interoperability	○	○	○
Share information	○	○	○
Environment	○	○	○
Redundancy management	○	○	○
80/20 solution	○	○	○
Manage IT risks	○	○	○
Education and training	○	○	○
Communication between IS and business units	○	○	○
Integrated data	○	○	○
Model base decision support	○	○	○
Model of inter or intra enterprise operations	○	○	○
Select and employ technology to support business	○	○	○
Right information in the right place	○	○	○
Cycle time reduction	○	○	○
Monitoring management system	○	○	○

8. Which of the following organizational objectives you believe influence the formulation of enterprise integration architecture strategy.

	Very Important	**Important**	**Of Less Importance**
Control and reduce costs	○	○	○
Increase revenue	○	○	○
Improve administrative efficiency	○	○	○
improve service	○	○	○
Supply products and services on time	○	○	○
Gain competitive advantage	○	○	○
Improve quality	○	○	○
Increase organizational productivity	○	○	○

C. Enterprise Integration

Enterprise integration is a strategy rather than a technology. Enterprise integration can be thought of as the means through which an enterprise enables the collective coordination of all parts of the enterprise to optimally execute the enterprise mission as established by management. This is accomplished through coordination of strategic, tactical, and day-to-day decisions by implementing efficient timely information flows and organization structure which allows the use of this information in an optimal way to control the physical flows. While business strategy defines the nature and type of integration an enterprise will embrace, enterprise integration goals support the business strategy by way of interaction of both business unit manager and information systems management within the underlying decision making infrastructure. These decisions are based on organizational objectives defined in the strategy making process.

9. Please rate the relative importance of the following enterprise integration objectives for business strategy support.

	Very Important	Important	Of Less Importance
Higher quality goods	○	○	○
Decrease unit costs	○	○	○
Improve product support	○	○	○
Improve customer satisfaction	○	○	○
Increase profits	○	○	○
Increased staff satisfaction	○	○	○
Better decision under uncertainty	○	○	○
Manage competitive activity	○	○	○
Track political legislation	○	○	○
Track economic trends	○	○	○
Track social influence	○	○	○
Track technology advances	○	○	○
Track industry structural changes	○	○	○
Products process cycle time reduction	○	○	○

D. Enterprise Integration Architecture

There are two types of enterprise integration architectures; type I deals with structural arrangement (design) of physical systems for systems integration purposes, and type II (may contain type I) describes the structural arrangement (organization) of the development and implementation of an enterprise integration project or program. Enterprise integration architecture is a type II architecture that structure the enterprise life-cycle activities.

10. The enterprise integration architecture is the product of (Select one):

- ○ Information systems planning process
- ○ Information technology strategy planning process
- ○ An integrated business strategy planning process
- ○ An enterprise integration program

11. Which of the following architecture framework or methodology is used by your organization in their architecture process (check all that apply):

- ☐ Computer Integrated Manufacturing-Open Systems Architecture (CIM-OSA)
- ☐ Purdue Enterprise Reference Architecture (PERA)
- ☐ Information Systems Architecture (ISA)
- ☐ Database Associates/Zachman Extended Framework (DA ZEF)
- ☐ Information FrameWork (IFW)
- ☐ Insurance Application Architecture (IAA)
- ☐ Integrated System Engineering Methodology Framework (ISEM)
- ☐ Stevenson's Interpretation of the Zachman Extended Framework (SIZE)
- ☐ Loosley Integration Framework Extension (LIFE) Matrix
- ☐ Architecture of Integrated Information Systems (ARIS)
- ☐ Enterprise Architecture Planning (EAP)
- ☐ Generalized Enterprise Reference Architecture and Methodology (GERAM)
- ☐ Federal Enterprise Architecture Framework (FEAF)
- ☐ The Open Group Architecture Framework (TOGAF)

12. What is the level of organizational participation in the development of the enterprise integration architecture

	A Lot Above Average	Above Average	Average	Below Average	Poor
CEO	○	○	○	○	○
CIO	○	○	○	○	○

Business unit managers	○	○	○	○	○
Supply chain partners	○	○	○	○	○
IS managers	○	○	○	○	○

13. The enterprise integration architecture includes the following sub-architectures (check all that apply):

- ☐ Human Resources Architecture
- ☐ Business Model Architecture
- ☐ Information Architecture
- ☐ Information Technology Architecture

14. Enterprise integration architecture ensures the following:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Make better use of current resources	○	○	○	○	○
Integration of current technology	○	○	○	○	○
Manage costs associated with developing enterprise wide systems	○	○	○	○	○
Improve the quality of systems development process	○	○	○	○	○
Contain metrics for exploring economic/technology options	○	○	○	○	○
Integration of the decision making process	○	○	○	○	○
Flexibility in systems configuration and change management	○	○	○	○	○
Visibility of the integrated nature of the enterprise	○	○	○	○	○
Development of a documented form of the enterprise processes	○	○	○	○	○

E. Enterprise Integration modeling

Enterprise integration modeling is a collection of tools and methods to design and continually maintain an integrated state of the enterprise, that is, to enable the collective co-ordination of all parts of the enterprise to enable it to optimally execute the enterprise mission as established by management.

15. Our strategy planning process employs enterprise integration modeling as the method for defining business models that reflect strategy direction.

- ○ Always
- ○ Sometimes
- ○ Never

16. We use enterprise integration models for defining the requirements for developing the enterprise integration architecture.

- ○ Yes
- ○ No

17. Our enterprise integration model includes the following perspectives (check all that apply):

- ☐ Functional
- ☐ Information
- ☐ Organization
- ☐ Resources

18. The enterprise integration models represent the organization's.

- ○ AS-IS State
- ○ TO-BE State
- ○ Both AS-IS and TO-BE State

19. Do business managers get involved in the enterprise integration modeling activity.

- ○ Yes
- ○ No

20. Do you view enterprise integration modeling a knowledge management tool.

- ○ Yes
- ○ No

21. Do you use enterprise integration models to assess and manage change.

- ○ Always
- ○ Sometimes
- ○ Never

Thank you for taking the time to complete this survey. Select rhodd@ix.netcom.com now to send your responses to us.

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