Developing a Model for Intellectual Capital Measurement in Knowledge-Based Organizations

Kiarash Yazdanfar
Department Of Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran

Abstract
Intellectual capital is knowledge that can be converted to value and researchers consider it to consist of the following components: human capital, structural capital, customer capital, and social capital. These components of intellectual capital are typically found in the minds of employees and within organizational structures and processes. In order to give intellectual capital a high level of attention and effectively manage an environment that helps to facilitate intellectual capital transfer, management must understand how it is transferred throughout the organization. Although specific mechanisms may not yet be fully understood, intellectual capital is thought to be transferred from source to receiver through an exchange process called knowledge transfer. Knowledge transfer has been described as the transmission and receipt of knowledge from sender to recipient. This study tries to develop a model for knowledge based organizations in science and technology parks using structural equations modeling using 74 company manager’s points of view. According to the SEM approach, the unknown model parameters are chosen to make, in general, the model-reproduced covariance matrix as close as possible to the sample covariance matrix. If the proposed model emulates the sample matrix (which can be measured by the goodness-of-fit indices) to a sufficient extent, it can be treated as a plausible description of the investigated phenomenon, and the theory from which the model has been derived is supported.

Keywords: Intellectual Capital, Knowledge-Based Organizations, structural equations modeling (SEM)

Introduction
Because it is important to manage knowledge development as a resource for sustainable competitive advantage (Bassi, Cheney, & Lewis, 1998; Bontis, 2001), it is important to establish a theory, a set of related concepts in an integrated framework that can be used to explain phenomena (Strauss & Corbin, 1998), that addresses the relationships between transfer channels and intellectual capital. Although Bontis (2002) asserts that intellectual capital is dependent on trust and organizational culture, the literature lacks sufficient evidence to either confirm or discredit this assertion. One of the reasons for this is that prior research of intellectual capital does not appear to have addressed in depth how the components of intellectual capital are transferred within an organization and how can measure in knowledge organizations. As a matter of survival, organizations in rapidly changing environments need to possess the ability to identify and react to changes that originate outside their boundaries. This construct, known as dynamic capabilities, has recently emerged as a key topic for researchers interested in explaining how firms adapt to shifting knowledge environments. This research posits that a firm’s dynamic capabilities enable it to integrate, build, and reconfigure internal and external competencies to address uncertain and changing environments (Teece, Pisano, & Shuen, 1997). It has been theorized that these capabilities can facilitate innovation and adaptation by allowing a firm the opportunity to derive economic rents from new and innovative processes, products, and services. Recent theoretical research suggests that these capabilities arise from an organization’s ability to both explore for new information and exploit its current knowledge base (O'Reilly & Tushman, 2007). Indeed, a significant amount of research has examined the characteristics of such capabilities (Eisenhardt & Martin, 2000; Winter, 2003), their evolution and role in firm learning (as well as the mechanisms that firms can employ to leverage their effectiveness (Rothaermel & Hess, 2007). Despite the insights offered in the extant literature, some researchers still question the validity and even the existence of dynamic capabilities. Such skepticism is
warranted, as dynamic capabilities researchers have struggled to answer the fundamental question of how these capabilities are formed. This significant gap in our understanding is a result of the fact that research has generally failed to consider the complex and multi-level nature of dynamic capability formation. We submit that to deepen our understanding of how an organization forms dynamic capabilities, an approach that considers a system of capability formation is vital. Such a system-level analysis allows us to analyze the linkages between each distinct stage in the dynamic capability development process beginning with exploration for new knowledge and culminating in its exploitation. We submit that such an analysis requires a multi-level approach. The need for such an approach is illustrated by the fact that a dynamic capability itself represents change at the routine or capability level of analysis. This perspective resonates with Helfat et al.’s (2007: 4) understanding of dynamic capabilities as “the capacity of an organization to purposefully create, extend, or modify its resource base.” While a change in an organization’s resource base is a direct result of the collective actions of individuals, the outcome of interest herein is the adaptation of the organization to an environmental knowledge shift. Therefore, we suggest that three levels of analysis are required to more fully understand both the inputs to and outputs of dynamic capabilities: the individual, routine, and organization level. Thus, a contribution of our research is to extend the current focus of dynamic capabilities researchers beyond the traditionally used capability level of analysis. While this focus is not surprising given that dynamic capabilities are often defined as higher-order capabilities or heuristics (Teece et al., 1997), viewing the construct through a broader lens will shed light on the system through which these capabilities emerge. While this focus is not novel, the prior research that has considered the role of individuals has focused primarily on the role of middle and top managers (O’Reilly & Tushman, 2007). While an analysis of different management layers clearly improves our understanding of the organizational decision making process, it does not directly allow for consideration of how organizations explore for new information or exploit current knowledge bases, especially in high-tech industries. A deeper understanding of these processes is vital, as both exploratory and exploitative activities are critical to an organization’s innovative efforts (Tushman, Smith, Wood, Westerman, & O’Reilly, 2004). We suggest that to understand the process through which organizations sense and react to environmental knowledge shifts requires a deeper analysis of the organization’s intellectual human capital. By considering the roles of both star and ‘non-star’ or average employees in the innovative activities of an organization we advance a framework that illustrates a system through which dynamic capabilities can be developed. To illuminate the roles that individuals play in facilitating these activities, we incorporate the construct of boundary spanning (Aldrich & Herker, 2006) into multi-level framework of organizational learning. Aldrich & Herker. (2006) offer a general theory of organizational learning that links the individual, group, and organizational levels of analysis. Of key interest is the authors’ position that two key aspects of organizational learning, the ability to intuit and interpret new knowledge, occur at the individual level. As part of our theoretical framework, we develop a typology of individuals, which organizations employ to overcome stage-specific knowledge gaps. This synthesis allows us to provide an analysis of how incumbent firms in knowledge-intensive industries utilize different individuals to effectuate their continuous adaptation and thus innovation efforts. The boundary condition imposed by this setting is appropriate given that the purpose of dynamic capabilities is to allow existing firms to address rapidly changing or high velocity environments (Eisenhardt & Martin, 2000; Teece et al., 1997) through a continuous change in a firm’s resource base (Helfat et al. 2007). In the spirit of Helfat, our theoretical analysis is buttressed by data and anecdotal evidence that detail the experiences of incumbent firms in knowledge-intensive industries that are attempting to build dynamic capabilities. We begin our framework development at the organizational level of analysis by investigating the different knowledge gaps an innovating firm faces. We then turn to a more micro-level of analysis to illustrate an important heterogeneity in an organization’s intellectual human capital. It is through this analysis that we develop a typology of individuals based on the nature and level of connectivity. Finally, we explicate how effective dynamic capabilities, in terms of technical and evolutionary fitness result when firms use different individuals to span different knowledge gaps.
Literature review

