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Abstract: This research, couched in the resource-based view of the firm, investigates the potential for reducing an organization's decision uncertainty within its intellectual capital (IC) operating environment. Using structural equation modeling, we empirically test if organizational design can reduce the perceived uncertainty related to an IC context, which we refer to as knowledge uncertainty. We found evidence that decentralization and technology infrastructure support a results-based IC management control system which in turn is associated with reduced internal decision uncertainty. Finally, our statistics support a good overall fit for our model. Our findings suggest that if managers structure their organizational control systems appropriately for developing IC capabilities, these systems can lead to reduced internal uncertainty regarding human, structural, and relationship capital.

Suggested Reviewers:

Intellectual Capital and Uncertainty of Knowledge: Control by Design of the Management System

Abstract

This research, couched in the resource-based view of the firm, investigates the potential for reducing an organization's decision uncertainty within its intellectual capital (IC) operating environment. Using structural equation modeling, we empirically test if organizational design can reduce the perceived uncertainty related to an IC context, which we refer to as knowledge uncertainty. We found evidence that decentralization and technology infrastructure support a results-based IC management control system which in turn is associated with reduced internal decision uncertainty. Finally, our statistics support a good overall fit for our model. Our findings suggest that if managers structure their organizational control systems appropriately for developing IC capabilities, these systems can lead to reduced internal uncertainty regarding human, structural, and relationship capital.

Keywords:

Decentralization

Capabilities

Intellectual capital

Results-based control system

Technology

Uncertainty

Intellectual Capital and Uncertainty of Knowledge: Control by Design of the Management System

Introduction

Two streams of research, resource-based view (RBV) of the firm and intellectual capital, are emerging that attempt to answer related questions. The resource-based view investigates how organizational capabilities are developed internally to maintain a competitive advantage. Intellectual capital (IC) research investigates how wealth is created for an organization by designing systems to develop, manage, monitor, and value what is essentially invisible and intangible. IC focuses on systems that create wealth, and wealth can be created is by developing capabilities that evolve from resources, giving an organization a competitive advantage; therefore, these two streams of research are related.

The RBV initially looks internally for sources of competitive advantage by defining and developing core competencies from firm-specific capabilities derived from stocks of assets, primarily intangible (Barney, 2001; Grant, 1991; Penrose 1980; Roos et al., 2001; Teece, 1984; Wernerfelt, 1984, 1995). These core competencies allow an organization to find a better fit with its external environment to withstand competitive forces. While an organization can have many capabilities, those that are widespread and successful in differentiating the organization from its competitors (thus making it unique or difficult to imitate) can be called core competencies (Barney, 2001; Chatzkel, 2002; Hamel and Prahalad, 1994; Leonard-Barton, 1992; Prahalad and Hamel, 1990). These competencies evolve from stocks of human knowledge, supported by organization structures, processes, and relationships. The combination of these capabilities (human, structural, and relational) is often referred to as IC (Boulton et al., 2000; Edvinsson and Malone, 1997; Stewart, 1997).

Why do some organizations appear to be more successful than others at IC management activities? These activities provide the foundation for capability development. However, their very nature makes them prone to uncertainty. We investigate the question of how an organization should be designed to reduce uncertainty specifically related to decisions associated with IC activities. We propose that decentralized operations supported with technology infrastructure are congruent with a results-based IC control system. This organizational design can reduce the perceived internal dynamics of the operating context of the organization.

Developing IC Capabilities

Winter (2000, 2003) suggested that an organization attempts to reduce tasks and problems to more or less routine solutions, referred to as an operational capability. An operational capability is defined as a collection of routines that confers on management a set of decision options for producing outputs (p. 991). He further explained that routines are “learned, highly patterned, repetitious, or quasi-repetitious, and found in part in tacit knowledge” (p. 991), making them complex, structured, and multidimensional (p. 992). As tacit knowledge becomes explicit, capabilities become reliable in solving problems for clients or performing tasks within the organization (Helfat and Peteraf, 2003, p. 999). As knowledge moves from the domain of the employees’ minds to knowledge captured in the organization's systems and processes, it becomes a part of an organization's IC stock (Bontis et al., 2002; Bontis and Fitz-enz, 2002; Crossan et al., 1999; Edvinsson and Malone, 1997; Levinthal and March, 1993; Roos et al., 1997; Stewart, 1997; see Kaufmann and Schneider, 2004 for a listing of terms and definitions used for the IC concept).). In addition to knowledge, Leonard-Barton (1992) and Makadok (2001) recognized the importance of the managerial and technical systems, as well as structures, for developing capabilities. Levinthal and March (1993) suggested that networks of contacts (relationships) aid in stockpiling knowledge about "products, technologies, markets, and social and political contexts" (p. 103). To synthesize, IC might be considered as an "over-arching meta-level capability" (Rastogi, 2003, p. 232) consisting of three dimensions: knowledge (human); structural; and relationships.

