Aligning Business and Information Systems Thinking: A Cognitive Approach

Felix B. Tan and R. Brent Gallupe

***Abstract*—Business-information systems (IS) alignment has become an important strategic imperative for organizations competing in the global economy. Recent research (Reich and Benbasat [56]) indicates that building a shared understanding between business and IS executives is one way of strengthening this alignment. This paper describes a study that examines the cognitive basis of shared understanding between business and IS executives. Using Personal Construct Theory (Kelly [36]), this study uses cognitive mapping techniques to explore the commonalities and individualities in the cognition between these executives. Eighty business and IS executives in six companies participated in this study. The results indicate that a higher level of cognitive commonality is positively related to a higher level of business-IS alignment. This is supported by findings that greater diversity in cognitive structure and cognitive content of business and IS executives coincide with a lower level of alignment. Implications for practitioners and researchers are discussed.**

***Index Terms*—Business-IS alignment, cognitive mapping, personal construct theory, repertory grid technique, shared cognition, shared understanding.**

I. Introduction

ONE OF THE key factors for successful strategic information systems (IS) planning and implementation is the close alignment between business and IS (Boynton *et al.* [4]; King and Sabherwal [37]; Lederer and Sethi [41]). Alignment may enable a firm to maximize its IS investments and to achieve harmony with the business strategies and plans. This, in turn, usually leads to increased profitability and competitive advantage (Henderson *et al.* [27]).

Reich and Benbasat [55] suggest that there are two dimensions to business-IS alignment—intellectual and social. They argue that intellectual alignment is achieved when a high-quality set of interrelated business and IS plans exists and that social alignment occurs when the IS and business executives understand each others' mission, objectives and plans. Studies into the intellectual dimension of business-IS alignment dominate the literature. These studies focus on the relationship between the business and IS domains and its impact on organizational outcomes (Chan *et al.* [8]; Floyd and Wooldridge [19]; Kearns and Lederer [35]; Luftman *et al.* [43]; Tan [67]; Zviran [78]). Fewer studies have explored the social dimension of alignment. These studies examine the conditions under which alignment is achieved and sustained (Broadbent and Weill [5]; Henderson [24]; Reich and Benbasat [56]). A major component of the social dimension of alignment is the shared understanding between business and IS executives. It has been suggested that shared understanding is a major factor in determining whether the social dimension of alignment is achieved and sustained (Reich and Benbasat [56]).

This paper examines shared understanding between business and IS executives using a cognitive approach. It employs the notion of shared cognition. The purpose is to explore if shared cognition (social alignment) is related to business-IS alignment (intellectual alignment). This study adopts the definition of shared cognition proposed by Simpson and Wilson [63]. Shared cognition is cognition that has "both commonality, involving cognitive structures that are held in common (among people), and individuality, which takes the form of personal cognitions that are contributed to the organizational pool" ([63, p. 73]). This study, therefore, explores both the commonalities (similarities) and individualities (differences) in the executives' cognition. Executives' cognition is defined as the mental models, assumptions, expectations, values and beliefs held by the business and IS executives. The definition of shared cognition is consistent with the notion that working in teams in organizations involves the interaction and negotiation of shared and idiosyncratic understandings (Eden *et al.* [15]).

Cognition has traditionally been thought of as an individual concept. That is, cognition deals with thinking that is individually created and structured (Arnold and Nicholson [1]; Bougon [3]; Shaw [61]). The research into individual cognition, particularly as it applies to individuals in organizations, has influenced management scholars for a number of years (Cossette and Audet [10]; Fournier [20]; Walton [73]). However, shared cognition at a group/organizational level is an area of growing interest and importance in strategic management and research (Eden and Spender [16]; Huff [28]; Walsh [72]; Weick [76]). The emergence of this research perspective in strategic management stems from the growing acceptance of the notion that organizations possess cognitive capabilities and that organizational development is dependent on shared managerial cognition (Simpson and Wilson [63]; Stubbart [65]).

A relatively small but growing body of cognitive research can be found in the IS field. However, it is primarily in the areas of the development, implementation, and use of IS (DeSanctis and Poole [12]; Griffith and Northcraft [23]; Orlikowski and Gash [50]). Despite the increasing acceptance of the cognitive perspective in IS research, relatively little

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TABLE I
SAMPLE OF RESEARCH ON INTELLECTUAL DIMENSION OF ALIGNMENT

Author	Category	Model	Issues Addressed in Present Study
Henderson and Venketraman, 1991	**Conceptual**	SAM – Strategic Alignment Model, where alignment is viewed as a dynamic fit between four domains; business strategy, IT strategy, organizational infrastructure and processes and IT infrastructure and processes.	The SAM model "defines the range of strategic choices that could be addressed" during the alignment process, but it does not discuss the involved processes (p. 73). The present study hopes to address some of these process issues. Acknowledges influence of the involvement of top executives on the quality of strategic choice. Leadership and top management support is viewed as inherent and crucial.
Henderson and Venketraman, 1999	**Conceptual**	Extends SAM.	Views alignment as a "process of continuous adaptation and change." Strategic Alignment is a viewed as a journey, not an event (p. 473). The authors suggest process of alignment needs to be more clearly articulated. The present study has been designed to lessen the gap in understanding of alignment process issues through the development of a theoretical framework.
Macdonald, 1991	**Conceptual**	Extends SAM	Highlights the supporting organizational and managerial processes that are required to achieve alignment. Takes into account both internal and external factors.
Zviran, 1990	**Empirical**	Data provided a profile of IS objectives which corresponded with Organizational Objectives.	The relationships between IS and organizational objectives demonstrated in this work "may be elaborated into IS planning methodologies" p. 81. Even this early research into IS alignment suggested the importance of developing a process guide for IS alignment.
Chan, et al., 1997	**Empirical**	The model "illustrates proposed links between realized business and IS strategy, alignment, and performance" p. 125.	This study provides a most detailed and comprehensive list of factors operationalizing alignment. Processes involved in formulating strategy and achieving alignment were not the subject of this study. It furthers our understanding of how the process of strategic alignment is achieved.
Tan, 1995, 1997	**Empirical**	Variations in IT-strategy responsiveness were linked to firm strategic orientation (defender, prospector, analyzer).	These studies suggest 'strategic choices are made as a result of attempts by top executives to align organizational considerations with environmental conditions" p. 849, (1997). The present study recognizes the need for managing powerful environmental forces.
Palmer and Markus, 2000	**Empirical**	The study uses a Basic Strategic Alignment Model, where Business and IT strategies lead to alignment which leads to performance.	The focus of the Palmer and Markus work is the outcome of alignment. This work focuses on creating alignment.
Sabherwal and Chan, 2001	**Empirical**	Classification based on business strategy types.	The focus of the Sabherwal and Chan work is the outcome of alignment. This work focuses on creating alignment.
Kearns and Lederer, 2003	**Empirical**	Model consists of six factors; two process constructs, four alignment constructs and two outcomes.	Alignment has a recursive relationship with some of its outcomes. Recursive relationships have been incorporated into this study. Strategic IS alignment requires the participation of the CEO and top executives and their participation if critical to successful implementation of strategies and use of IT. Leadership and top management support is viewed as inherent and crucial in the present study.

of this research could be found that looked at cognition and business-IS alignment. This investigation aims to address this gap in the research by drawing on Kelly's Personal Construct Theory (PCT) (Kelly [36]) and its cognitive mapping technique, the Repertory Grid Technique (RGT), to examine the cognitive basis for the social dimension of alignment. It attempts to extend the use of this technique by comparing executives' individual cognitive maps to determine the degree of commonality or individuality in those maps. This investigation, therefore, extends the work of Reich and Benbasat ([56] and [55]) by turning to a cognitive theory and method to better understand the social dimension of business-IS alignment. In terms of practice, this paper highlights the importance of recognizing the commonalities and individualities in the shared cognition of business and IS executives to business-IS alignment.

This paper begins with the literature review and the study's research propositions. Next, the alignment instrument, the cognitive mapping methodology, and other measurement issues are described. This is followed by a description of the findings. Finally, implications of the study for practice and research are discussed.

II. LITERATURE REVIEW AND PROPOSITIONS

This study focuses on two basic concepts: business-IS alignment and shared cognition between business and IS executives. This section discusses both these concepts, as well as provides relevant background on PCT (Kelly [36]) and the RGT technique.

A. Business-IS Alignment (Intellectual Dimension)

In this study, the business-IS alignment construct denotes the intellectual dimension proposed by Reich and Benbasat [55]. It refers to the alignment of the company's IS plans to its business plans. That is, a high-quality set of interrelated business and IS plans exists, where the IS plan reflects the business plan's mission, goals, and strategies, the business plan must also make reference to the IS plan, IS applications, and specific technologies. In achieving alignment, the business and IS plans must take into account the external business and IS environments and constraints. This study has assumed that if business and IS plans reflect each others' mission, goals and strategies, as well as recognize the constraints in each others' environments, there is alignment.

The 1990s saw great strides in the conceptual development and empirical examination of the intellectual dimension of alignment. Table I presents a sample of the works on this topic.