Edvinsson and Sullivan (1998a) define intellectual capital as “the knowledge that can be converted into value” (p.358). The scholars Nahapiet and Ghoshal (1998) use the term to refer to “the knowledge and knowing capability of a social collectivity, such as an organization, intellectual community, or professional practice” (p. 245). In spite of the elusiveness of its definition, scholars and practitioners concur that intellectual capital is a valuable organizational resource that can be used to create differential advantage (Nahapiet & Ghoshal, 1998; Stewart, 1997). Part of the elusiveness of its definition resides on the fact that much of the knowledge in an organization is tacit rather than explicit and is therefore difficult to explain or even to see.

Much of it exists in the intangible and un-codified talents of experts and the experience of employees. For Sullivan (1998), an organization’s intellectual capital is composed of human capital, structural capital, and customer capital. Human capital is the tacit knowledge or know-how that resides in the minds of the organization’s employees and cannot be owned by the company. Structural capital relates to the knowledge from which an organization can derive value as well as the knowledge that “describes or defines the ways in which the firm operates” (p. 179). The latter includes the definition of the structure and organization of the company, operational or technical methods and procedures, administrative and managerial methods and analysis, and the “collective ethos or way of doing business” (p. 179). Customer capital includes the knowledge embedded in the relationships with the company’s customers. According to Sullivan (1998), structural and customer capital encompass both tacit knowledge and knowledge codified and captured in a format that can be described and used by others. Codified, explicit knowledge is considered the intellectual assets owned by the organization. Some of these intellectual assets can be commercialized and thus legally protected. Sullivan emphasizes that organizations seek to develop intellectual assets and leverage them. Based on the “organizational knowledge” literature, Bontis (1996, 1999) conceptualizes intellectual capital as a second order multi-dimensional construct which includes three sub-domains: (a) the human capital, the tacit knowledge in the minds of the employees; (b) the structural capital, the organizational routines of the business; and (c) the relational capital, the knowledge embedded in the relationships established with customers and the outside environment.