Even though viewing IC as three dimensional is common place, Rastogi (2000) warned that structural and relational capital "cannot meaningfully exist, or function, independent of human capital and knowledge management" (p. 229). Human capital manifests itself into structures, such as business processes and relationships with customers, suppliers, and other stakeholders; therefore, they are not easily separated. Knowledge possessed by workers automatically prescribes competitive position and eventually survival or death in the marketplace; consequently, an important decision for the organization is the extent that these three dimensions of IC actively need to be emphasized, managed, and monitored to ensure that the organization's capabilities fit with its external environment.

Uncertainty and IC Capabilities

Over the past decade, more than 30 conceptual models have emerged dealing with attempts to classify and/or measure IC (Sveiby, 2002). However, while most of the focus has been on how to determine if IC exists by applying measurement models to or within organizations, we know little about determining the appropriate organizational design to motivate the development of IC capabilities and reduce the uncertainty associated with resources that are intangible, less concrete, and thereby more susceptible to misunderstanding and potential mismanagement. In knowledge-intensive environments, managers and others charged with the role of ensuring corporate survival must be aware of the nature of the conditions that can reduce tasks and problems to routine solutions, referred to as operational capabilities, while at the same time encouraging creativity. What type of organizational design supports the movement of knowledge from tacit to explicit, the development of accepted processes, and the development of relationships thereby reducing the uncertainty associated with making decisions within the organization?

Rastogi (2003) suggested that IC is primarily deployed in environments that are dynamic or in rapid flux; therefore, “deployment of IC implies a relentless process of foresight, assessment, orchestration, action, feedback, learning and insight” (p. 233) to reduce the internal uncertainty inherently associated with these resources. Because knowledge is dispersed throughout most organizations, managers must deal with the time and resources required to draw together the fragments, deal with the related asymmetries of information, and attempt to reduce the uncertainty associated with decisions for which the decision maker lacks access to all the information necessary (Becker, 2001). Thus, development of IC capabilities requires an organizational design that encourages creativity by providing systems that are both adaptive and proactive. "The more dynamic (frequency and intensity of environmental changes), complex (number and relatedness of environmental changes), and unpredictable the environment (extent to which cause-effect relationship are incomplete), the more difficult it is to handle the managerial and organization design tasks" (Volberda, 1996, p. 365). With this in mind, we suggest that the very nature of IC (intangible, abstract, and difficult to comprehend) suggests a higher degree of uncertainty. Knowledge organizations work in business environments in which it is difficult to predict outcomes successfully and resolve problems and in which knowledge can possess a limited shelf life due to frequent changes. Therefore, the degree of *knowledge uncertainty* ought to dictate the type of organization design and control system that is most appropriate to direct behaviors related to IC. As the knowledge or human dimension drives the necessity for the support of the other two dimensions of structural processes and relationships, the degree of knowledge change (or shelf life) is the predominant concern.

Early work on uncertainty did not pertain specifically to knowledge-intensive organizations. Knowledge capabilities have always been important for organizations to deal with uncertainty in their environments; however, in the past more than today, organizations were concerned with the traditional balance sheet assets of manufacturing companies. Today, both the abundance of knowledge available in certain environments and the length of knowledge usefulness make it more difficult to predict outcomes. Consequently, heavy reliance on intangible resources for competitive advantage calls for research to determine which organizational design is appropriate for reducing uncertainty regarding knowledge, its supporting technologies, and relationships in the process of developing capabilities. Therefore, we first review the literature on uncertainty and control systems as it pertains to organizations and then adapt and expound on the literature in terms of knowledge uncertainty.

Duncan (1972) defined environment as “the totality of physical and social factors that are taken directly into consideration in the decision-making behavior of individuals in the organization” (p. 314). Then, he distinguished between the internal and external environment by considering those factors which occur inside (internal) or outside (external) the organization’s boundaries when making decisions (Duncan, 1972, p. 314). Early researchers generally classified uncertainty as either static (slow changing) or dynamic (fast changing) (Robbins, 1990). Burns and Stalker (1961) found that structures were different in organizations that operated in rapidly changing environments (organic structures) from those that operated in slow changing environments (mechanistic structures). Probing deeper into the environmental classifications of static and dynamic, Emery and Trist (1965) provided additional insight. Static environments can be characterized as either unchanging or changing slowly. In contrast dynamic environments with turbulent fields change rapidly and their components are less identifiable (rapid change from identifiable components but also from the complexity and character of the field). Organizations in this last field face continuous change similar to those described by Eisenhardt and Martin (2000) as high-velocity environments. High-velocity environments have “fluid business models, ambiguous and shifting players, and nonlinear and unpredictable change” (p. 1115).