Conceptual pieces provide an explanation of the phenomenon. For example, the Strategic Alignment Model (Henderson and Venkatraman [25]; Henderson and Venkatraman [26]) views alignment as a dynamic fit between four domains—business strategy, IS strategy, organizational infrastructure and processes, and IS infrastructure and processes. In an extension of this model, the Strategic Alignment Process Model (MacDonald [45]), highlights the supporting organizational and managerial processes that are required to achieve alignment. The majority of the empirical investigations focus on the relationship between the business strategy domain and IS strategy domain and its impact on performance (Chan *et al.* [7]; Kearns and Lederer [34]; Palmer and Markus [51]; Sabherwal

TABLE II
PUBLISHED MEASURES OF THE INTELLECTUAL DIMENSION OF ALIGNMENT

	Chan et al., 1997	Luftman et al., 1999	Kearns & Lederer, 2003
Number of items	80 item instrument - 40 Business & 40 IS Strategies	36 items based on Strategic Alignment Model.	12 items - 6 BPALIGN & 6 ISALIGN
Index of Alignment	Yes	Yes	Yes
Validated/Tested	Yes	Yes	Yes
Ease of Use	Very large instrument. Requires extensive computations to calculate alignment.	One day executive workshop is required to familiarise participants with Strategic Alignment Model.	Simple to complete. Measures business plan alignment to IS plan and vice versa.

and Chan [59]; Tan [66]; Tan [67]; Zviran [78]). Overall, the results of these studies indicate that alignment is important to IS effectiveness and to a lesser extent firm performance.

A number of instruments have been developed to measure the intellectual dimension of alignment. Table II outlines the instruments considered in this study.

The Kearns and Lederer questionnaire was chosen because of its established validity and reliability (Kearns and Lederer [34, p. 15–17]), its ease-of-use for busy executives, but mostly because it measures the intellectual dimension of alignment as defined by Reich and Benbasat [55]. The Kearns and Lederer instrument provides an index of alignment for each of the participating companies. This index is used to plot the strength of alignment of all companies relative to each other. Additional details about this instrument and how it was used in this study are found in Section III.

B. Shared Cognition (Social Dimension)

The second basic concept is the shared cognition between business and IS executives. This is an extension of the social dimension of alignment (Reich and Benbasat [55]), but using cognitive lens. As noted previously, shared cognition has two meanings. The first relates to commonalities (similarities) in individuals' cognition. This is consistent with the notion that shared cognition is the overlapping set of individuals' cognition which grows over time as individuals in a team interact, debate, and clarify their shared understandings (Langfield–Smith [38]). The second relates to individualities (differences) in individuals' cognitions, reflecting diversity in the values and beliefs of individuals in a team. The former is associated with greater team homogeneity and the latter with heterogeneity in a team (Simpson and Wilson [63]). That is, shared cognition has elements of both commonality and individuality.

A method that captures the cognitions held in common within a top management team and the distributed cognitions held by individuals within the team was developed using variations of the RGT, by Simpson and Wilson [63]. In the same vein, this study uses a modified version of the RGT to capture both the commonalities and individualities in the cognition of business and IS executives. The technique is grounded in PCT (Kelly [36]).

C. PCT and the RGT

PCT (Kelly [36]) is used as theoretical basis to understand shared cognition. PCT argues that individuals use their own personal constructs to interpret and understand events that occur around them and that these constructs are tempered by the individual's personal experiences. Thus, individuals come to understand the world in which they live in by erecting a personally organized system of interpretation or constructs of experienced events. The system is personal in that each individual makes their own interpretations of their experiences. But, the individual can share a view and appreciate another individual's interpretation or construction of events. Furthermore, Kelly contends that personal constructs are bipolar in nature. For instance, based on their experiences, employees may organize their organization's senior management team into those that have good leadership skills and those with poor leadership skills, or those who are good communicators and those who are poor communicators. "Good Leadership Skills—Poor Leadership Skills" and "Good Communicator—Poor Communicator" are considered the bipolar constructs used by employees to categorize the organization's senior management team. The use of bipolar labels increases understanding of how a construct may be employed by an individual to facilitate interpretation.

The technique used to determine personal construct systems is the RGT. The RGT contains three major components—elements, constructs, and links (Easterby–Smith [14]).

1) Elements are the objects of attention within the domain of investigation. They define the entities upon which the administration of the RGT is based. For example, to explore the critical success factors (CSFs) of IS projects, IS researchers can use IS projects as elements in the RGT.
2) Constructs represent the research participant's interpretations of the elements. Further understanding of these interpretations may be gained by eliciting contrasts resulting in bipolar labels. Using the same example, research participants may come up with bipolar constructs such as "high user involvement—low user involvement" to differentiate the elements (i.e., IS projects). The labels represent the CSFs of IS projects.
3) Links are ways of relating the elements and constructs. The links show how the research participants interpret each

element relative to each construct. Further, the links reveal the research participant's interpretations of the similarities and differences between the elements and constructs. From the example above, a seven-point rating scale can be used to get participants to differentiate between the IS projects (i.e., elements) along each elicited CSFs (i.e., constructs).

In general, elements are the objects of the research participant's interpretations, while constructs are labels attributed to these interpretations. Constructs are bipolar, indicating how elements are interpreted as similar or different from others. Various methods may be employed to link elements and constructs, including rating and ranking.

The PCT and RGT were developed in the mid 1950s and despite its share of criticisms—for example, being inherently complex (Reynolds and Gutman [57]), remain a well accepted theory and technique in the field of psychology (Neimeyer and Neimeyer [48]; Warren [74]). Both theory and technique have since been widely used in organizational and IS research. Recent applications in organizational studies include organizational design (Wacker [70]), organizational dynamics (Dunn and Ginsberg [13]), strategic groups (Reger and Huff [54]) and managerial competencies (Cammock *et al.* 1995). In IS, the technique has been used in developing an expert system in customer tender evaluation (Phythian and King [52]), modeling knowledge (Latta and Swigger [40]), assessing IS project risk factors (Moynihan [46]), and exploring what make "excellent" systems analysts (Hunter [29]; Hunter and Beck [30]). A comprehensive discussion of the relevance of the PCT and RGT to IS research and practice can be found in Tan and Hunter [68].

This study employs a modified version of the RGT to assess both commonalities and individualities in managerial cognition. This technique highlights the individual's cognitive categories or categorization scheme (i.e., patterns). The modified RGT process and its elicitation techniques will provide both data at the level of individual business and IS executives, as well as data which can yield commonalities amongst these executives. The RGT 1) provides a means of assessing both the commonality and individuality in the cognition (i.e., shared cognition between business and IS executives) which are being applied to business-IS alignment within the companies being studied; 2) provides data that can be analyzed through statistical methods and leads to results that can be replicated and validated (Ginsberg [22]; Simpson and Wilson [63]); and 3) exhibits acceptable psychometric properties, such as validity (Epting *et al.* [17]) and reliability (Bannister and Mair [2]).

D. Research Questions and Propositions

Most of the existing research using cognitive mapping methods produces maps for key decision-makers in organizations. The reasoning behind this interest in the mental maps of top managers is the assumption that cognition of top managers crucially determines the strategic direction of organizations (Jelinek and Litterer [32]; Schwenk [60]). For this research, we argue that a better understanding of the similarities and differences in the cognition of business and IS executives will lead to a better understanding of business-IS alignment in organizations. The study's research questions therefore are the following.

1) Is there a positive relationship between business-IS alignment and shared cognition between business and IS executives?
2) Are the content and structure of the cognitive maps of business and IS executives more diverse in companies with lower levels of business-IS alignment?

This study examines the relationship between the shared cognition of business and IS executives (social dimension) and business-IS alignment (intellectual dimension). Although previous research suggests that there is a link between shared domain knowledge and richer Line-IS communication (Reich and Benbasat [56]), innovation (Lind and Zmud [42]), and IS performance (Nelson and Cooprider [49]), no prior research has validated the relationship between shared cognition and business-IS alignment. However, shared cognition is found to be positively related to team cohesiveness, and hence better decision making (Simpson and Wilson [63]). It is therefore reasonable to expect that shared cognition between business and IS executives will be positively related to business-IS alignment. As a higher level of shared cognition means a greater degree of commonality in the cognition of business and IS executives, it seems reasonable that these business and IS executives will show stronger agreement in developing a high-quality set of interrelated business and IS plans. Our first proposition follows.

Proposition 1: Commonality in the Executives' Cognition: A higher level of shared cognition between business and IS executives will be associated with a higher level of business-IS alignment.

To achieve a deeper level of understanding on the shared cognition between business and IS executives, we examine the structure and content of their cognitive categories. As previously suggested, the structure and content of a manager's categorization scheme influences the decisions they make and behavior they exhibit (Calori *et al.* [6]; Weick [75]). Some authors argued that the social and cultural environment of managers, in turn, influences cognition in organizations. For example, Johnson (1987) has contended that each organization has its own set of beliefs and assumptions, and Bowman (1991) argues that the functional areas of management (marketing, production, etc.) seem to influence belief structures. In a study testing the assumption of homogeneity of cognitions of competition, Daniels *et al.* [11] found that managers' cognitive maps of competition are diverse and that this diversity increases as functional boundaries and company boundaries are crossed. Based on this research, it is reasonable to expect greater diversity in the cognitive maps of business and IS executives in companies that report lower levels of business-IS alignment. This leads to the following propositions.

Proposition 2a: Individuality in Cognitive Structure: The structure of the cognitive maps of business and IS executives in companies with a higher level of business-IS alignment will be less diverse than in companies with a lower level of business-IS alignment.

Proposition 2b: Individuality in Cognitive Content: The content of the cognitive maps of business and IS executives in companies with a higher level of business-IS alignment will be less diverse than in companies with a lower level of business-IS alignment.