Human capital represents the aggregate knowledge, skills, abilities and other competencies (KSAOs) of an organization’s employees (Ployhart, Weekley, Baughman, 2006). The RBV allows any resource that is valuable, rare, inimitable, and non-substitutable to be a source of sustained competitive advantage (Barney, 1991). Perhaps “the most strategically important of the firm’s resources” (Grant, 1991, p. 110) is knowledge. The focus of the current study is on resources in the form of human capital. While human capital is not as tangible as other forms of capital controlled by organizations, it has been referred to as “the ultimate determinant of organizational performance” (Youndt, Snell, Dean, & Lepak, 1996, p. 836). Human capital has been referred to as the “productive capabilities of human beings” (Snell & Dean, 1992, p. 469), it is in fact more accurately the net productive capabilities of human beings within an organization (Ployhart et al., 2006). The economic view of human capital conceptualizes it as knowledge nested within individuals and views it as existing at the individual level, not the firm (Becker, 1964). Knowledge investments may either reflect general or specific “human capital”. According to Becker, general investments benefit not only the investing firm but all firms, while specific investments have a disproportionate benefit to the investing firm. Because Becker cites hiring costs as a source of specific human capital investment (i.e., it only increases productivity for the investing firm and its value is lost when the employee leaves), it should be noted that most employees within an organization represent at least some portion of firm-specific human capital investment. The value of human capital has been touted by numerous researchers (Dencker, Gruber, & Shah, 2009) and it has often been cited as a source of competitive advantage. Dierickx and Cool (1989) and provides a useful framework for tying together these different conceptualizations of human capital with the RBV to understand how organizations maintain their optimum human capital levels. In many organizations human capital resource levels exist
in a state of constant fluctuation. Staffing levels describe the current state of human capital levels. When the number of employees in the organization is below the number desired the organization is said to be understaffed while too many employees would be found in an overstaffed organization. When an organization is understaffed, qualified applicants will be sought out, high performance work systems are used to recruit and select qualified new hires from potential employees. When these individuals join the organization, human capital accumulation takes place. Once these individuals are hired, they are then trained and deployed within the organization so that their KSAs may add to the organization’s human capital asset stocks, which increases the organization’s staffing level. Eventually turnover occurs and these employees leave the organization (erosion) which results in a reduction of staffing levels. If turnover leads to a reduction in staffing levels which falls below the organization’s targeted level, this cycle is triggered and begins again. Each link in the cycle is important to organizational performance and most have been examined in prior research. Despite the attention given to these interconnected processes, little attention has been paid to the importance of staffing levels. This is especially surprising given the goal of this cycle is to maintain staffing levels so that acceptable levels of human capital exist to guarantee sustainable operations within the organization. Considering the vast number of articles examining the importance of human capital quality, it is surprising that none have examined the importance of quantity. It should be noted that some researchers have examined the effects of human capital loss as a result of turnover, however this only provides us with an incomplete picture of human capital levels within an organization. It is impossible to fully comprehend asset stocks when we focus solely on assets flowing from the organization but ignore the flow of assets entering the organization (Dierickx & Cool, 1989). As long as new employees are hired and trained at a rate that matches organizational turnover then human capital levels remain relatively unchanged. Organizations would benefit from understanding the relationship that exists between human capital and staffing levels. Simply having human capital within an organization is not enough to guarantee success. As organizations struggle to remain competitive, they often downsize which results in remaining employees assuming higher workloads often leading to adverse organizational outcomes (see De Meuse, Marks, & Dai, 2010, for a recent review).