Even though it is extremely difficult to change or control uncertainty in the external environment, managers can develop systems to reduce the uncertainty within the organization and accumulate strength for dealing with external uncertainty. Regarding internal management response in these environments, Emery and Trist (1965) suggested that for static environments, strategy and tactics are essentially the same and response to change is on a trial and error basis (Ashby, 1960). As environments become less static, strategy emerges separately from tactics as survival is based on the organization's knowledge of its environment and how it impacts the organization (Emery and Trist, 1965). Therefore, a concentration of resources to develop a "distinctive competence" (Selznick, 1957) is necessary. Because of the intangibility of IC capabilities, appropriate strategy must recognize a need for a "conjoined, cumulative, and mutually reinforcing thrust of the firm's" direction (Rastogi, 2003, p. 233).

Duncan (1972) added insight by identifying three characteristics hindering the manager in decision making in dynamic environments: 1) a deficit in available information; 2) inability to assess in advance the effect of an incorrect decision; 3) inability to assign probabilities to predict outcomes (p. 318). Perrow's (1967) work clarified situations in which these characteristics can occur by considering two dimensions. Task variability ranges from routine (few exceptions) to highly variable (many exceptions). Problem analyzability ranges from well defined (analyzable) to ill-defined (un-analyzable). For well defined problems, logical reasoning prevails to solve problems. In contrast, for ill-defined problems, worker experience, know-how, judgment, and experimentation leads to problem solutions.

Regarding organizational design, Burns and Stalker (1961) found that structures were different in organizations that operated in rapidly changing environments (organic structures) from those that operated in slow changing environments (mechanistic structures). In rapidly changing environments, a different style of management system, although unable to change the external environment, can help monitor the situation and thus stabilize internal operations. With a proper management planning and control system managers can access information to help make decisions regarding the organization's own moves, its competitors' moves, the impact on the organization, and possible responses.

Application to Knowledge-Intensive Organizations

Based on the previous literature on uncertainty, we suggest that knowledge-based organizations or business units may vary in the manner in which they deal with *task variability* and *problem analyzability*. Some organizations attempt to follow routine tasks with well laid pathways of reason to solve problems encountered. If work assignments differ greatly from project to project and employees must rely upon judgment, shared knowledge developed internally from experience and experimentation, the structure and control systems must accommodate these characteristics. To add to the complexity, decision makers are challenged by the sheer growth of knowledge. Therefore, simply choosing the right information or finding the information that is most appropriate for analyzing a problem adds complexity to decision making and, once again, depends greatly on structure and control systems.

Volberda (1996) noted that “firms may drive their environments or vice versa” (p. 365). Firms that are flexible can attempt to control their environments and reduce uncertainty, by having a managerial capability and firm response for each competitive change (Volberda, 1996). Becker and Knudsen (2005) found that organizational routines were successful in reducing pervasive uncertainty in decision making, and availability of information is useful in situations with less demanding forms of uncertainty. Consequently, firms with greater varieties of capabilities (some not activated yet, but stored in IC inventories), more sophisticated systems, and stronger relationships will be in better positions to respond to uncertainties caused by change. In conclusion, it appears that management must increasingly take control of its IC and nurture it as the knowledge environment becomes less certain.

Management Planning and Control Systems in Dynamic Environments

Because all organizations face uncertainty, enterprise risk management (ERM) is a means of dealing with that uncertainty which can be managed, often referred to as risk (COSO, 2004, 1999). However, uncertainty can present itself as either negative or positive. The negative side of uncertainty is risk; the positive side is opportunity. Organizations face risk at many organizational levels and apply appropriate controls that will avoid, share, or manage the risk. If the negative aspects of a particular strategy can be managed, it may be perceived as an opportunity to enhance value for the organization. Some form of control activities (often policies and procedures) are implemented to pursue a particular strategy by reducing the significant risks and thereby presenting an opportunity to the company. However, the appropriate control can hinder rather than provide opportunities.

Consistent with empowering employees, a type of controls referred to as “results” controls influence behavior by motivating employees to take actions necessary to achieve the end results or consequences (Merchant and Van der Stede, 2007). Results controls do not state the specific actions to achieve the end result but rather provide direction as to what the end result or goal is, leaving the method by which to achieve the goal up to the discretion of the employee. Results controls are appropriate in learning environments. As the specific method for learning in a situation cannot always be determined by managers, flexibility must be given to employees to choose the most appropriate methods. A results-based control system is consistent with “establishing a mutually aligned set of agile processes and a flexible organization design” (Rastogi, 2003, p. 241) to set the stage for an organization to develop its IC capabilities.

Research Hypotheses

Because knowledge changes frequently, can be difficult to access or locate within an organization, or is complicated with unclear cause and effect relationships, an organization’s IC management system should be characterized to reduce this uncertainty to develop necessary capabilities. Several researchers provide a basis for believing that perceptions are more significant in understanding organizations’ actions in responding to its environment (see Leifer and Huber, 1977, p. 236). Thus, the discussion focuses on perceived uncertainty.

To summarize our model briefly before discussing each detailed hypotheses, we are testing if decentralized operations along with high technology infrastructure, coupled with a results-based IC management and control system, will lead to reduced perceived internal uncertainty to develop capabilities within the organization.

(Insert Figure 1 here)

Uncertainty and IC Results-Based Control Systems. Referring to the work of Emery and Trist (1965), Volberda (1996), and Becker and Knudsen (2005), dynamic environments require sophisticated management systems to monitor variability, providing access to information for better decisions. Having the proper IC management system in place to develop the human, structural, and relational IC capabilities can lessen instability. In regard to the human dimension, that means creating avenues for extensive knowledge sharing, ensuring that turnover does not mean loss of knowledge and encouraging workers to look for better ways of doing things. For the structural dimension, that means employees have access to the information that they need and that the organization has systems necessary to capture and measure the value of knowledge. For the relationship dimension, that means maintaining appropriate communication with stakeholders, ensuring that clients believe the organization has their best interests in mind, and sharing valuable contacts within the organization. These elements working together can reduce task variability and make problems more analyzable (Perrow, 1967) by having less frequent changes in job responsibilities, providing on-going training, keeping up with reporting relationships, and knowing exactly and at all times who is responsible for what functions. The extensiveness of the culture, networks, avenues of communication, and other results-based control elements will determine the controllability of the organization's responsiveness (Volberda, 1996) and provide internal flexibility, thus developing resource capabilities. Therefore, we propose Hypothesis 1 regarding internal uncertainty for each of the IC dimensions of human, structural, and relational capabilities.

Hypothesis 1: Perceived internal uncertainty will be lower in operating environments that have results-based IC management control systems for developing (human, structural, and relationship) capabilities.

However, the management and control system must be given the appropriate context in which to operate to reduce internal uncertainty. We argue that a decentralized structure equipped with appropriate technology can enable the management system to reduce internal uncertainty.

Organizational Design and IC Results-Based Control Systems. An organization must be designed to align the structure with the objectives that are to be achieved in the organization. Furthermore, the proper types of controls will support the linkage between the organization's structure and its objectives (Robbins, 1990; Macintosh, 1994) to guide employees in fulfilling them.

When referring to authority for decision making, organizational structures can be described on a continuum, anchored with centralization and decentralization. Organizational structure refers to the degree to which decision making is limited to a few top level managers (centralization) or dispersed throughout several layers of management within the organization (decentralization). Most organizations can be characterized some place in between completely autocratic decision making (extreme centralization) and joint decision making between employees and their supervisors (extreme decentralization) (Richardson et al., 2002). Robbins (1990) provided a formal definition of the centralization/decentralization continuum as “the degree to which the formal authority to make discretionary choices is concentrated in an individual, unit, or level…thus permitting employees input into their work” (p. 106).

Along these same lines, Macintosh (1994) suggests that optimal performance is reached when matching a control system’s characteristics with its organizational characteristics. When organizations experience a rapid rate of advancement in knowledge and frequent market changes, organic (rather than mechanistic) structures and systems allow for complex exchanges in information to cope with these changes (Burns and Stalker, 1961). Organic systems of control are consistent with decentralized structures and are appropriate for responding to domain characteristics that are dynamic. In contrast, mechanistic structures are consistent with highly centralized and formalized decision making and are appropriate for responding to domain characteristics that are stable (Burns and Stalker, 1961). Organic control systems offer flexibility and adaptability for organizations operating in turbulent domains. Organic control systems, which emphasize lateral communication, authority based on expertise, performance results, and culture controls, orient themselves toward partnerships and teamwork. Responsibility is given to the employee to act in the best interest of the organization (van Marrewijk and Timmers, 2003). Consistent with market structures, organic control systems provide for general instructions through results controls rather than specific behaviour instructions for reaching an objective as do command-and-control structures (Macintosh, 1994). As Starbuck (1992, p. 730) suggested in regard to knowledge-intensive firms, “close control would induce exits;” rather matrix structures, fluidity, nondirective supervision, and liaisons are more appropriate. He continued to explain that routines support learning, but formal routines can appear bureaucratic; and experts prefer autonomy. Thus, the challenge that organizations face is to provide a balance between the autonomy needed for creativity and the control needed to ensure that results are produced (Feldman, 1989). Consequently, controls must be appropriately structured.

We build a case that an IC control system can best reduce internal uncertainty when it is matched with an organization that is structured for participatory decision making. Furthermore, the system should be designed with results-oriented objectives consistent with a market approach rather than process-oriented objectives consistent with a command-and-control approach. Amabile (2005) found that a positive attitude affects creativity; therefore, if decentralization motivates employees in a positive manner (Richardson, et al. 2002), it is likely that creativity will result. Sharing personal knowledge for capability development is more likely to occur when employees are allowed to make decisions about potential solutions (Davenport and Prusak, 2000) within an organizational context that recognizes and allows the use of employees' experiences and knowledge (Hasgall and Shoham, 2008).

Studies on knowledge creation or knowledge sharing (one dimension of IC capabilities) found that decentralization can enhance outcomes. Kasper et al. (2008) found that a decentralized structure has a positive impact on the technical and personal knowledge flows across different sites in multinational corporations. Anderson (2004) found that in dynamic environments a decentralized decision structure for strategy making and planning processes will enhance performance. However, the challenge is to ensure that the related control processes enable and foster rather than hinder knowledge sharing (Kasper et al., 2002). Therefore, to achieve objectives related to IC capabilities, especially when the organization is situated in a turbulent context, decisions must be made rapidly and close to the point at which the decision is to be implemented. Structures should support decentralized, participatory decision-making, and control systems should be designed with an intent to develop capabilities through a results-oriented approach. Therefore, we propose the following hypothesis:

H2: Higher levels of decentralized decision making will support capability development through a results-based IC management control systems.

Technology and IC. Knowledge management systems are defined as information technology (IT) systems developed specifically to support and enhance the "processes of knowledge creation, storage/retrieval, transfer, and application" (Alavi and Leidner, 2001, p. 114). As the cost for computers, networks and software is decreasing, there is a tendency for organizations to create an infrastructure for knowledge exchange with the intent to provide knowledge management opportunities. Technology, such as e-mail, groupware, intranets, video conferencing, and databases, provide storage and sharing capabilities to enable knowledge creation (Davenport and Prusak, 2000) and substitute knowledge with access to knowledge, thereby increasing available information (Becker, 2001). Alavi and Leidner (2001) noted that the literature suggests three common applications for knowledge management IT systems. First, technology allows for the development of internal benchmarking systems through the coding and sharing of best practices. Second, corporate directories aid in the mapping of expertise within an organization, allowing employees to identify where knowledge and contacts are located.

Third, creating knowledge networks allows for the easy sharing of knowledge among employees, especially in different organizational units.

However, knowledge management systems provide only the means for knowledge exchange; they do not create knowledge or ensure that employees will actually use the technology to achieve IC objectives for building relationships and creating knowledge capabilities. Personal contacts and networking, coupled with the corporate communication infrastructure, should motive knowledge creation and sharing results (Kasper et al., 2002). Therefore, technology is a necessary but insufficient enabler of IC management control systems designed to develop IC capabilities. We therefore propose the following hypothesis:

H3: Higher level of technology will support capability development through a results-based IC management control system.

Methodology

Scale Development. To test these hypotheses we used Likert-scale questionnaire items based on the extant literature to assess four constructs: Level of technology (1 item); level of centralization/decentralization (1 item); three dimensions of IC as results-oriented controls, aggregated as one construct: human (8 items), structural (5 items), and relational (6 items); perceived controllable internal uncertainty (3 items). The scales for IC control systems and internal uncertainty utilized in this study were created by the authors, as existing scales did not capture the concepts that we wished to examine. However, our items were developed from theoretical sources through careful adaptation from existing scales to ensure valid representation of the elements of IC that would be appropriate for a results-based IC control system.

The subscale items were mixed; therefore, respondents were not aware of which items belonged to which subscale. Respondents answered all items using a 5-point Likert-type scale with the following anchors: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree. Scales were unit-weighted. To ensure that respondents did not adopt a particular response format, a few items were reverse coded.

Data Collection Procedures. We took procedural precautions when designing our data collection instrument and collecting data, as suggested by Podsakoff et al. (2003), to control for potential sources of common methods bias. Because collecting predictor and criterion variables from different sources would render validity concerns, we instead used temporal, proximal, psychological, and methodological separation of measurement (Podsakoff et al., 2003, p. 887). We used several different companies and professional organizations in a variety of industries and in different levels of management, professional positions, and technical expertise.

The responsibility for the distribution of the manual surveys within the organizations was left with our contact persons from the various organizations. They reported an approximate 70 percent response rate. To improve sample size, we provided the survey to other organizations on a random basis through electronic means; therefore, it is impossible to determine exactly who received notice to complete the survey and ultimately decided to participate in the second round. We had two conditions for participation in this study. First, subjects were required to be employed, and second, they had to have worked in their companies for at least one year. All responses were anonymous. The instrument stated that there were no right or wrong answers, and respondents were encouraged to provide honest opinions.

Furthermore, we mixed predictor and criterion variable items to the extent that it did not disrupt the logical flow. To avoid ambiguity, we provided a definition of any technical terms at the front of the instrument, but avoided using any jargon, complicated syntax, or double-barreled questions by pre-testing with individuals unfamiliar with the context of the study and its variables. Each of the five points on the Likert-scale was anchored with word labels rather than numbers. Demographic information was collected via a different set of scales and open-ended questions. Because IC is created at all levels of management, we ensured that we had a cross-section of managerial levels, functional positions, industries, ages, gender, sizes, and profit or non-profit status.

(Insert Table I about here)

Statistical Procedures

We tested our hypothesized paths and the fit for our models using LISREL 8.4 with maximum likelihood estimation allowing for simultaneous estimation of our proposed relationships. The relationships were tested by entering the correlation matrix into the program, using a single indicator structural equation model with measurement error terms specified (Bollen, 1989). Specifying measurement error (1 – reliability) in each of our constructs allows for a more rigorous method of analysis. Through the use of structural equation modeling, we test the significance of the individual paths in the model (via the specified structural paths), clearly stating the measurement error in each of the paths, and then test the model as a whole. This approach affords simplicity, statistical elegance, efficiency, and effectiveness.

Findings

Sample Characteristics. Respondents to the survey totaled 190. However, 28 cases showed 27 percent or more of the data points missing for these scales. These respondents were removed from further analysis, resulting in a total of 162 respondents. For other than demographic variables, we substituted a “3” for the missing values (less than 5% of the data were missing). As this response is “neither agree nor disagree” on a 5-point scale, this procedure is the most conservative and is justified.

Each of the subscales (IC control systems and internal uncertainty) was tested for reliability. Even though the tests for reliability for the three separate dimensions of IC were acceptable as separate dimensions, because of high correlations among the three dimensions, it was decided to combine the three dimensions into one IC control systems scale. For the IC subscales, Cronbach’s alphas were .75 (human), .77 (structural), and .72 (relational) and for the IC summated scale the alpha is .85. Regarding the internal uncertainty subscale, the Cronbach’s alpha was .74. As mentioned earlier, the level of decentralization and technology were collected with respondents answering to a Likert scale. Therefore, there was only one item for each variable. Descriptive statistics for the multiple dimensions for each subscale are presented in Table II.

We first tested the model to determine if it fits the data. Table III shows minimum fit chi-square and fit indices for the model. All are in the specified ranges, showing a good fit of the data to the model.

(Insert Table II and III about here)

We correlated the variables as per the hypothesized relationships. We found significant correlations between internal uncertainty and the summated scale of IC results-based control systems thus fully supporting hypothesis 1. The correlation was negative, as expected. The negative correlation indicates that the more the respondents agreed that internal uncertainty existed within their operating environments, the lesser developed were their IC results-based management control systems. For those organizations that responded that their perceived internal uncertainty was low, we suggest that their IC management systems might indeed have lowered the perceived uncertainty within their organizations. We found strong positive correlations between the results-based control system and the level of technology and degree of decentralization, suggesting that a decentralized organization design and access to technological infrastructure supports the IC control system, supporting hypotheses 2 and 3.

(Insert Table IV)

Hypotheses 1, 2, and 3 were all supported. Hypothesis 1 suggested that a results-oriented IC control system is consistent with reduction in internal uncertainty ($\beta = -.29$; $z = -4.66$, $p < .01$). Hypothesis 2 was supported and suggested that decentralization is consistent with a results-oriented IC controls system ($\beta = .26$; $z = 4.14$, $p < .01$). Hypothesis 3 was supported and suggested that a high level of technology would be consistent with a results-based IC control systems. ($\beta = .13$; $z = 2.02$, $p < .05$).

Discussion

This research offers a contribution to both the IC and the resource-based view streams of research in the process of creating wealth through competitive advantage. The

IC literature does not distinguish the specific characteristics of the organizations which enable the development of IC management control systems to support IC organizational objectives of resource capability development. The literature recognizes that the type of environment in which an organization operates, such as high-velocity or turbulent fields, will dictate the type of manager response to uncertainty and the type of uncertainty the manager will encounter; however, it fails to recognize that some types of internal uncertainty might be reduced, or rendered more controllable, by a sophisticated IC management control system; thus, enabling more efficient and effective capability development.

Other organizational characteristics that were related to the IC management system were the extent to which decision-making authority was decentralized and the technological level of the organization. Regarding decentralization, Robbins (1990) suggests that highly complex organizations tend to decentralize because the complexities need to be backed with expertise and capabilities in the form of human knowledge, supported with structures and processes. Knowledge workers also tend to participate more in decision-making, and decentralization makes the process more effective (Robbins, 1990). Decentralized structures generally come with more participative forms of decision making which spreads the responsibility for capability development among a broad number of organizational members (Volberda, 1996). Regarding technology levels, to maintain competitive advantage, a stock of IC itself is insufficient to ensure the appropriate evolution of capabilities; therefore, technology infrastructure helps to maintain systems whereby access to knowledge and development of relationships can be done more efficiently.

We found significant negative correlations between IC results-based control systems and perceived internal uncertainty, suggesting that the more sophisticated an organization's IC results-based management system, the less uncertainty the organization perceives and thus the greater ability to develop necessary capabilities. This controllability concept is consistent with Volberda (1996) and Dreyer and Grønhaug (2004), who suggested that internal flexibility is necessary for organizations to respond to competitive changes. An organization with internal flexibility more likely has greater IC inventories from which to develop capabilities as they are needed. Controllable internal uncertainty is also similar to lessening task variability and problem analyzability (Perrow, 1967), developing routines, or increasing the availability of information (Becker and Knudsen, 2005). The manager can develop an IC system which helps the organization clarify its own direction (reduce variability) and clarify the components of its IC (problem analyzability) by defining the results expected; consequently, the manager will be able to determine the effect and appropriate response to maintain the organization's competitive advantage. These organizations also tended to perceive themselves as making greater use of technology to connect themselves to systems for transferring and sharing knowledge and developing stronger relationships.

Future Research and Conclusions

We tested our model using structural equation modeling. We found strong positive relationships between a results-based IC management control system and both a decentralized organizational structure and a high level of technology. We also found a negative relationship between internal uncertainty and a results-based control system, suggesting that the appropriate control system can lead to reduced internal uncertainty. We suggest further research in the area of perceived internal uncertainty and how it specifically impacts knowledge-intensive organizations. Refinement of these constructs will help to understand how certain barriers can be overcome in the evolution of dynamic capabilities to sustain competitive advantage. Furthermore, distinguishing between routine and non-routine technologies in future research might help to provide further insight into the relationship between IC and technology. We would speculate that knowledge workers tend to work more with non-routine technologies, as they tend to be associated with greater complexity as decisions become more customized to each situation (Robbins, 1990). Regarding decentralized operations, future research would investigation with more detail the organizational design characteristics that lead to achieve the desired results in the IC management and control system.

APPENDIX

Items used in the data collection process.

Results-Based IC Management Control System – Human Capital

1. The knowledge that each co-worker/associate has is not really appreciated until that person leaves the organization.
2. Most co-workers/associates clearly understand "why" they do what they do in their jobs.
3. Extensive knowledge sharing occurs between experienced and new people in our organization.
4. Because knowledge is shared non-systematically (e.g. sporadically, informally), dependency on a few key individuals for success is high.
5. Bureaucracy within our organization does not slow down the application of new ideas.
6. We are able to link the success of our organization to our knowledge and expertise.
7. We often develop techniques or processes based upon what we have learned from earlier experience.
8. It is easy to spread individual knowledge throughout this organization for others to use.

Results-Based IC Management Control System - Structural Capital

1. People have access to the information systems they need to fulfill organizational objectives.
2. Our organization possesses processes to develop fully its unique capabilities, skills, and knowledge.
3. Features of our information systems capture the knowledge that exists in this organization.
4. Most co-workers/associates are familiar with organization information systems that assist job performance.
5. We have good systems within our organization to measure the value of our knowledge.

Results Based IC Management Control System – Relationship Capital

1. We maintain appropriate communication with our stakeholders.
2. Suppliers and customers have a clear picture of who we are and what we offer.
3. Our clients believe that we work towards their best interests.
4. We emphasize getting to know one another in this organization.
5. Co-workers/associates generally confide in one another.
6. The structure within this organization promotes caring relationships

Internal Uncertainty

1. Change within the organization is so rapid that we are no longer certain who is responsible for what.
2. We frequently make decisions with a lack of complete knowledge
3. Our industry is changing so fast that our organization cannot keep up.

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Figure 1
Model: Effects of Decentralization, Technology, and IC Results-Based Control System on Internal Uncertainty

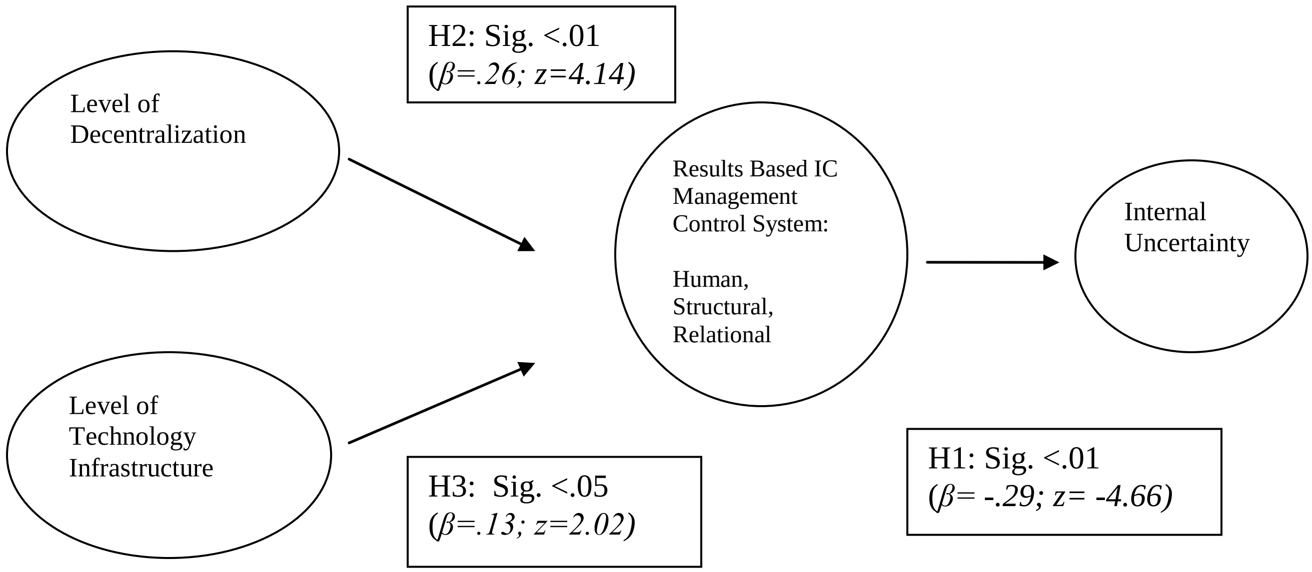

Table I

Respondent and Organizational Demographic Characteristics

For Respondents

Characteristics	Statistics
Age:	Range from 20 to 70, Mean = 30, Standard Deviation = 9
Gender:	48% Male, 43% Female
Hierarchy	
Upper Level Managers:	10%
Middle Level Managers:	30%
Lower Level Managers:	13%
Professional/Non-Managers:	40%

For Organizations

Characteristics	Statistics
Size Range	1.5 to 109,000 Full-Time Equivalent Employees
Sector	
For-Profit:	70%
Non-Profit:	22%
Structure	
Simple:	6%
Functional:	20%
Divisional:	38%
Matrix:	28%
Industry Type	
Service:	54%
Consulting:	13%
Oil and Gas:	11%
Manufacturing:	3%
Retail/Sales:	3%
Government:	2%

Table II
Descriptive Statistics
(N = 162)

	No. of Items	Mean /No. of Items	Standard Deviation
Decentralization	1	2.68	.92
Technology	1	3.26	.83
Results-Based IC Mgmt System	18	3.31	.55
Internal Uncertainty	3	2.84	.81

Table III
Minimum Fit Chi-Square Values and Fit Indices for the Models

Statistic	Value	Explanation
Min. Fit χ^2 (df) p	14.10 (9) p=0.12	Minimum Fit chi-square value of the model with the relevant degrees of freedom is used to test whether or not the model fits the data. Lower values indicate better fits and a non-significant *p* value indicates that the model fits the data.
NFI = Normed Fit Index	0.89	Good fitting models have values .90 and above.
GRI = Goodness of Fit Index	0.98	Good fitting models have values .90 and above.
AGFI = Adjusted Goodness of Fit	0.95	Good fitting models have values .90 and above.
CFI = Comparative Fit Index	0.95	Good fitting models have values .90 and above.
SRMR = Standardized Root Mean Residual	0.045	Good fitting models have values .10 and below.
RMSEA=Root Mean Square Error of Approximation	0.047	Good fitting models have values .10 and below.

Table IV

Correlation Matrix

(N = 162)

	Decentralization	Technology	Results-Based IC Mgmt System	Internal Uncertainty
Decentralization	1.00			
Technology	0.01	1.00		
Results-Based IC Management System	0.26	0.13	1.00	
Uncertainty	-0.05	0.01	-0.29	1.00