TABLE III
CHARACTERISTICS OF PARTICIPATING COMPANIES

Company	Industry Sector	Total Number of Employees	Executives Interviewed	Size of IS Department	IS Budget (% of Sales)
A	Financial Services	430+	7 Bus Execs 5 IS Execs	20 permanent 4 contractors	18
B	Health	2600	12 Bus Execs 7 IS Execs	35 permanent 20 contractors	5.7
C	Financial Services	1350	6 Bus Execs 4 IS Execs	75 permanent 15 contractors	2.1
D	Financial Services	2937	9 Bus Execs 4 IS Execs	200 permanent	13.7
E	Health	7500	11 Bus Execs 5 IS Execs	50 permanent 20 contractors	2.6
F	Health	4200	5 Bus Execs 5 IS Execs	34 permanent 1 contractor	3.5

Diversity in cognitive maps highlights the dissimilarity in the categories used (structure) and the values placed on these categories (content) in the system of constructs employed by business and IS executives. Diversity in the executives' construction of their experiences regarding the factors influencing alignment describes the degree of individuality in the structure and content of their cognitive maps. Although diversity among executives is considered important to effective strategic decision making (Bantel and Jackson, 1989), IS research has shown that diversity in the "frame of reference" employed by user and IS groups have unfavorable effects on IS outcomes (Orlikowski and Gash [50]) and that congruence in the understanding between technology providers and users has a positive effect on IS innovativeness (Lind and Zmud [42]). It is therefore reasonable to expect that the structure and content of the cognitive maps of business and IS executives will be less diverse in companies with higher levels of alignment than in companies with lower levels of alignment.

III. RESEARCH METHODOLOGY

A. Sample and Research Participants

This study examines the shared cognition of business and IS executives in two industries in New Zealand—financial services and health services. These industries were chosen because: 1) the companies that make up these industries are information intensive—that is, there is a significant information component in the value chain activities of these industries (Cherian [9]; Teo and King [69]) and 2) they also rely heavily on IS as one of their major technologies (Jarvenpaa and Ives, 1990). This is especially so in an open New Zealand economy where pressures of increasing competition in the financial services sector and the drive for healthcare providers to operate and survive in a business environment, have forced these companies to turn to IT. Consequently, the issue of business-IS alignment is considered important to senior management in the sample companies as they seek to exploit IS to deliver new products and services and to improve efficiency, effectiveness, and competitiveness. Interviews were conducted in three companies in the financial services sector and three organizations in the health services sector. Table III summarizes the number of business and IS executives interviewed, number of employees, the size of the IS department and the IS budget as a percentage of sales of the six participating companies.

The size of the IS department of the participating companies ranged from 24 to 200 staff. Operational budgets ranged from 2.1% to 18% of annual sales. Company size in terms of the number of employees ranged from 430 to 7500. In the New Zealand context, these firms would be characterized as medium to large in size as 98.8% of all businesses that have turnover of less than NZ$10 million are considered small (Infometrics Ltd. [31]). In the global context, these firms would be considered small to medium sized organizations. All six companies had a formal IS Department and were responsible for setting their own strategic business and IS plans. Table IV presents an overview of the planning processes in each of the six participating companies.

Annual business and IS plans are produced in all six companies, with projections ranging from 3 to 5 years. The Chief Information Officers (CIOs) in all six companies participate in both business and IS planning, whereas the Chief Executive Officers (CEOs) and senior management's involvement with IS planning varies. The business and IS plans are developed both formally via written plans and informally through discussions.

Each of these organizations provided between 10–19 interview sessions lasting between 60–90 minutes. Eighty business and IS executives were interviewed. Business executives invited to participate were those reporting directly to the CEO. Examples of job titles of business executives included Clinical Director, Finance Manager, Manager of Retail Banking, and Operations Manager. Likewise, IS executives who participated were the CIOs direct reports. Examples of job titles of IS executives included Systems Development Manager, Manager of Operations, and IS Projects Manager. A general discussion was held with individual business and IS executives at the start of the interview about their experiences with business-IS alignment. This was to set the scene and also to ensure that the executives are knowledgeable about the issues relating to alignment in their companies. The CEOs and CIOs from all six companies participated.

On average, business executives had more than 15 years and IS executives had more than 10 years of experience in their industry. Business executives reported a high number of years experience in line management, but little experience in IS management. In contrast, a few IS executives from companies in both sectors have had a number of years experience managing other business functions.

TABLE IV
BUSINESS AND IS PLANNING PROCESSES

	Company A	Company B	Company C	Company D	Company E	Company F
Who is responsible?	CEO & Senior Management give final approval to IS plan. CIO involved in business planning	CEO, Senior Management, including CIO involved in business & IS planning	CEO & Senior Management give final approval to IS plan. CIO involved in business planning	CEO & Senior Management give input and reviews IS plan. CIO involved in business planning	CEO, Senior Management, including CIO involved in business & IS planning	CEO, Senior Management, including CIO involved in business & IS planning
How is IS accomplished?	Formal plans bottom up process	Formal plans & informal discussions	Formal plans & informal discussions	Formal plans top down process	Formal plans & informal discussions	Formal plans & informal discussions
What types of plans?	Annual business & IS plans with projections for 5 years	Annual operating plans & 3 year IS strategic plan	Annual business and IS plans and 3 year IS strategic plan	Annual business & IS plans. 5+ years IS strategic infrastructure plan reviewed 4 monthly	Annual business and IS plans and 5 year IS strategic plan	Annual business & IS plans with projections for 3 years
What is the planning cycle?	Annual	Annual	Annual	Annual	Annual	Annual

B. Measuring and Analyzing Business-IS Alignment

As previously noted, the Kearns and Lederer's [34] 12-item instrument was used to measure the intellectual dimension of alignment. There are two parts to the Kearns and Lederer's instrument. Six of the 12 items measure alignment of business plans to IS plans (BPALIGN) and the other six items measure the alignment of IS plans to business plans (ISALIGN). Appendix A presents the actual seven-point business-IS alignment instrument used in this study. The items in the instrument focus on the extent to which the IS plan reflects the business plan and the business plan refers to the IS plans. Executives were not asked about specific applications in their organizations, but rather the extent business and IS plans were aligned. In a test for reliability, Kearns and Lederer [34] established a Cronbach alpha of 0.851 and 0.880 for BPALIGN and ISALIGN, respectively, demonstrating internal consistency and precision of their alignment instrument. Participating business and IS executives had little difficulty completing this 12-item instrument in a reasonable time. The sixth item for both BPALIGN and ISALIGN was used to validate the score for index of alignment generated by the first five items in each category.

Data collected from both business and IS executives in each company were analyzed to determine the index of business-IS alignment for each participating company. Data from the first five items for both BPALIGN and ISALIGN were averaged for each executive. The overall alignment index was therefore the average of these scores for all executives in each company. The closer it was to the score of 7, the higher the level of business-IS alignment was for that company.

C. Eliciting and Analyzing Shared Cognition

As previously stated, a variation of the RGT technique was employed to assess commonality and individuality in the cognition of business and IS executives (Tan and Hunter [68]).

TABLE V
ALIGNMENT AND SHARED COGNITION SCORES FOR PARTICIPATING COMPANIES

Company	Alignment Index	Weirdness Index
A	4.76	.1983
B	5.39	.0510
C	4.69	.2157
D	5.46	.0306
E	4.94	.1140
F	4.67	.1565

The repertory grid for each executive was elicited through interviews. A combination of supplied constructs to measure individuality and full context forms of elicitation to measure commonality were used (Easterby–Smith [14]; Fransella and Bannister [21]). This approach to measure the cognitive maps of individual managers and the gross cognitive map of the organization these managers serve was adapted from Simpson and Wilson [63]. Appendix B outlines and discusses in detail the interview process using the modified RGT technique and how cognitive commonality and individuality (i.e., shared cognition of all business and IS executives) are measured.

IV. RESULTS

A. Linking Business-IS Alignment and Shared Cognition

In order to test the relationship between business-IS alignment and the shared cognition between a company's business and IS executives, indexes of alignment and of shared cognition were calculated from their respective measures. Table V presents the results.

The results suggest that Companies B and D have higher levels of alignment, with scores over 5 and Companies A, C, E, and F have lower levels of alignment with scores ranging

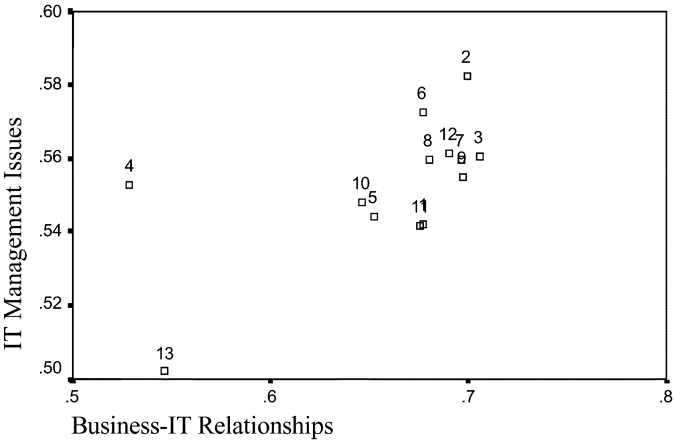


Fig. 1. Weighted differences for individual executives from Company D.

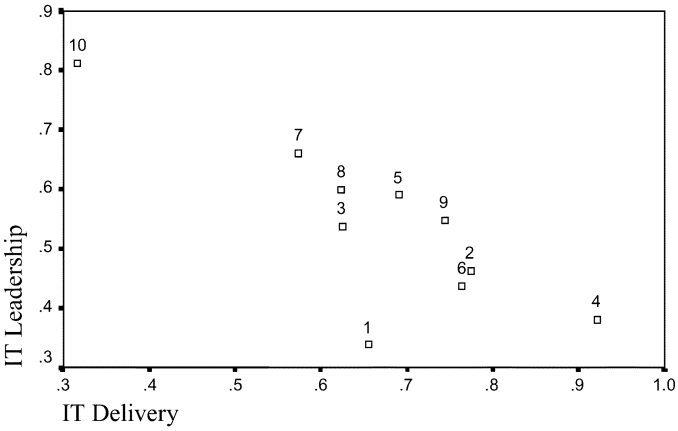


Fig. 2. Weighted differences for individual executives from Company C.

from of 4.67 to 4.94. The average ISALIGN and BPALIGN scores (across all participating executives) for Company D, as an example, are 5.50 and 5.42, respectively. For Company F, the scores are 4.68 and 4.66, respectively.

The weirdness index scores which describe the extent to which the individuals were different from the organization's average (see Appendix B for more details) also suggest that business and IS executives in Companies B and D have a higher level of commonality in their cognition compared with companies A, C, E, and F. To better illustrate this point, the gross cognitive maps of Companies D and C are discussed (Appendix C contains the cognitive maps of Companies A, B, E, and F). These maps describe the extent of commonality in the cognition of business and IS executives.

Fig. 1 portrays the gross cognitive map for Company D. The closer clustering of individual points along the diagonal suggests a higher level of cognitive commonality between the executives' cognition.

In contrast, Company C's gross cognitive map (Fig. 2) suggests a greater inconsistency between cognitive maps of individual executives in this company as evidenced by the wider spread of individual plots. This indicates that the executives in Company C not only differ in their classification of key alignment dimensions to executives in Company D, but also differ in their system of constructs.

Fig. 3 presents a scatterplot diagram showing the distribution of the 6 participating companies along the two dimensions of alignment index (AI) and weirdness index (WI).

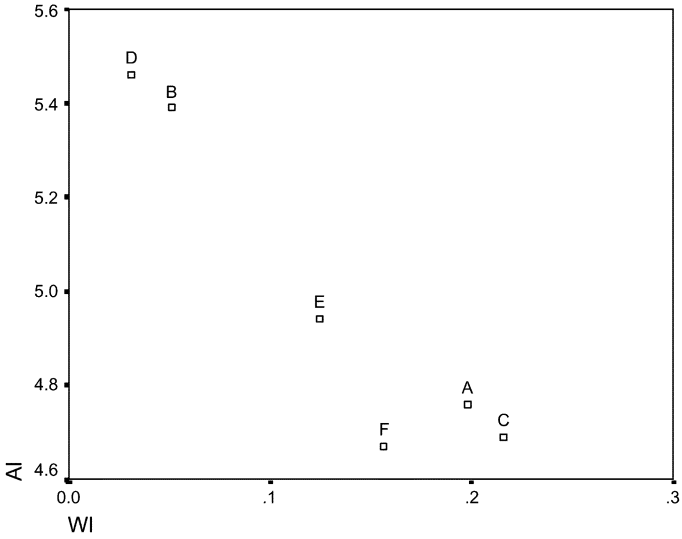


Fig. 3. Scatterplot of Companies along the alignment and weirdness indexes.

The elliptical scatterplot indicates the existence of a statistical association between the alignment and weirdness indexes. The slope of the axis is negative suggesting that the variables are negatively correlated. Remembering that the lower the weirdness index the higher the level of commonality, the negative correlation implies that in the sample studied, companies with a higher level of business-IS alignment have a higher level of cognitive commonality between business and IS executives.

A Spearman rank correlation analysis (Table VI) was conducted to measure the strength of association and statistical significance of this relationship (i.e., Proposition 1). The Spearman test was used because it is regarded as an appropriate test of association for low values of N (Johnson and Kuby [33]; Mullen [47]; Siegel [62]). The result indicates that the test is significant at the 0.05 level.

This result supports this study's Proposition 1—that business and IS executives, who reported a higher level of business-IS alignment in their companies, demonstrated a higher level of cognitive commonality than business and IS executives who reported a lower level of business-IS alignment in their companies.

B. Differences in Cognitive Maps

To better understand the shared cognition between business and IS executives, we examined the differences in the cognitive structure and content of these executive groups. A parametric test for independent samples was used to test if there is a significant difference between the cognitive structure and content of business and IS executives in companies with higher levels and lower levels of alignment. Table VII presents the results of the t-test.

In terms of cognitive structure (i.e., Proposition 2a), no significant difference was found in the cognitive maps of the executive groups in higher level alignment companies, but a significant statistical difference did exist between these groups in lower level alignment companies. This is consistent with expectations that the cognitive maps of business and IS executives in companies that reported lower levels of alignment are not as cohesive, demonstrating greater differences in terms of discrimination between the factors influencing alignment, as compared with those

TABLE VI
SPEARMAN CORRELATION BETWEEN THE ALIGNMENT AND WEIRDNESS INDEXES

		Alignment Index	Weirdness Index
Alignment Index	Spearman Correlation	1.000	-.829*
	Sig. (2-tailed)		.042
	N	6	6
Weirdness Index	Spearman Correlation	-.829*	1.000
	Sig. (2-tailed)	.042	
	N	6	6

* Correlation is significant at the 0.05 level (2-tailed)

TABLE VII
T-TESTS COMPARING THE COGNITIVE STRUCTURE AND CONTENT OF BUSINESS AND IS EXECUTIVES

Dimension	**Alignment**	**Execs**	**Mean**	**t**	**Sig. (2-tailed)**
Structure (Proposition 2a)	Higher	Bus	0.0855	-.209	.836
		IS	0.1519		
	Lower	Bus	0.2251	2.304	.026*
		IS	-0.5177		
Content (Proposition 2b)	Higher	Bus	.4047	1.537	.117
		IS	.3791		
	Lower	Bus	.4143	4.994	.000**
		IS	.3271		

* Significant at $p<0.05$
** Significant at $p<0.01$

in companies that reported higher levels of alignment. It could therefore be argued that the structure of the cognitive maps of business and IS executives in companies with a lower level of alignment is more diverse than those in companies that reported a higher level of alignment, Proposition 2a is supported.

In terms of cognitive content (i.e., Proposition 2b), no significant difference in the content of the cognitive maps of business and IS executives in higher level alignment companies, but a significant statistical difference was found in lower level alignment companies. This finding is in line with expectation that the importance placed on the factors enabling/inhibiting alignment by business and IS executives is dramatically different in lower level alignment companies. That is, in these companies, business and IS executives do not agree on the factor that is most central to influencing alignment. For instance, the business executives regarded "clear goals and vision" as most important, whereas, the IS executives considered "close relationship between business and information technology (IT)" as central to achieving alignment. In contrast, both business and IS executives in higher level alignment companies agree that the factor most important to enabling or inhibiting alignment is the "relationship between business and IS." This result supports Proposition 2b—that the content of the cognitive maps of business and IS executives was less diverse (i.e., more similar) in companies that reported a higher level of business-IS alignment than in companies that reported a lower level of business-IS alignment.

V. DISCUSSION

A. Business-IS Alignment and Shared Cognition

The result suggests that there is a strong link between business-IS alignment and shared cognition between business and IS executives. These findings confirm and extend those found in the literature on cognition in organizations where the importance of shared or converging cognition to coordinated decisions and actions is demonstrated. Basic research in cognition suggests that shared cognition between organizational groups permits these groups to leverage pooled resources more effectively in decision making (Williams and Sternberg [77]). Congruent technological frames (i.e., similar assumptions, knowledge and expectations individuals, and groups of individuals use to understand technology in organizations) positively influences the development and use of technology (Orlikowski and Gash [50]). This study highlights the importance of developing higher levels of shared cognition between business and IS executives if higher levels of business-IS alignment are to be attained.

It is important to note that this study is not saying that the cognition between business and IS executive groups be identical. Business and IS executives differ from each other in their assumptions, knowledge and expectations regarding business-IS alignment. The extent to which these business and IS executives employ similar assumptions, knowledge, and expectations regarding alignment reflects the level of their shared cognition. While members of a particular organization have individual interpretations, they also have a set of core beliefs in common (Porac and Thomas [53]). Business and IS executives in the companies that report a higher level of business-IS alignment do have a set of core beliefs in common regarding IS, while those in companies that report a lower level of alignment have a more diverse set of assumptions and beliefs.

B. Diversity in the Cognitive Maps

The results suggest that the structure of the cognitive maps of business and IS executives in lower level alignment companies are not as cohesive, demonstrating greater differences in terms

of discrimination between the factors influencing alignment as compared with those in companies that report higher levels of alignment. The mean structural score for business executives in lower level alignment companies are significantly higher than their IS colleagues. This diversity in their cognitive maps may help explain the lower level of business-IS alignment in these companies.

In terms of content, both executive groups in higher level alignment companies agree that "close business/IT relationship" and "good communication between business/IT" are key enablers to business-IS alignment. This sharing of assumptions, knowledge, and expectations between business and IS executive groups in higher level alignment companies allows each group to better visualize the perspective and anticipate the actions of the other group. In contrast, in companies reporting lower levels of alignment, business and IS executives do not agree on the factor that is central to influencing alignment. The business executives in lower level alignment companies regard having "clear goals and vision" as most important. For instance, these business executives commented the following.

> "Business and IS do not put down on paper their vision."
> "Goals and vision not articulated. Business needs to take the lead... IS should not be setting priorities."

On the other hand, the IS executives in lower level alignment companies consider the "close relationship between business and IS" as central to achieving alignment. For instance, these IS executives explained the following.

> "The constant changing in senior executive positions is leading to instability in the trust between business and IS."
> "Communication (between business and IS) has been very poor . . . ."

Greater diversity in the cognitive maps of business and IS executives in lower level alignment companies suggest that these executive groups employ different assumptions, knowledge, and expectations in their everyday sensemaking associated with IS in their business.

VI. Implications for Practitioners and Researchers

The findings of this investigation, the application of the modified RGT technique, and the use of cognitive maps to examine the quality of shared cognition between business and IS executives have some important implications for both practice and research.

A. Practical Approaches to Developing Shared Cognition

The personal construct research reported by Duck (1977 and 1979) noted that individuals are constantly trying to verify their construction of reality by seeking interaction with others who share the same construction of the world. Individuals initially seek to form relationships with others that construe the world in the same way they do. Once the relationship has been established, individuals are influenced by those aspects of one another's system of constructs that are different from their own. These relationships place emphasis on social interactions and the importance of group expectancies (Walker [71]). In the context of this study, social interactions can take the form of collective encounters (Langfield–Smith [38])—defined as "situations where the members of a group are present, and where there is the opportunity to discuss issues that are of concern to the group: problems are communicated, there is opportunity to explore anticipated (or unanticipated) outcomes of actions, and opportunities for individuals within a group to test and debate "theories" ([38, p. 360]).

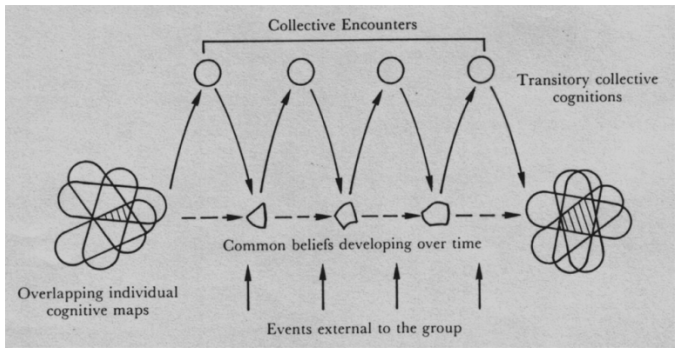


Fig. 4. The interaction between individual and collective cognitions (Langfield–Smith [38]).

Collective encounters between business and IS executives is therefore one practical approach to developing shared cognition. According to Langfield–Smith [38], these encounters need not be prescribed forums, but there must be meetings (formal or otherwise) where shared feelings, assumptions, and expectations are collectively experienced by the group members. This concept is illustrated in Fig. 4.

Langfield–Smith argues that "individuals are viewed as possessing their own unique systems of beliefs, but when individuals function as members of an organizational group, there will be some degree of overlap in the content of those individual's cognitive structures. The specific areas of commonality that exist between the various individuals within the group can differ—within the one group there may be differing coalitions and shared beliefs . . . These shared beliefs (even if it is not extensive) provide the basis upon which transitory collective cognitions (transitory agreements and perceptions) are negotiated . . . it is through successive collective encounters that shared beliefs will develop" ([38, p. 361]).

Business and IS executives functioning as an organizational group may have some degree of overlap in the structure and content of their cognitive maps. The findings of this study suggest that one can expect greater overlapping cognitive maps in companies that reported a high level of business-IS alignment, while in low alignment companies, the cognitive maps are more diverse (i.e., less overlap). The specific areas of shared cognition that exists between business and IS executives can differ. Even if the shared cognition is not extensive, it can be transformed or developed over time via the social processes that take place during successive collective encounters. In the longer term, the assumptions, beliefs, and expectations of business and IS executives can change, are reaffirmed and new ones created. Examples of collective encounters include committee meetings, informal discussion groups, and the day-to-day interaction of work groups—all of which must involve business and IS executive representatives.

A general theme from these implications is that shared cognition can only be developed "over time." There are no quick fixes. It is argued that business and IS executives need to recognize the

importance of their shared cognition to business-IS alignment. Successive collective encounters can, over time, help develop shared understanding. In the short to medium term, there is a need to recognize the diversity in their cognitive maps and a need to recognize and appreciate the assumptions, beliefs, and values of each member of the team.

B. Implications for Researchers and Future Research Directions

IS researchers have traditionally examined business-IS alignment from a behavioral perspective. Relatively few studies have looked at alignment through a cognitive lens. This study indicates that PCT and its RGT technique can be used to develop cognitive maps to measure the shared cognition between business and IS executives regarding the enablers/inhibitors of alignment. This study and previous research indicate that the RGT technique is a valid and reliable methodological approach to capture the personal constructs of the individual or groups of individuals, in particular, business and IS executives. This technique may be used to assess other assumptions and beliefs of IS users and IS personnel on such topics as web page design and use, or knowledge management design and use.

A second implication is that other research studies could use PCT to develop a richer understanding of important IS concepts such as trust and loyalty in e-business environments or creativity in IS systems development. This investigation advances research on business-IS alignment by taking a personal construct theory perspective and applying the RGT to provide insights into the shared cognition of business and IS executives. The cognitive maps produced highlight the cognition held in common by the executives as a whole in a given organization. Furthermore, the maps also reveal the differences in constructs between business and IS executive groups. These maps provide the platform upon which the overall group can collectively diagnose disagreements.

A third implication is that other research techniques might be used to assess shared cognition in this domain. Although the findings suggest that there is a strong positive link between business-IS alignment and shared cognition, and that the cognitive maps of these executive groups are more diverse in companies reporting lower alignment, the research did not explore the qualitative and evaluative aspects that will allow for a richer understanding. Other variations of the RGT technique can be employed to achieve this. One alternative is the laddering technique (Stewart and Stewart [64]), a series of why and how questions prompts the participant to provide more details. The laddering technique is elaborated elsewhere (Reynolds and Gutman [58]). Another alternative is the group construct elicitation, where elements and constructs are elicited by all participants involved in the study through a group "workshop" (Stewart and Stewart [64]).

Finally, a broader set of companies in terms of size and location of these companies can help test the generalizability of the findings of this study.

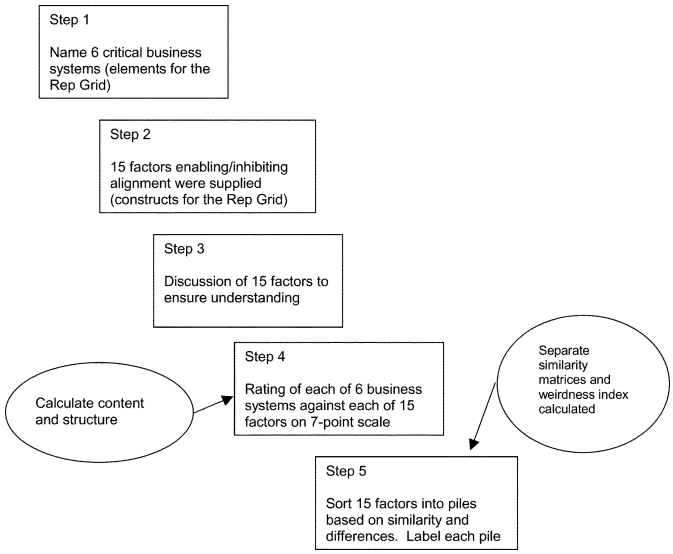
VII. Conclusion

Research into business-IS alignment continues to be an important stream of IS research. The intellectual dimension of alignment has been well researched but this study, in extending the social dimension of alignment using a cognitive approach, contributes to our knowledge of how the shared cognition of business, and IS executives influence business-IS alignment. We found that aspects of both commonality and individuality in cognitions seem to impact business-IS alignment, but that in general, greater shared cognition is related to greater business-IS alignment. Finally, this study supports the notion that shared cognition, as measured by a comparative analysis of individual cognitive maps developed using a modified version of the RGT Technique, is an important component of the social dimension of alignment.

Appendix A
Alignment of Information Systems Plans With Business Plans

Please see Table VIII and rate the following statements concerning the alignment of your company's information systems plans with business plans using the seven-point scale.

Appendix B
Modified RGT Technique Used in the Interviews



The interview began with a general discussion with the individual executive about his/her experiences with business-IS alignment. The executive then completed the alignment questionnaire and was asked to name six business systems critical to achieving the company's business plans. These business systems serve as the elements in the grid. The elements were elicited. Eliciting elements ensured that the business systems named were within the executive's experience. The business systems named by individual participants in each organization were not completely identical, although there was a large overlap in the systems named. Table IX portrays the business systems portfolio named by the executives from each of the participating companies.

The business systems identified ranged from enterprise wide applications such as Oracle Financials, to those that cater to specific areas of the business, for example, radiology or clinical systems. It is important to note that the elements in the grid need not

TABLE VIII

SD	**D**	**MD**	**N**	**MA**	**A**	**SA**
Strongly Disagree	Disagree	Mildly Disagree	Neutral	Mildly Agree	Agree	Strongly Agree

Please circle the appropriate answer in response to each statement.

The IS Plan is Aligned with the Business Plan (ISALIGN)	**SD**	**D**	**MD**	**N**	**MA**	**A**	**SA**
The IS Plan reflects the business plan mission.	1	2	3	4	5	6	7
The IS Plan reflects the business plan goals.	1	2	3	4	5	6	7
The IS Plan supports the business strategies.	1	2	3	4	5	6	7
The IS Plan recognizes external business environment forces.	1	2	3	4	5	6	7
The IS Plan reflects the business plan resource constraints.	1	2	3	4	5	6	7
The IS Plan is aligned with the Business Plan.	1	2	3	4	5	6	7
The Business Plan is Aligned with the IS Plan (BPALIGN)							
The Business Plan refers to the IS Plan.	1	2	3	4	5	6	7
The Business Plan refers to specific IS applications.	1	2	3	4	5	6	7
The Business Plan refers to specific information technologies.	1	2	3	4	5	6	7
The Business Plan utilises the strategic capability of IS.	1	2	3	4	5	6	7
The Business Plan contains reasonable expectations of IS.	1	2	3	4	5	6	7
The Business Plan is aligned with the IS Plan.	1	2	3	4	5	6	7

THANK YOU VERY MUCH

TABLE IX
BUSINESS SYSTEMS PORTFOLIO OF PARTICIPATING ORGANIZATIONS

Company A	Company B	Company C	Company D	Company E	Company F
Vantive Workflow	Patient Info Mgmt	SOLVIT	Online Teller System	Oracle ERP	Case Mgmt System
Vantive CRM	Web Éclair	BrokerLink	Sales Support	ADT System	HRIS
Wills Support	Concerto	COMNET	Customer Info File	Pharmx	Rostering System
OLAS	Plato	BT Aqua	FASTNET	Laboratory IS	Resource Utilization
HiPortfolio	PeopleSoft	Expiry System	CRABBS	Radiology IS	Women's Health
Trustee System	OneStaff	Life 400	General Insurance Sales	Clinical Appointment Scheduling	FFARS
Customer Management	Terranova	Enquiry Suite	FOCIS	Maternity System	Document Mgmt
Tax Management	Theatre System	Illustrations	Advanced Sales Tracking	GALEN	Clinical IS
Conveyancing System	HRIS	Customer Insight	Treasury System	HR System	CHIPS
Mortgage Administration	Service Order Mgmt	Fusion Quoting	Lending System	Emergency Dept System	Delphic
GSP Financials	SouthNet	Optimum	SST	Theatre System	ICWS
AusMaq	Digital Radiology	Telephone Mgmt	DTAG	NBRS	Theatre Mgmt
	MedDocs	CHARM	EPW	IBA PMS	Détente
	Lab Reporting	IMIA	SWIFT	Acuity System	CHAMP
	Disease Mgmt	HRIS	Trade Finance	NCTN Database	Elective Surgery Booking
	Community Nursing	Underwriting System	Securities System		Activity Mgmt
	Community Mental Health	ShowCase	Retail Foreign Exchange		Oracle Financials
	Surgical Audit				Radiology System
	CaseMix				Patient Scheduling
	Acuity System				

be identical to permit comparisons between the grids. As long as the constructs in the grid are supplied, it is possible to compare the grids of business and IS executives (Easterby–Smith [14]; Langfield–Smith [39]; Tan and Hunter [68]).

Individuality—Supplied Constructs: This study explored the shared cognition of business and IS executives regarding the factors influencing alignment. As such, the factors enabling/inhibiting alignment were introduced as constructs in the grid.

TABLE X
ENABLERS AND INHIBITORS OF ALIGNMENT (BIPOLAR CONSTRUCTS USED IN THIS STUDY)

Enablers	Inhibitors
Senior executive support IS	Senior executive do not support IS
IS understands business	IS does not understand business
IS & business executives have close relationship	IS & business executives lack close relationship
IS management shows strong leadership	IS management lacks leadership
IS efforts as well prioritised	IS does not prioritise well
IS meets commitments	IS fails to meet commitments
IS plans linked to business plans	IS plans and business plans are not linked
IS achieves its strategic goals	IS fails to meet its strategic goals
Goals/vision are defined	Goals/vision are vague
Good IS /business communication	IS does not communicate well
IS involved in strategy development	IS not involved in strategy development
IS /business partnerships	Resistance from senior executives
Adequate resourcing of IS	Budget and staffing problems
Up-to-date IS infrastructure	Antiquated IS infrastructure
IS applied for competitive advantage	IS applied to automate

TABLE XI
INDICES USED TO MEASURE COGNITIVE STRUCTURE

Indices	Measures	Reference
Complexity	Cronbach Alpha	Bell (1994)
Intensity	Sum of absolute values of the Pearson correlations between ratings performed on all possible pairs of constructs and then multiplying by 100	Feixas *et al.*(1992)
Ordination	Multiply the number of different rating values used on a given construct by the difference between the highest and lowest rating	Feixas *et al.* (1992)
Skewness	Skewness statistics	Bell (1994)

The 15 factors influencing alignment were developed *a priori*, based on published research into the enablers and inhibitors of alignment (Luftman *et al.* [44]). On closer examination, the enablers had corresponding inhibitors. For example, according to the Luftman *et al.* "references by respondents to effective or noneffective dialogue between IS professionals and their business partners were sorted into "Good IS/business communication" or "IS does not communicate well" in the final list of categories" ([44, p. 9]). In this study, the 15 factors were thus treated as bipolar constructs during the RGT exercise. These 15 bipolar factors are illustrated in Table X.

The factors that Luftman *et al.* identified in their study have support in the strategic IS literature. For instance, Broadbent and Weill ([5]) identified several organizational planning practices that contribute to and enhance such alignment. A number of these support Luftman *et al.*'s findings, including clarity and consistency of strategy; business and IS staff interaction; appropriate IS architecture; IS understanding in business managers; and business management leadership.

Some time was spent explaining the factors to ensure the executive understood what each factor meant. This was to ensure that the supplied constructs were meaningful to the executive and that they would be able to attach their own meaning to the supplied constructs. The executive was asked to rate each of the named business systems along each of the 15 factors enabling/inhibiting alignment along a seven-point scale.

Individual repertory grids were produced from the elicited elements (business systems) and supplied constructs (enabling/inhibiting factors). Data from these grids were entered into SPSS and measures of cognitive structure and content of individual executives' system of constructs calculated. These indices of structure and content were then compared across executive groups using a parametric test for independent samples. Cognitive structure refers to "rigidity—flexibility" in the individual's system of constructs (Feixas *et al.* [18]). In this study, it was related to how the executives discriminate between the business systems and as such reflected the subjective meanings attached to the 15 alignment factors used in the rating task. Table XI outlines the indices for cognitive structure, their measures and the literature upon which these are based on.

Cognitive complexity (Reger, 1990) is the degree to which each construct is different in meaning from every other con-

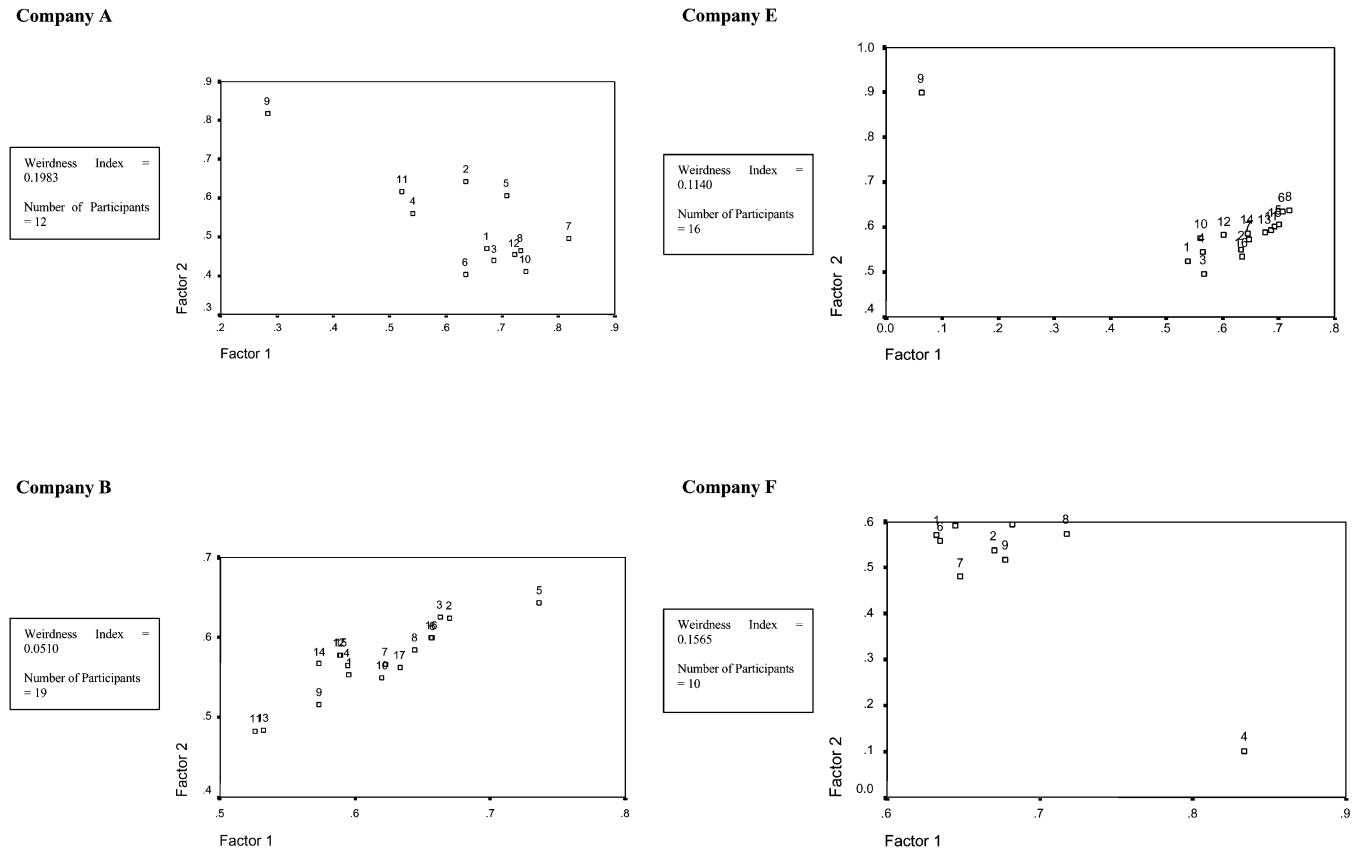


Fig. 5. Gross cognitive maps of participating companies. Weirdness index and number of participants.

struct. It is measured by examining the correlations among the constructs. One measure of complexity is the intraclass correlation (Bell 1981), which is closely related to coefficient alpha, the traditional test for reliability (Bell 1990, Bell 1994). Cognitive intensity (Fransella and Bannister [21]) is the degree of interrelatedness among constructs on the grid. Intensity is calculated by summing the absolute values of the Pearson correlations between ratings performed on all possible pairs of constructs and then multiplying them by 100 (Feixas *et al.* [18]). Ordination (Landfield 1988) is a measure of the superordinate/subordinate status of constructs in the grid. The ordination score can be more parsimoniously interpreted as a measure of flexibility in construing a set of elements. It is computed by multiplying the number of different rating values used on a given construct by the difference between the highest and lowest rating. The overall ordination score is simply the mean of the scores for each construct on the grid (Feixas [18]). Skewness (Bell 1994) refers to the relative lopsidedness of the constructs in the grid. The skewness score for each grid can be easily derived along with other descriptive statistics produced by standard statistical packages.

The content of an individual's system of constructs refers to the importance of a construct in relation to all other constructs, i.e., construct centrality (Ginsberg [22], Reger 1990). Kelly [36] theorized that certain constructs might be central to all individuals' system of constructs. In this study, the factors with high centrality were those that were highly correlated to every other construct and were measured by the mean of the construct correlations for each grid.

Commonality—Full Context Elicitation: In the second stage of the modified RGT technique, full context elicitation phase, the executive was then asked to sort all of the 15 factors into piles based on their judgement of similarity or dissimilarity. A short descriptive title was given to each pile.

The full context form allowed the measurement of cognition held in common amongst business and IS executives (commonality) in each of the participating companies. Data gathered from the full context form of elicitation were formatted as separate similarity matrices for each participant. Matrices for all participating executives from each organization were processed using SPSS's Individual Differences Multidimensional Scaling (INDSCAL) algorithm, a multidimensional scaling (MDS) technique. INDSCAL also produced a "weirdness index," which described the extent to which the individual was different from the organization's average. The average "weirdness index" of all participating business and IS executives in each of the participating organizations would provide a measure of the cognitive commonality amongst the executives in that organization (Simpson and Wilson [63]). The closer the average "weirdness index" is to 0.00, the higher the level of cognitive commonality between the business and IS executives in that organization.

The weirdness index score for each company is therefore the measure of cognitive commonality between business and IS executives in that company. In using INDSCAL, this study was able to determine the configuration of constructs in multidimensional space, where points were arranged in this space so that

pairs of constructs, which were more frequently judged similar, appear closer together. The resulting normative map represented a best fit distribution of points based on the judgements of all the participants who provided ratings of construct similarities. INDSCAL not only generated a multidimensional point map, but also assessed differences between individual's judgements of similarities along the two dimensions which account for the largest variance in the ratings provided by all executives in that company. This gross cognitive map represented the cognitive commonality between business and IS executives within that organization.

By employing a combination of elicitation techniques, cognitive commonality and individuality (i.e., shared cognition of all business and IS executives) could be accurately measured.

APPENDIX C
GROSS COGNITIVE MAPS OF PARTICIPATING COMPANIES

Shared cognition is measured using the weirdness index scores calculated using SPSS's INDSCAL algorithm. The weirdness index describes the level of shared cognition amongst business and IS executives in these companies. The weirdness index for each company is the average derived from the individual weirdness index scores for all executives (both business and IT) in that company. See Fig. 5.

REFERENCES

[1] J. Arnold and N. Nicholson, "Construing self and others at work in the early years of corporate careers," *J. Org. Behav.*, vol. 12, pp. 621–639, 1991.

[2] D. Bannister and J. M. M. Mair, *The Evaluation of Personal Constructs*. New York: Academic, 1968.

[3] M. G. Bougon, "Uncovering cognitive maps: The self Q technique," in *Beyond Method: Strategies for Social Research*, G. Morgan, Ed. Newbury Park, CA: Sage, 1983, pp. 173–188.

[4] A. C. Boynton, R. W. , Z. , and J. C. Jacobs, "The influence of IS management practice on IS use in large organizations," *MIS Quart.*, vol. 18, no. 3, pp. 299–318, 1994.

[5] M. Broadbent and P. Weill, "Improving business and information strategy alignment: Learning from the banking industry," *IBM Syst. J.*, vol. 32, no. 1, pp. 152–179, 1993.

[6] R. Calori, G. Johnson, and P. Sarnin, "French and British top managers' understanding of the structure and the dynamics of their industries: A cognitive analysis and comparison," *British J. Manage.*, vol. 3, pp. 61–92, 1992.

[7] Y. E. Chan, S. L. Huff, and D. G. Copeland, "Assessing realized information systems strategy," *J. Strategic Inf. Syst.*, vol. 6, no. 4, pp. 273–298, 1997a.

[8] Y. E. Chan, S. L. Huff, D. G. Copeland, and D. W. Barclay, "Business strategic orientation, information systems strategic orientation and strategic alignment," *Inf. Syst. Res.*, vol. 8, no. 2, pp. 125–150, 1997b.

[9] S. J. Cherian, "Investing in information technology: Where do Canadian hospitals stand?," *Electronic Healthcare*, vol. 1, no. 4, pp. 35–38, 2002.

[10] P. Cossette and M. Audet, "Mapping of an idiosyncratic schema," *Journal of Management Studies*, vol. 29, pp. 325–347, 1992.

[11] K. Daniels, G. Johnson, and L. de Chernatony, "Differences in managerial cognitions of competition," *British J. Manage. (Special Issue)*, vol. 5, pp. S21–S29, 1980.

[12] G. DeSanctis and M. S. Poole, "Capturing the complexity in advanced technology use: Adaptive structuration theory," *Org. Sci.*, vol. 5, no. 2, pp. 121–147, 1994.

[13] W. N. Dunn and A. Ginsberg, "A sociocognitive network approach to organizational analysis," *Human Relations*, vol. 40, no. 11, pp. 955–976, 1986.

[14] M. Easterby-Smith, "The design, analysis and interpretation of repertory grids," *Int. J. Man-Machine Studies*, vol. 13, pp. 3–24, 1991.

[15] C. Eden, S. Jones, D. Sims, and T. Smithin, "The intersubjectivity of issues and issues of intersubjectivity," *J. Manage.Studies*, vol. 18, no. 1, pp. 37–47, 1981.

[16] *Managerial and Organizational Cognition: Theory, Methods, and Research*C. Eden and J. C. Spender, Eds. Newbury Park, CA: Sage, 1998.

[17] F. R. Epting, D. J. Suchman, and K. J. Nickeson, "An evaluation of elicitation procedures for personal constructs," *British J. Psychology*, vol. 62, pp. 512–517, 1971.

[18] G. Feixas, J. L. Moliner, J. N. Montes, and M. T. Mari, "The stability of structural measures derived from repertory grids," *International Journal of Personal Construct Psychology*, vol. 5, pp. 25–39, 1992.

[19] S. W. Floyd and B. Wooldridge, "Path analysis of the relationship between competitive strategy, information technology and financial performance," *J. Manage. Inf. Syst.*, vol. 7, no. 1, pp. 47–64, 1990.

[20] V. Fournier, "Cognitive maps in the analysis of personal change during work role transition," *British J. Manage.*, vol. 7, pp. 87–105, 1996.

[21] F. Fransella and D. Bannister, *A Manual for Repertory Grid Technique*. New York, NY: Academic Press, 1977.

[22] A. Ginsberg, "Construing the business portfolio: A cognitive model of diversification," *J. Manage. Studies*, vol. 26, no. 4, pp. 417–438, 1989.

[23] T. L. Griffith and G. B. Northcraft, "Cognitive elements in the implementation of new technology: Can less information provide more benefits?," *MIS Quart.*, vol. 20, pp. 99–110, 1996.

[24] J. C. Henderson, "Plugging into strategic partnerships: The critical IS connection," *Sloan Manage. Rev.*, vol. 3, pp. 7–18, 1990.

[25] J. C. Henderson and N. Venkatraman, "Understanding strategic alignment," *Bus. Quart.*, vol. 55, no. 3, pp. 72–78, 1991.

[26] J. C. Henderson and N. Venkatraman, "Strategic alignment: Leveraging information technology for transforming organizations," *IBM Syst. J.*, vol. 38, no. 2/3, pp. 472–484, 1999.

[27] J. C. Henderson, N. Venkatraman, and S. Oldach, "Aligning business and IS strategies," in *Competing in the Information Age: Strategic Alignment in Practice*, J. F. Luftman, Ed. New York: Oxford Univ. Press, 1996, pp. 21–42.

[28] A. S. Huff, *Mapping Strategic Thought*. New York: Wiley, 1990.

[29] M. G. Hunter, "The use of RepGrids to gather interview data about information systems analysts," *Inf. Syst. J.*, vol. 7, pp. 67–81, 1997.

[30] M. G. Hunter and J. Beck, "Using repertory grids to conduct cross cultural information systems research," *Inf. Syst. Res.*, vol. 11, no. 1, pp. 93–101, 2000.

[31] Infometrics Ltd., "Evaluation of Technology New Zealand," A report to the Ministry for Research, Science and Technology, Wellington, New Zealand, 2001.

[32] M. Jelinek and J. A. Litterer, "Toward a cognitive theory of organizations," in *Advances in Managerial Cognition and Organizational Information Processing*, C. Stubbar, J. R. Meindl, and J. F. Porac, Eds. Greenwich, CT: JAI Press, 1994, pp. 3–41.

[33] R. Johnson and P. Kuby, *Elementary Statistics*, 8th ed. Pacific Grove, CA: Duxbury, 2000.

[34] G. Kearns and A. Lederer, "A resource-based view of strategic IS alignment: How knowledge sharing creates competitive advantage," *Decision Sciences*, vol. 34, no. 1, pp. 1–29, 2003.

[35] G. S. Kearns and A. L. Lederer, "Alignment of information systems plans with business plans: The impact on competitive advantage," in *Proc. Americas Conf. Inf. Syst.*, Indianapolis, IN, 1997.

[36] G. A. Kelly, *The Psychology of Personal Constructs*. New York: W. W. Norton & Company Inc., 1955.

[37] W. R. King and R. Sabherwal, "The factors affecting strategic information systems applications: An empirical assessment," *Inf. Manage.*, vol. 23, pp. 217–235, 1992.

[38] K. Langfield-Smith, "Exploring the need for shared cognitive map," *J. Manage. Studies*, vol. 29, no. 3, pp. 349–368, 1992a.

[39] K. Langfield-Smith, "Measuring differences between cognitive maps," *J. Oper. Res. Soc.*, vol. 43, pp. 1135–1150, 1992b.

[40] G. F. Latta and K. Swigger, "Validation of the repertory grid for use in modeling knowledge," *J. Amer. Soc. Inf. Sci.*, vol. 43, no. 2, pp. 115–129, 1992.

[41] A. L. Lederer and V. Sethi, "The implementation of strategic information systems planning methodologies," *MIS Quart.*, vol. 12, no. 3, pp. 445–461, 1988.

[42] M. R. Lind and R. W. Zmud, "The influence of a convergence in understanding between technology providers and users of information technology innovativeness," *Org. Sci.*, vol. 2, no. 2, pp. 195–217, 1991.

[43] J. N. Luftman, P. R. Lewis, and S. H. Oldach, "Transforming the enterprise: The alignment of business and information technology strategies," *IBM Syst. J.*, vol. 31, no. 1, pp. 198–221, 1993.
[44] J. N. Luftman, R. Papp, and T. Brier, "Enablers and inhibitors of business-IS alignment," *Commun. Assoc. Inf. Syst.*, vol. 1, 1999.
[45] H. MacDonald, "Business strategy development, alignment and redesign," in *Corporation of the 1990s: Information Technology and Organizational Transformation*, M. S. S. Morton, Ed. New York: Oxford Univ. Press, 1991.
[46] T. Moynihan, "An inventory of personal constructs for information systems project risk researchers," *J. Inf. Technol.*, vol. 11, pp. 359–371, 1996.
[47] M. Mullen, *Applied Statistics for Business and Economics*. Reading, MA: Addison-Wesley, 1975.
[48] *Advances in Personal Construct Psychology: New Directions and Perspectives*G. J. Neimeyer and R. A. Neimeyer, Eds. Westport, CT: Greenwood Press, 2002.
[49] K. M. Nelson and J. G. Cooprider, "The contribution of shared knowledge to IS group performance," *MIS Quart.*, vol. 20, no. 4, pp. 409–429, 1996.
[50] W. J. Orlikowski and D. C. Gash, "Technological frames: Making sense of information technology in organizations," *ACM Trans. Inf. Syst.*, vol. 12, no. 2, pp. 174–201, 1994.
[51] J. W. Palmer and M. L. Markus, "The performance impacts of quick response and strategic alignment in specialty retailing," *Inf. Syst. Res.*, vol. 11, no. 3, pp. 241–259, 2000.
[52] G. J. Phythian and M. King, "Developing an expert system for tender enquiry evaluation: A case study," *Eur. J. Oper. Res.*, vol. 56, no. 1, pp. 15–29, 1992.
[53] J. F. Porac and H. Thomas, "Competitive groups as cognitive communities: The case of Scottish knitwear manufacturers," *J. Manage. Studies*, vol. 26, no. 4, pp. 397–416, 1989.
[54] R. K. Reger and A. S. Huff, "Strategic groups: A cognitive perspective," *Strategic Manage. J.*, vol. 14, no. 2, pp. 103–124, 1993.
[55] B. H. Reich and I. Benbasat, "Measuring the linkage between business and information technology objectives," *MIS Quart.*, vol. 20, no. 1, pp. 55–81, 1996.
[56] B. H. Reich and I. Benbasat, "Factors that influence the social dimension of alignment between business and information technology objectives," *MIS Quart.*, vol. 24, no. 1, pp. 81–114, 2000.
[57] T. J. Reynolds and J. Gutman, "Laddering: Extending the repertory grid methodology to construct attribute-consequence-value hierarchies," in *Personal Values and Consumer Psychology*, R. E. Pitts and A. G. Woodside, Eds. Toronto, ON, Canada: Lexington Books, 1984, pp. 155–167.
[58] T. J. Reynolds and J. Gutman, "Laddering theory, method, analysis, and interpretation," *J. Advertising Res.*, pp. 11–31, Feb.–Mar. 1988.
[59] R. Sabherwal and Y. E. Chan, "Alignment between business and IS strategies: A study of prospectors, analyzers, and defenders," *Inf. Syst. Res.*, vol. 12, no. 1, pp. 11–33, 2001.
[60] R. C. Schwenk, "The cognitive perspective to strategic decision making," *J. Manage. Studies*, vol. 25, no. 1, pp. 41–55, 1988.
[61] M. L. G. Shaw, *On Becoming a Personal Scientist: Interactive Computer Elicitation of Personal Models of the World*. New York: Academic, 1980, p. 322.
[62] S. Siegel, *Nonparametric Statistics for the Behavioral Sciences*. New York: McGraw-Hill, 1956.
[63] B. Simpson and M. Wilson, "Shared cognition: Mapping commonality and individuality," *Advances in Qualitative Org. Res.*, vol. 2, pp. 73–96, 1999.
[64] V. Stewart and A. Stewart, *Business Applications of Repertory Grid*. New York: McGraw-Hill, 1981.
[65] C. I. Stubbart, "Managerial cognition: A missing link in strategic management research," *J. Manage. Studies*, vol. 26, no. 4, pp. 325–347, 1989.
[66] F. B. Tan, "The responsiveness of information technology to business strategy formulation: An empirical study," *J. Inf. Technol.*, vol. 10, pp. 171–178, 1995.
[67] F. B. Tan, "Strategy types, information technology and performance: A study of executive perceptions," in *Proc. 3rd AIS Americas Conf. Inf. Syst.*, Indianapolis, IN, 1997, pp. 848–850.
[68] F. B. Tan and M. G. Hunter, "The repertory grid technique: A method for the study of cognition in information systems," *MIS Quart.*, vol. 26, no. 1, pp. 39–57, 2002.
[69] T. S. H. Teo and W. R. King, "Integration between business planning and information systems planning: An evoluntionary-contingency perspective," *J. Manage. Inf. Syst.*, vol. 14, no. 1, pp. 185–214, 1997.
[70] G. I. Wacker, "Toward a cognitive methodology of organizational assessment," *J. Appl. Behav. Sci.*, vol. 17, pp. 114–129, 1981.
[71] "A psychology for adventurers: An introduction to personal construct psychology from a social perspective," in *The Construction of Group Realities*B. M. Walker, D. Kalekin-Fishman, and B. M. Walker, Eds. Melbourne, FL: Krieger, 1996.
[72] J. P. Walsh, "Managerial and organizational cognition: Notes from a trip down memory lane," *Org. Sci.*, vol. 6, no. 3, pp. 280–321, 1995.
[73] E. J. Walton, "Managers' prototypes of financial terms," *J. Manage. Studies*, vol. 23, pp. 679–698, 1986.
[74] W. Warren, *Philosophical Dimensions of Personal Construct Psychology*. New York: Routledge, 1998.
[75] K. E. Weick, "Managerial thought in the context of action," in *The Executive*, S. S. Mind, Ed. San Francisco, CA: Jossey-Bass, 1984.
[76] K. E. Weick, *Making Sense of the Organization* . Malden, MA: Blackwell, 2001.
[77] W. M. Williams and R. J. Sternberg, "Group intelligence: Why some groups are better than others," *Intelligence*, vol. 12, pp. 351–377, 1998.
[78] M. Zviran, "Relationships between organizational and information systems objectives: Some empirical evidence," *J. Manage. Inf. Syst.*, vol. 7, no. 1, pp. 65–84, 1990.

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