Research Methodology & Approach
Research can be classified as quantitative and qualitative in nature. Quantitative research is the focus of the current study. According to Ary, et al. (2002), quantitative research explains phenomenon by using objective measurement and statistical analysis of numeric data. Quantitative research can be classified as either experimental or non-experimental. Experimental research involves the manipulation of one variable on another variable. Non-experimental research looks for relationships among variables, but does not manipulate them. Three types of non-experimental research include: a) causal-comparative research; b) correlational research; and c) survey research (pp. 24-25). The methodology chosen for the present study is survey research. Survey research provides a broad picture of the subject being studied and provides an easy way to generalize to a population (Salkind, 2000). Many advantages and disadvantages have been cited in regards to survey research. He cites the following advantages: a) the ability to collect a wide scope of information from a large population; b) it deals with a real situation in the sense that a researcher collects data in the actual situation; and c) it provides a first step in developing hypotheses or in identifying more specific problems for research. The disadvantages suggest that survey research can be: a) more extensive than intensive in the sense that it does not dig down to discover deeper issues below the surface; b) demanding of time and money; and c) lacking in external validity (p. 61). The current study will employ a cross-sectional method. Salkind (2000) highlights some of the advantages and disadvantages for using this type of approach. The advantages for using cross-sectional survey research include: a) it is relatively inexpensive; b) the study can be conducted in a short-time span; c) there is a low-rate of subjects who drop out the study; and d) it requires no long-term administration or cooperation between staff and participants. The disadvantages are related to the following: a) it limits the comparability of groups; b) it does not reveal
the continuity of development on a person-by-person case; c) it examines people of the same chronological age who may be of different maturational ages; and d) it does not reveal the direction of changes that may take place in a group (p. 202). For purposes of the current study, the advantages far outweigh the disadvantages for using cross-sectional survey research. The setting of this study, in order to examine reliability and validity of measure in knowledge based organizations, is a survey based case study of 74 managers of Pardis science and technology park in Tehran. Based on literature review we found six construction of our model namely: Knowledge/skill, Customer/relations, Organizational structure, Technology, Human capital, Brand capital.

Structural equation models require a fairly large sample size for effective analysis (Tabachnick & Fidell, 1996). General structural equation models (SEM) are comprised of two interrelated components, a measurement model and a structural model. The measurement model specifies relationships between observed variables (manifest variables) and latent variables (Medsker, Williams, & Holahan, 1994), while the structural model explains the relationships among latent variables. Anderson and Gerbing (1988) advocated a two-step approach starting with the measurement model. The measurement model builds on a priori theoretical foundation to describe or explain the relationship between the underlying latent factors and the empirical measures. Confirmatory factor analysis (CFA) is used to evaluate the measurement model with respect to the degree to which the data are consistent with the proposed model. Thus, testing whether the observed variables represent the latent variables well and the overall fit of the measurement model needs to be done prior to testing the proposed structural model (Anderson & Gerbing, 1988). It is very common to consider the re-specification of a baseline measurement model when the initial model fails to fit the data adequately. Re-specification of the model, however, is controversial in that a re-specified model with an improved fit to the data may not be the best-fitting model in the sense that it capitalizes on chance co variation in the sample data and thus, compromises the generalize ability of the model (MacCallum, Roznowski, & Necowitz, 1992).

Data Analysis & Findings

The likelihood that the model capitalized on chance is reduced considerably with cross-validation. A number of fit statistics are applied to assess the goodness-of-fit of the model. Measures of fit include the goodness-of-fit index (GFI), the adjusted goodness-of-fit (AGFI), the comparative fit index (CFI), the normed fit index (NFI), the Tucker-Lewis coefficient (TLI) which is also called the Bentler-Bonett non-normed fit index (NNFI), and the root mean square of approximation (RMSEA). Values over 0.9 on the four indexes GFI, AGFI, TLI, and NFI indicate reasonable fit (Jöreskog & Sörbom, 1996). The CFI is the least affected by sample size and values of CFI over 0.9 indicate a reasonable fit and values over 0.95 represent a good fit (Holmes-Smith, 2001). RMSEA represents the discrepancy per degree of freedom, which is measured in terms of the population, not only in the sample used for estimation. RMSEA is relatively robust to sample size and values between .00 and .05 indicate a close fit, values between .05 and .08 indicate reasonable fit, and RMSEA greater than 0.08 reflects a poor fit (Browne, 1993).
Figure 1: Scale Model for Measurement of Intellectual Capital

Chi-Square=19.01, df=9, P-value=0.02511, RMSEA=0.193

Figure 2: T-Student Statistics and Relationships Significance

Chi-Square=19.01, df=9, P-value=0.02511, RMSEA=0.193
Figure 3: Modification on Model for RMSEA decline

Chi-Square=19.01, df=9, P-value=0.02511, RMSEA=0.193

Figure 4: Standardized Model after Modification

Chi-Square=0.52, df=8, P-value=0.38430, RMSEA=0.047
To gain the reliability of model, a panel of Experts were informed on the study and provided directions in order to critique the proposed instrument for improvement. The experts were asked to categorize and rate the entire instrument and each item within the questionnaire for content, clarity, wording, format, and thoroughness, ease of use, focus, and appropriateness. The panel of experts allowed for the examination of face and content validity to ensure the items developed obtain the proper results. This procedure identified if any questions needed updating due to new developments in the field of service quality and safety quality. Moreover, a confirmatory factor analyses (CFA) was carried out to assess the validity of the questionnaire. In other words, this analysis assessed the fit between the data and the specified CFA Measurement Model. The second set of analyses tested the structural model.

Discussion & Conclusion
How do organizations identify and react to changes that originate outside their boundaries? This question is fundamental to both organization theory and strategic management. Organization theory scholars that draw on the organizational learning literature suggest that the ability to simultaneously explore new knowledge and to exploit existing knowledge allows an organization to continuously adapt to changing environments and this is named intellectual capital (Levinthal and March, 1993; March, 1991). The ability of an organization to concurrently pursue exploration and exploitation has been described as ambidexterity (O’Reilly and Tushman, 2007), because engaging in exploration requires fundamentally different routines, processes, and skills than those necessary for exploitation. To answer the question of how organizations identify and react to changes that originate outside their boundaries, strategy scholars have recently begun to advance a dynamic capabilities perspective. They suggest that a firm’s “ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” lies at the center of its capability to not only adapt to changing environments (Teece, Pisano, and Shuen, 1997: 516), but also to introduce favorable market change (Eisenhardt and Martin, 2000). Thus, a dynamic capability has been defined as “the capacity of an organization to purposefully create, extend, or modify its resources base” (Helfat et al., 2007: 4). Key to understanding dynamic capabilities, therefore, is the organization’s ability to alter its resource base in a repeatable and reliable fashion, as guided by the organization’s strategic intent. In their recent theoretical treatise, O’Reilly and Tushman (2007) synthesized these two theoretical perspectives to suggest that ambidexterity is an important dynamic capability. The creation and maintenance of this dynamic capability, therefore, requires that an organization not only engages in exploration to create new capabilities, but also that the organization builds on and exploits current capabilities as well. While it is readily apparent that managers have at their disposal multiple mechanisms to build dynamic capabilities (for an overview see Helfat et al., 2007), we have virtually no understanding of the nuanced contingency effects that arise when different antecedents to dynamic capabilities within and across the dimensions of the exploration-exploitation framework are employed simultaneously. The critical theoretical dimension that we highlight, therefore, is whether the different dynamic capability mechanisms that firms use to build and change their resources are exploratory or exploitative in nature. We focus here in on one mechanism that firms can employ to build dynamic capabilities: recruiting and retaining of
intellectual human capital while explicitly controlling for acquisitions. Our choice in focusing on this mechanism stems from the fact that expertise in these activities are representative of dynamic capabilities that allow firms to access and build new capabilities in order to change their existing resource base (Gulati, 1998; Cockburn and Henderson, 2001), and thus to develop new processes, products, or services. While some of these mechanisms have been studied in isolation in prior research (Zucker and Darby, 1997; Gardner, 2005), we know very little about the simultaneous effects of these mechanisms on innovative performance in general (Rothaermel and Hess, 2007). We know practically nothing about the simultaneous effects of leveraging different types of intellectual human capital and different types of strategic alliances in an effort to modify a firm’s existing resources or to create new resources. In high velocity industries antecedents to innovation often come from outside of the organizational boundaries (Powell et al., 1996). Therefore, in such industries, an organization’s innovative performance is inextricably linked to its ability to create and manage connections with other organizations. Prior research investigating the importance of this connectivity has primarily focused on the important role strategic alliances play in developing an organization’s ability to access sources of external knowledge (Hagedoorn, 1993; Gulati, 1999; Rothaermel and Deeds, 2004). It is important to note however, that this capability is also related to the firm’s scope of collaborations; both formal (strategic alliances) and informal (interpersonal) relationships (Powell et al., 1996).
References:


