

Knowledge Assets and Firm Performance: An Empirical Approach Examining the Causal Ambiguity Paradox

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Abstract

In the new economy, the sustainable competitive advantage of business firms flows from the creation, ownership, protection and use of difficult-to-imitate commercial and industrial knowledge assets. Such assets include tacit and codified know-how, both technical and organizational. Competitive advantage undergirded by such assets can be sustainable to the extent to which it is transferable and useable inside the firm, but difficult for outsiders to access and/or recreate. Knowledge management can be used to describe the plethora of procedures and techniques used to get the most from a firm's knowledge assets.

Resource-based theory argues that resources must be valuable, rare inimitable, and lack substitutes to confer competitive advantage. Although scholars recognize a positive relationship between causal ambiguity and inimitability, the relationship among critical resources called competencies, causal ambiguity, and firm performance remains an unresolved conundrum.

This paper takes a resource-based view to develop and test hypotheses that relates managers' perceptions of causal ambiguity to their firm's performance. The hypotheses examine relationships between firm performance and (1) causal ambiguity regarding the link between competencies and competitive advantage, and (2) causally ambiguous characteristics of competencies.

Research involving 105 executives in 15 organizations provides valuable insights into the relationships between causal ambiguity and firm performance. Particular consideration is given to the differing ways top and middle managers in a firm may experience causal ambiguity and to how these differences may be understood and managed.

Keywords: Knowledge Management, Firm Performance, Resource-Based Theory, Competitive Advantage

1. Introduction

Now, as in the past, people use face-to-face and “hands-on” methods to convey their “know-how” or tacit knowledge to others (Hansen, et. al., 1999).

Knowledge belongs to the family of steadily increasing corporate assets, like management systems, brand identity, customer information and corporate reputation (Pascarella, 1997). Knowledge is a human, highly personal asset and represents the pooled expertise and efforts of networks and alliances. Reportedly, 99 percent of the work people do is knowledge based (Wah, 1999b).

Knowledge management, an ongoing process, finds value and use for raw information, which is shared across organisational boundaries (Bonner, 2000). This process guides the organisation’s development and exploitation of tangible assets and intangible knowledge resources (McCune, 1999). *“Knowledge management is a formal, directed process of determining what information a company has that could benefit others in the company and then devising ways to making it easily available”* (Liss, 1999, p. 1). Steps in this process include how knowledge is captured, evaluated, cleansed, stored, provided and used (Chait, 1998).

The management of knowledge is increasingly considered as a main source of competitive advantage for corporations (Grant, 1996; Hedlund and Nonaka, 1993; Prahalad and Hamel, 1990; Prusak, 1996; Roth, 1996). It is argued that companies enjoy a competitive advantage if they know how to expand, disseminate, and exploit organizational knowledge internally (Bierly and Chakrabarti, 1996; Szulanski, 1996), if they know how to protect their knowledge from expropriation and imitation by competitors (Liebeskind, 1996), if they know how to effectively share with, transfer to, and receive knowledge from business partners (Appleyard, 1996; Mowery, Oxley, and Silverman, 1996), and if they are able to effectively source knowledge from distant locations (Almeida, 1996).

In today’s environment, much of the knowledge that companies possess and value will provide only a transient competitive advantage. Moreover, core competencies can turn into core rigidities impeding performance, if changes in an industry, or advances by one’s competitors, are not countered by the ability to rapidly develop and spread new knowledge.

Although research in this field is still expanding, it appears that first attempts are being made to identify strategies, which help organizations to better manage their knowledge. Some researchers have emphasized organizational learning as a source of competitive advantage (Bierly and Chakrabarti, 1996; Inkpen, 1995; Rahim, 1995; Spender, 1994). Others have explored strategic implications of learning barriers (Levinthal and March, 1993; Nordhaug, 1994; Szulanski, 1996). Again, others have emphasized knowledge creation (e.g., Nonaka and Takeuchi, 1995) and still others have emphasized replication and transfer of knowledge (e.g., Zander and Kogut, 1995).

There are two paths by which companies can use knowledge to create sustained competitive advantage (Lubit, 2001). First, companies can act to internally spread knowledge that other companies will find almost impossible to copy, that is, tacit knowledge. Second, companies can create superior knowledge management capabilities and thereby foster on both tacit knowledge and outstanding knowledge management capabilities can be the basis for sustained competitive advantage in today's economic environment.

An important means to effective management of knowledge flows is the codification (articulation) of organizational knowledge. When organizations codify their knowledge, they package it into formats that facilitate knowledge in formulas, codes, expert systems, etc.

Codification can greatly facilitate flows of organizational knowledge between departments or subsidiaries, and thereby help to identify new opportunities or emerging threats across markets and geographical regions. However, codification is no panacea. Codification can facilitate involuntary transfer of strategic know-how to competitors. From this perspective, organizations might abstain from codification and choose to keep their knowledge tacit.

Unfortunately, few organisations handle explicit and tacit knowledge effectively (Bonner, 2000). Exceptions are learning organisations that are skilled at creating, acquiring and transferring knowledge and at modifying their behaviour to reflect new knowledge and insights (Garvin, 1993).

2. The causal ambiguity Paradox

Firm performance is a function of how well managers build their organizations around resources that are valuable, rare, inimitable, and lack substitutes (Barney, 1991).

Resources may be protected from imitation in a variety of ways. History-dependent factors (Barney, 1991), Socially complex resources (Dierickx and Cool, 1989; Barney, 1991) and Causal ambiguity (Reed and DeFillippi, 1990; Barney, 1991) protect resources from competitive imitation. The rewards of history dependent factors and socially complex resources are straightforward. The rewards of a causal ambiguity, however, are more complicated.

Causal ambiguity is the ambiguity about the link between firm resources and sustained competitive advantage (Reed and DeFillippi, 1990; Barney, 1991).

The benefits of causal ambiguity arise if causal ambiguity exists among all firms, including the focal firm, regarding the sources of sustainable advantage for the focal firm (Lippman and Rumelt, 1982; Barney, 1991). Although Reed and DeFillippi (1990) dismiss causal ambiguity among managers at the focal firm as an 'extreme' example, causal ambiguity among internal managers is quite plausible given the complexity and messiness of managing strategic resources (Barney, 1991).

Causal ambiguity among managers at a focal firm leads to an interesting and unresolved paradox surrounding the relationship between competencies, causal ambiguity, and sustainable competitive advantage. The crux of the causal ambiguity paradox is that "ambiguity as to what factors are responsible for superior (or inferior) performance acts as a powerful block on both imitation and factor mobility" (Lippman and Rumelt, 1982:420). Thus, while on one hand, causal ambiguity among managers benefits a firm because it protects a firm's competitive advantage from imitation, on the other hand, it may impede imitation of significant resources within the boundaries of the firm. This factor immobility limits managers' abilities to leverage resources for competitive advantage (Reed and Defillippi, 1990).

Research to date has not adequately resolved this paradox. Some research attempts have operationalised firm-level causal ambiguity using random variables in economic modeling (Lippman and Rumelt, 1982), decreasing function of a

firm's age (Mosakowski, 1997), and two-item survey responses by a single-level executive within an organization (Simonin, 1999).

To explore the causal ambiguity paradox from a management perspective, strategic researchers and managers must be able to identify and describe the resources or competencies that are associated with superior performance. Competencies are designed as knowledge sets that distinguish the firm and provide competitive advantage (Leonard-Barton, 1992: 113). Consistently, the resource-based view of the firm recognizes knowledge as a key intangible resource that drives competitive advantage and superior firm performance (Collis and Montgomery, 1995; Conner and Prahalad, 1996; Spender and Grant, 1996). Competencies are a function of individual firm strategies and industry in which organization competes (Collis and Montgomery, 1995).

The risks of causal ambiguity are particularly acute regarding knowledge-based resources because competencies are increasing returns resources (Arthur, 1996) that lose value if they are not applied and shared (Prahalad and Hamel, 1990). Failure to recognize the value of competencies may seriously damage a firm's ability to compete (Cohen and Levinthal, 1990; Bettis, Bradley, and Hamel, 1992).

Causal ambiguity has been examined in the literature in two different ways, but the distinction in these approaches has not been clearly explicated. First, linkage ambiguity is ambiguity among decision-makers about the link between competency and competitive advantage (Barney, 1991). Second, characteristic ambiguity focuses on the characteristics of competencies that can be simultaneous sources of advantage and ambiguity (Reed and DeFillippi, 1990). Characteristic ambiguity is ambiguity inherent to the resource itself. Tacitness is one causally ambiguous characteristic (Szulanski, 1996; Inkpen and Dinur, 1998; Simonin, 1999).

3. Knowledge, codification, and knowledge flows

All too often, knowledge management efforts are limited to creating electronic means to foster knowledge transfer and storage. Far more needs to be done for a company to successfully leverage its knowledge (Lubit, 2001). First, it is

necessary to develop a knowledge-sharing culture. Second, companies need to overcome defensive routines inhibiting open communication. Third, a system of measures and rewards needs to be developed that encourages people to make full use of the electronic means of information transfer and storage. Fourth, there needs to be a knowledge-management department that not only places information in databases, but categorizes it so that people can readily find the information in databases, but categorizes it so that people can readily find the information they seek. Finally, companies need to develop a variety of organizational levers promoting implementation of the best ideas held in the company.

There is a paradox that one must overcome to develop inimitable core competencies based in knowledge. To become the basis for a sustainable competitive advantage, knowledge must be readily spread to other firms. Because tacit knowledge is much harder for competitors to copy than explicit knowledge, the ability to capture and transfer tacit knowledge is the key to developing sustainable competitive advantage.

It is frequently argued (e.g., Barney, 1991; Dierickx and Cool 1989) that immobile is a very competitive advantage for companies. Keeping organizational knowledge immobile is a very competitive strategy especially when the knowledge at hand helps to generate significant returns and when it is difficult to generate. Yet, it is also well known that companies need to keep knowledge resources sufficiently mobile to facilitate coordination between subunits (e.g., Egelhoff, 1991) and to replicate past success when they expand into new international environments (Simonin, 1999).

Finding the appropriate level of mobility of organizational knowledge thus faces a trade off between potentially beneficial intraorganizational knowledge flows and potentially detrimental interorganizational knowledge flows to competitors.

Organizational knowledge does not flow easily by itself. Rather, organizational knowledge flows can be greatly facilitated if knowledge is codified. In his work on private knowledge, Polanyi (1958) distinguishes between “tacit” and “explicit” knowledge. Explicit knowledge consists of knowledge that can be expressed in symbols and can be communicated through these symbols to other people. Tacit knowledge consists of knowledge that is difficult to express and communicate to other people by means of symbols (Hill and Ende, 1994; Spender, 1993). Tacit

knowledge in general is more difficult to transmit than codified knowledge; it travels particularly poorly between organizations (Kogut and Zander, 1993). Efficient transmission of tacit knowledge requires its codification into explicit forms.

HYPOTHESES

Linkage ambiguity is high when managers differ in their beliefs about the contribution of a competency to their firm's competitive advantage. Linkage ambiguity protects a firm's competitive advantage from imitation. Because internal managers are uncertain of the competencies that lead to competitive advantage, it is more difficult for competitors to appropriate value (Lippman and Rumelt, 1982: 420). This protection from imitation helps sustain competitive advantage and may have positive effects in the performance of the firm. In addition, linkage ambiguity within a firm may help sustain competitive advantage by providing access to new conversations, new perspectives, and new experiments that lead to valuable emergent strategies (Hamel, 1998). An abundance of research supports the strategic value of disagreement among key decision-makers. For example, Prahalad and Bettis (1986) suggest that multiple dominant logics increase the likelihood that a firm can perceive relevant alternatives in order to 'respond appropriately' and quickly to unfamiliar situations. Competency traps (Levitt and March, 1988), core rigidities (Leonard-Barton, 1992), and group-think (Janis, 1972) are similar risks that face firms of like-minded individuals. Similarly, the principle of complementarity (Bohr, 1950; Bartunek, Gordon, and Weathersby, 1983) proposes that a variety of perspectives is necessary for understanding and representing most complicated phenomena. High linkage ambiguity, therefore, may provide the organization with a better toolkit to recognize, shape, and respond to a wider range of challenges, and it would have positive performance implications for a firm.

The perceptions of both top and middle managers should be considered to determine how a firm experiences causal ambiguity (Mosakowski, 1997). Because middle managers' perceptions of strategic situations can vary considerably from top managers' perceptions (Westley, 1990), these two groups are considered separately.

Therefore, the following hypotheses are proposed:

Hypothesis 1: *High linkage ambiguity among the top management team (TMT) is positively associated with firm performance.*

Hypothesis 2: *High linkage ambiguity among middle managers is positively associated with firm performance.*

Previous research, however, indicates that shared beliefs by organizational decision-makers are necessary for basic sense making (Weick, 1979; Lyles and Schwenk, 1992). These shared beliefs play an essential role in framing interpretations of complicated events, which include almost all strategic issues (Daft and Weick, 1984; Hambrick and Mason, 1984). High linkage ambiguity, therefore, may threaten organizational success. As Reed and DeFillippi (1990: 90-91) suggest, *'where ambiguity is so great that managers do not understand intra-firm causal relationships, or factor immobility exists, it may be impossible to utilize competencies for advantage'*. Whether this misunderstanding is found among top managers who allocate scarce organizational resources or among the middle managers who are responsible for the day-to-day management of these competencies, the negative implications for an organization are considerable.

Senior managers may make strategic decisions that are inconsistent with important competencies, or they may fail to invest in the development and maintenance necessary to sustain competitive advantage (Hunt and Morgan, 1995). Middle managers may not leverage these competences appropriately, undermining their competitive advantage. Therefore, the following alternative hypotheses are suggested:

Hypothesis 1a: *High linkage ambiguity among the TMT is negatively associated with firm performance.*

Hypothesis 2a: *High linkage ambiguity among middle managers is negatively associated with firm performance.*

As with linkage ambiguity, characteristic ambiguity may have a paradoxical effect regarding competitive imitation, factor mobility, and firm performance. Reed and

DeFillippi (1990: 88-89) suggest that *'when an advantage is based on competencies that have causally ambiguous characteristics, then it will be difficult for competitors to overcome the advantage by imitation'*. Resource-based scholars argue that **tacitness** and **location in a firm's culture** are two causally ambiguous characteristics that increase a competency's potential to confer competitive advantage (Reed and DeFillippi, 1990; Hart, 1995). Tacit competencies are more opaque and inherently more difficult to imitate than articulated knowledge (Winter, 1987; Dierickx and Cool, 1989; Reed and DeFillippi, 1990; Kogut and Zander, 1992). Competencies that reside in organizational culture and values (Leonard-Barton, 1995) are characterized as causally ambiguous (Mosakowski, 1997). They are better protected from acquisition or imitation by competitors, and, therefore, may provide a superior source of competitive advantage (Barney, 1986; Reed and DeFillippi, 1990; Badaracco, 1991). Therefore, the following hypothesis is offered:

***Hypothesis 3:** Organizations with managers who characterize competencies as causally ambiguous (high characteristic ambiguity) are positively associated with firm performance.*

A concurrent risk, however, is associated with characteristic ambiguity: Causally ambiguous characteristics may impede mobility of competencies within an organization, obstructing efforts to sustain competitive advantage (Matusik and Hill, 1998). Knowledge, characterised as tacit that reside in organizational culture and values, is difficult to transfer among organization members (Grant, 1996). Thus, the terms 'core rigidities' or 'traps of distinctive competencies' used by many authors (Leonard-Barton, 1992 and 1995; Levinthal and March, 1993; Argyris, 1993). Szulanski (1996) found that causally ambiguous knowledge characteristics, including location and tacitness, erected significant barriers to the transfer of best practices within organizations. These barriers would obstruct an organization's ability to transfer and leverage competencies for sustained competitive advantage. Therefore, the following alternative hypothesis is offered:

Hypothesis 3a: Organizations with managers who characterize competencies as causally ambiguous (high characteristic ambiguity) are negatively associated with firm performance.

METHODS

Empirical research on organizational knowledge is still in its infancy. In many areas, theory development has not yet advanced to a level that warrants elaborate scale development. This study explores a number of novel theoretical constructs for which limited empirical precedent exists. Due to the exploratory character of this study, the scales developed and used are necessarily experimental, and the database is limited. We thus regard our empirical analysis more as an illustration of our theoretical ideas than as a definitive test. Nevertheless, the results presented below give rise to interesting insights regarding knowledge assets and firm performance and do not display obvious symptoms of biases. Hopefully, these results will stimulate future studies, which may develop more elaborate scales and gather more comprehensive data. This study suggests that doing so would be very worthwhile.

To explore the critical relationships among causal ambiguity, competencies, and firm performance, competencies must be specified in usable ways. Competency is an often used but poorly defined and measured concept (Schendel, 1996: 3). Managers cannot refer to objective accounting data or market valuations; valuable resources such as competencies must be considered within limited industry and temporal contexts (Collis and Montgomery, 1995: 120; Glazer, 1998). A crucial step, therefore, was to identify competencies and measure causal ambiguity within these relevant contexts.

New approaches to data collection and analysis are required to examine the causal ambiguity paradox. The key methodological challenges were: (1) identification of a comprehensive range of competencies; (2) identification or development and testing of measures of causal ambiguity; and (3) quantitative tests to explore key relationships.

Sample selection

We must note here that this study is only part of a bigger research project, started at the beginning of this year and will last for three years, which tries to examine the stated hypotheses of the previous section in as many Greek industries (and companies within each industry) as possible and in different time periods. So, in this paper we are trying to explore the critical relationships mentioned above, starting with data just received from only one industry, the truck international transport industry.

Exploring causal ambiguity as managers experience it requires a focus on managers' perceptions of the characteristics of these competencies, as well as their perceptions of relationships between competencies and competitive advantage. Many competencies are inextricably tied to an *'industry recipe...this body of knowledge which everyone who knows this industry understands'* (Spender, 1989: 6). Multiple respondents per industry, combined with the insight of outside experts in each industry, provide valuable opportunities for triangulation about competencies in that industry. Comparison within industries also provides a compelling context for measuring relative levels of causal ambiguity. In addition, analysis of many industries allows for comparison across subsamples for insight into systematic differences and similarities between industries.

Data were drawn from 15 organizations of the international transport industry. To gain access to at least 15 organizations, 30 firms were solicited to participate in the study. The sample was selected to cover a wide range of performance in the industry. The CEO of each organization was sent a letter describing the project and requesting an interview. Once 15 organizations agreed to participate, the researchers contacted the CEOs who were undecided and informed them that the study sample was complete. Within the industry, t-tests conducted on the most recent performance data indicated no significant differences among: (1) the sample universe, (2) the final sample selected for the study, (3) the firms that refused to participate, and (4) a combination of the firms that refused to participate and those that were undecided regarding participation.

Data collection

On-site interviews were held with the chief executive of each organization in the sample to generate a comprehensive list of specific and timely competencies for that industry. All four researchers conducted these interviews; each interview lasted between 1 and 2 hours. A protocol of open-ended questions was used to identify a range of competencies, based on discussions with two industry experts and a previously contacted similar research for the textile manufacturing and hospital industries (King and Zeithaml, 2001). All CEOs expressed great interest in the topic, and they were anxious to learn the perspectives of their managers regarding the organization's competencies. The conclusions of the researchers regarding the organization's competencies were subsequently confirmed in writing with each CEO. Based on these interviews, 23 different competencies were identified in the international transport industry. In addition, the researchers explored the characteristics of one or two key competencies. Each CEO also supplied the researchers with the names of all TMT members (the CEO and all direct reports) and three to six middle managers, whose responsibilities placed them approximately midway between CEO and the lowest-level managers.

Surveys were sent to all identified managers. A total of 105 usable surveys were returned. Overall response to the survey was outstanding, 87.5 percent for the whole industry. Response rate by organization ranged from 75 percent to 100 percent. A copy of the survey is available from the researchers. Table 1 provides an overview of the demographics of the respondents.

Table 1. Demographics of respondents

International Transport		Top managers		Middle managers		
Firm	Age	Company tenure	Years in industry	Age	Company tenure	Years in industry
IT1	55.6	22.4	27.7	51.2	17.8	20.3
IT2	52.0	20.5	25.4	43.3	12.6	16.2
IT3	51.8	14.0	23.7	40.1	7.9	13.8
IT4	54.5	8.8	26.6	47.4	14.3	22.8
IT5	50.7	12.4	20.9	46.6	10.2	16.2
IT6	47.8	16.3	20.2	37.8	9.8	14.6
IT7	44.3	6.8	16.7	43.4	15.9	20.9
IT8	47.4	16.8	18.5	46.2	15.7	22.2
IT9	48.0	21.6	25.2	36.9	7.2	12.9
IT10	47.6	18.0	23.7	43.0	15.8	18.0
IT11	54.7	14.8	26.2	45.2	9.5	19.4
IT12	47.2	10.5	19.8	42.5	10.1	20.2
IT13	52.2	20.4	22.4	46.6	8.5	24.4
IT14	43.5	4.5	14.5	34.9	4.2	10.2
IT15	46.3	6.9	19.3	41.4	10.4	17.5

Linkage ambiguity

One hundred and five executives evaluated competencies. Each executive indicated, on a +3 to -3 scale, whether his organization was at an advantage or disadvantage with respect to its competition for each competency. Participants were not informed about the perceptions of the CEO regarding their own organization's competencies.

Prior research provides a theoretical rationale for the existence of competency categories (Porter, 1985; Henderson and Cockburn, 1994; McGrath, MacMillan, and Venkataraman, 1995; Miller and Shamsie, 1996). Following the survey therefore, principal component analysis was conducted on the scaled responses to aggregate managers' perceptions of competencies into categories or types of competencies. Bartlett's test of sphericity displayed levels of correlations indicating that a factor model was appropriate ($p < 0.001$) (Norusis, 1994: 50). In addition, the sample exceeded the acceptable level (0.6) on the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy having a level of 0.747 (see Appendix).

Varimax rotation was used to identify a set of factors that were uncorrelated with each other. The survey revealed categories or types of competencies that were logical and fit with past categorizations. The Appendix contains examples of factors. Factor scores were assigned to each respondent. A factor score measured each respondent's perception of the importance of each factor in contributing to the relative competitive advantage of his or her organization.

To measure linkage ambiguity, average Euclidean squared distance (henceforth called Euclidean distance) among members of a team was used. Euclidean distance, an accepted measure in the literature (Walsh, Henderson, and Deighton, 1988), begins with the calculation of distances between each pair of individuals within a designated group. For a dyad, distance is measured by summing the squared differences between individual responses to an identified set of questions. A high distance score regarding competencies implies high linkage ambiguity among members of that organization. A team score is then derived by summing the distances between each unique dyad within a team and dividing the sum by the number of unique dyads.

Linkage ambiguity was measured based on distances derived from all competency factor scores for that industry (seven in total). The level of ambiguity was assessed relative to other organizations in the industry and was assessed at two levels: among top managers and among middle managers.

Characteristic ambiguity

Characteristic ambiguity was measured using responses to questions from a modified scale by Zander and Kogut (1995) and a newly developed measure of knowledge location based on Leonard-Barton (1995). To measure tacitness and culture location, managers were asked a set of questions about two individual competencies. Each manager answered questions regarding the competency that he/she considered most important to the firm's current success. In addition, each manager answered the same set of questions regarding the competency of 'cost containment'¹. This competency was selected because interviews and other research prior to the finalization of the survey indicated that this competency was critical for success in every industry².

Tacitness

With regard to the competency in question, managers were asked to assess four statements, modified from Zander and Kogut (1995), on a 7-point scale. Principal component analysis was then conducted on these four items, revealing two stable two-item factors that were consistent with Winter's (1987) dimensions of tacitness. The second factor represents managers' perceptions that the competency has been articulated. The first factor represents managers' perceptions that the competency is articulable. Table 2 provides a summary of the instructions, questions, and factors that the ambiguity characteristic measures. Tacitness was measured based on the

¹ In cases where a manager indicated that 'cost containment' was the most important competency, he/she was asked to answer questions regarding the competency perceived as second most important for the firm.

² The survey responses supported this approach, as cost containment was the most frequently mentioned response to the question, 'What are the three most important competencies to your firm's current success?'

mean value of the two factor scores for each firm, and was assessed at two levels: among top managers and among middle managers.

Knowledge location

Competency culture was measured using a forced-choice question based on Leonard-Barton's (1995) framework. Managers were asked to allocate 100 points among the four locations, depending on how similar they thought each knowledge location was to their own organization: (1) employee knowledge and skill; (2) physical systems such as computer data bases, equipment, and software programs; (3) carefully designed education and incentive systems that support and reinforce knowledge growth; and (4) organizational mission, culture, or values that screen and encourage different kinds of knowledge. This approach gave respondents the opportunity to indicate both the type of knowledge location that characterized their organization and the strength of the location (i.e., the more points given to a specific location, the stronger, or more dominant, the knowledge location type was). Knowledge location was measured based on the highest mean value of the four locations, specifically the mean value of the fourth location, and was also assessed, for each organization, at two levels: among top managers and among middle managers.

The rationale for this type of question is that underlying assumptions related to organizational knowledge location are more likely to emerge from questions that ask respondents to react to already-constructed conceptual frameworks than from questions asking respondents to generate the descriptions themselves (Beck and Moore, 1985; Martin and Powers, 1983). The questions were intended to serve as mirrors, where respondents rated the familiarity of each different reflection³.

³ A study by Zammuto and Krakower (1987) used this same instrument to assess culture in organizations, and they produced several analyses of its construct validity.

Table 2**Characteristic ambiguity measures. Tacitness instructions, questions and factor matrices.**

Instructions: please circle the number from 1 to 7 which describes how much you agree with each statement

1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neither agree nor disagree, 5= slightly agree, 6=agree, 7=strongly agree.

1. In my firm, extensive employee training is offered specifically regarding this competency (TRAINING).
2. There is extensive written documentation of this competency in my firm (WRITDOC).
3. A useful manual or handbook to describe the knowledge necessary for this competency could be written (MANUAL).
4. A competitor could acquire this competency by analyzing trade or other publicly available publications (TRADEPUB).

	A Most important		B Cost Containment	
	Factor 1*	Factor 2*	Factor 1*	Factor 2*
WRITDOC	0.553	0.589	0.179	0.813
TRAINING	0.014	0.937	0.004	0.856
TRADEPUB	0.864	0.202	0.886	0.009
MANUAL	0.881	0.009	0.874	0.138
Eigenvalue	2.13	0.96	1.89	1.11
Cumulative percent variance explained	53.16	77.24	47.43	75.13

*Factor 2 captures whether the knowledge is articulated; Factor 1 captures whether it is articulable.

Knowledge location (culture) questions: Valuable competencies can be located in a variety of places in the firm. Please take a moment to review four ‘places’ we have listed. With regard to this competency at your firm please distribute 100 points among the four places to indicate where this competitive advantage is located at your firm.

- _____ points employee knowledge and skill
- _____ points physical systems such as computer data bases, equipment, and software programs
- _____ points education and incentive systems that support and reinforce knowledge growth
- _____ points organizational mission, culture, or values that screen and encourage different types of knowledge

Total 100 points

Control variables

This study included two control variables: organization size, and team size. Organization size is a powerful explanatory variable regarding organization performance (Weiner and Mahoney, 1981; Wernerfelt and Montgomery, 1988). In addition, Blau (1970) established that organization size plays an important role in organization information processing. By definition, middle managers in this study have responsibilities that fall approximately midway between the CEO and the lowest-level managers. The level of information and knowledge sharing between top and middle managers, which influences causal ambiguity, may be a direct function of organization size. Organization size was based on organization sales.

Finally, team or group size may be an important factor in considering causal ambiguity. Large TMTs may be able to manage a wider variety of organization competencies and tolerate a wider range of viewpoints. Conversely, inclusion of, or responses by, relatively large numbers of middle managers may indicate an infrastructure of communication and inclusivity that facilitates shared knowledge among and between levels outside the TMT. The number of managers in each group, therefore, was included as a control variable (King and Zeithaml, 2001).

Dependent variable

The dependent variable in the model is firm performance. A rich and long tradition operationalizes firm performance based on financial data from secondary sources, such as return on assets (ROA), return on invested capital, and return on sales (Rumelt, 1974; Bettis, 1981; Christensen and Montgomery, 1981). ROA presented several advantages as a measure of performance. Hill, Hitt, and Hoskisson (1992) argue that this measure provides superior relative year-to-year stability *vis a vis* other measures. ROA continues to be accepted in the current literature (Wiersema and Bantel, 1993; Baliga, Moyer, and Rao, 1996), and, in particular, in studies regarding knowledge strategies (Bierly and Chakrabarti, 1996).

Measures of association

Relationships were tested using Pearson correlations with controls. Correlation relationships with a *p*-value of less than 0.10 were considered significant in this

analysis. This significance level was consistent with other empirical studies of complex organization-level issues that used similar methodologies (Woodridge and Floyd, 1990).

RESULTS

Hypothesis 1 asserts that linkage ambiguity among the TMT is positively related to firm performance. Tests, however, revealed marginal support ($p < 0.10$) for the alternative hypothesis, Hypothesis 1a, indicating that higher-performing firms tended to exhibit low levels of linkage ambiguity. Top managers in higher-performing organizations were more likely to agree on the 'competencies that contribute to competitive advantage than top managers in lower performing organizations.

Hypothesis 2 predicts that middle-management linkage ambiguity is positively related to firm performance. Again, the findings revealed support for the alternative hypothesis. Hypothesis 2a was also marginally supported ($p < 0.10$), indicating that low linkage ambiguity among middle managers is associated with higher firm performance. Table 3 summarizes the correlation results for these hypotheses.

In sum, the empirical results revealed consistent evidence regarding the first two hypotheses. Support was found for the assertion that linkage ambiguity is negatively related to firm performance at the TMT and middle-management levels. These findings contradict the rationale of the primary hypotheses, which maintains that high levels of linkage ambiguity among internal managers are necessary to sustain competitive advantage. In other words, with regard to linkage ambiguity, the *advantages* of factor mobility appear to outweigh the *disadvantages* of increased risks of imitation.

Table 3. Hypotheses 1, 2 and 3: summary and results

Hypothesis (N = 15)	Correlation***	Interpretation
H1a) High linkage ambiguity among the TMT is <i>negatively</i> associated with firm performance	-0.3529* (-0.3730*)	H1a supported (marginal)
H2a) High linkage ambiguity among middle managers is <i>negatively</i> associated with firm performance	-0.3648* (-0.4545**)	H2a supported (marginal)
H3) Organizations with managers who characterize competencies as causally ambiguous (high characteristic ambiguity) are <i>positively</i> associated with firm performance:		
• Tacitness among TMT	0.4120*(0.4473*)	H3 supported (marginal)
• Tacitness among middle managers	0.4436** (0.4648**)	H3 supported
• Culture location among TMT	-	-
• Culture location among middle managers	-	-
H3a) Organizations with managers who characterize competencies as causally ambiguous (high characteristic ambiguity) are <i>negatively</i> associated with firm performance:		
• Tacitness among TMT	-	-
• Tacitness among middle managers	-	-
• Culture location among TMT	-0.0476 (0.2473)	Not supported
• Culture location among middle managers	-0.3756*(0.3716*)	H3a supported (marginal)

**p < 0.05; *p < 0.10 .

*** The numbers in parentheses indicate the research result findings of a similar study for the textile manufacturing and hospitals industries (King and Zeithaml, 2001). As we can see, we agree in all hypotheses, except for hypothesis 3a on the knowledge location characteristic.

Hypothesis 3 proposed that firms in which important decision-makers characterize key competencies as causally ambiguous are associated with high firm performance. With regard to tacitness, support was found at both the TMT (marginal, $p < 0.10$) and middle-management levels ($p < 0.05$). As predicted, TMT members and middle managers in higher-performing organizations described their competencies as more tacit than managers from lower-performing organizations.

With regard to culture location, the alternative hypothesis 3a was marginally supported at the mid-level manager level ($p < 0.10$). However, findings at the TMT level were not significant. Here we have similar results with those of linkage ambiguity: low levels of characteristic ambiguity are related to firm performance, or high levels of characteristic ambiguity are negatively associated with firm performance.

In sum, low linkage ambiguity, particularly among middle managers on competitively superior competencies, is positively related to firm performance. In addition, middle managers in higher-performing organizations characterize their competencies as more tacit, whereas the middle managers in lower performing organizations characterize their competencies as more likely to be located in an organization's culture. Top managers in higher-performing organizations tend to characterize their organization's competencies as more tacit. Results did not reveal that TMT perceptions of culture location were related, either positively or negatively, to firm performance.

DISCUSSION

The results reveal that the dominating influence in the paradox depends on the causal ambiguity lens that is applied. The first lens, linkage ambiguity, focuses on managers' perceptions of the link between resources and competitive advantage. The second lens, characteristic ambiguity, focuses on managers' perceptions of the resources themselves. Consideration of both lenses is both theoretically and practically important. The implications of each, and their possible interrelationships, need to be examined and incorporated into a framework for understanding competencies, inimitability, and firm performance.

These results contest arguments that linkage ambiguity is necessary to sustain competitive advantage. Instead, the findings suggest that low linkage ambiguity, particularly by middle managers on the 'core' competencies (Prahalad and Hamel, 1990; Leonard-Barton, 1995), may provide a firm with great abilities to recognize, appropriate, and transfer competencies for competitive advantage (Cohen and Levinthal, 1990; Garud and Nayyar, 1994). The potential factor mobility associated with low linkage ambiguity may sustain the competitive advantage derived from competencies because knowledge may be assimilated and transferred among internal managers for use throughout an organization. Management consensus on competencies (low linkage ambiguity) may indicate an established base of related knowledge. This

base provides a valuable platform for sustaining competitive advantage by recognizing, importing, sharing, and exploiting external and internal knowledge throughout the organization.

In particular, the results suggest that middle managers may be the most direct catalysts for factor mobility of key competencies within a firm. Middle managers are engaged in the challenging process of developing and exploiting competencies. When these managers agree on the competencies that contribute to firm success, they are better prepared to exploit key competencies, to assimilate and share new knowledge, and, therefore, to contribute to the success of a firm (Floyd and Wooldridge, 1994: 47).

Monitoring middle managers' perceptions about key resources is more easily said than done. The number and geographic dispersion of middle managers make them more difficult to track than the TMT. Recent models of knowledge management (Hedlund, 1994; Nonaka and Takeuchi, 1995; Sherman, 1996) focus on middle managers, and particularly on the role that they play in transferring and leveraging knowledge throughout the organization. Empirical strategic research, however, continues to marginalize middle managers as valuable strategic decision-makers. By considering the roles of top and middle managers in terms of the causal ambiguity paradox (factor vs. inimitability), the findings of this study provide a new perspective, and important empirical support, for middle managers as critical managers of competencies, and factor mobility, in an organization.

This study also extends the understanding of the relationship between causally ambiguous characteristics and firm performance. Based on survey results and the analysis of CEO interviews, middle and top managers may experience causal ambiguity differently in some circumstances.

Empirical evidence consistently supports a relationship between managers' perceptions of competency tacitness and firm performance. Both top and middle managers in successful firms are more likely to believe that their organizations' important competencies are tacit than managers in less successful firms. These findings are consistent with previous research. Spender (1993) maintains that competitive advantage originates from tacit knowledge. In ethnographic studies, Brown and Duguid (1991: 40) observed that organizational value is created and sustained from knowledge communicated in 'communities-of-practice' that 'usually differ fundamentally from the ways organizations describe that work in manuals,

training programs, organizational charts, and job descriptions'. Although previous theory and ethnographic observation indicated the importance of the tacit characteristic to organizational success, this research reveals empirically the relationship between managers' perceptions of tacitness regarding organization-level competencies and firm performance. While tacitness may impede the speed of transfer of competencies in an organization, it appears that the advantages of competitive inimitability outweigh the disadvantages to factor mobility.

The results regarding organizational culture, however, differed by managerial level; additional insights into differences in the types of responsibilities between middle and top managers may explain these findings.

An insignificant relationship between culture location and firm performance among top managers may reveal an ongoing tension top managers face. Top managers of successful organizations may recognize that building competencies that reside in organization culture helps build and sustain competitive advantage. Changes in the environment, however, put the value of competencies that reside in organization culture at risk. Successful top managers often assume responsibility for continually scanning the competitive environment to ensure that current organizational resources add value in the face of environmental change (Hambrick, 1982; Hambrick and Mason, 1984; Daft, Sormunen, and Parks, 1988). Top managers who engage in a 'process of gently upsetting preconceptions of what the organization is doing' (March and Olsen, 1976: 80) help ensure that organizational solutions change with the environment and organizational imperatives. Top managers, therefore, may continually question the organization culture, particularly under the new conditions of the global competition.

Managing organizational culture, however, is considered outside the range of middle managers. Middle managers instead are engaged in the challenging process of developing and exploiting competencies. Middle managers in successful firms tend to describe competencies as more firmly embedded in a difficult-to-imitate company culture. This knowledge is not only more difficult to imitate because of its complexity, but also is better protected from imitation due to moral hazard (Spender, 1993). These perceptions may provide middle managers with psychological protection, allowing them to take risks and make commitments necessary to exploit and sustain competencies (Schein, 1984; Hirschhorn, 1990). Organizations, therefore, may be more successful when middle managers operate in an environment where their confidence in a competency's causal

ambiguity to competitors encourages them to share knowledge and exploit competencies. These actions, in turn, help sustain competitive advantage of these competencies.

On the other hand, as our empirical evidence suggest, organizations should always have in mind the flip side of the core competencies, the so-called 'core rigidities'. As we have discussed previously, this is one of the main duties of the TMT. In our study the results show that organizations with middle managers, who characterize competencies (as far as culture location is concerned) as causally ambiguous (high characteristic ambiguity) are negatively related with firm performance. Concerning knowledge location, Leonard-Barton (1995: 24-27) says: *'Some corporate values are generic: they apply to human interactions within the corporation in general or to a general outlook on life. At the same time, values can be more limited in scope. They are concerned with the choice of technology, the value placed on types of knowledge, or on the way in which generic values are operationalized. They contribute to the strategically significant technological capabilities that distinguish one company from another. However, these values are by far the most difficult dimension to alter and thus could lead to core rigidities'*.

CONCLUSIONS-IMPLICATIONS

The linkage ambiguity findings challenge previous theory (Lippman and Rumelt, 1982) regarding the risks firms face when managers clearly understand the link between resources and competitive advantage. Characteristic ambiguity may help explain these findings. The paradox, therefore, may be resolved by explicating the implications of linkage ambiguity, characteristic ambiguity, and competitive advantage by managers at a focal firm. Barney suggests this approach when he outlines the steps by which causal ambiguity is related to sustainable competitive advantage: *'If a firm with a competitive advantage understands the link between the resources it controls and its advantage, then other firms can also learn about the link, acquire necessary resources (assuming they are not imperfectly imitable for other reasons), and implement the relevant strategies'* (Barney, 1991: 109). This study tries to explore the implications of the link (linkage ambiguity) and the 'other reasons' (characteristic ambiguity) from the perspective of managers at a focal firm.

This research revealed that causally ambiguous characteristics regarding key competencies were associated with higher firm performance. The findings,

particularly with regard to tacitness, indicate a significant, positive relationship between causally ambiguous characteristics and firm performance. Consistent with this and previous theory, the findings suggest that all characteristics that protect competencies from imitation, such as enforceable property rights (Porter, 1980; Lippman and Rumelt, 1982) and reputation (Dierickx and Cool, 1989; Barney, 1991), sustain value to a firm.

The linkage ambiguity findings revealed a consistent pattern that low linkage ambiguity is associated with higher firm performance. The risk of competitive imitation appears modest even if the link between competencies and their advantage is quite clear among key managers. These findings indicate that efforts to decrease linkage ambiguity among key decision-makers, and particularly middle managers, offer greater reward than risk despite imitation pressures.

These findings may be explained if linkage ambiguity acts as a mediator in a relationship between competency characteristics and firm performance. In other words, the outcome of the linkage ambiguity paradox may be determined by the inimitability characteristics of the competency in question. If characteristic inimitability is high and linkage ambiguity is low (managers clearly understand the link between competencies and performance), competitors may not be able to imitate these competencies due to the characteristics of these competencies (Barney, 1991). Competitive advantage, therefore, is sustained. If competencies are not characterized in ways that protect them from imitation (which may include not only causally ambiguous characteristics, but also other characteristics such as legally protected property rights), high linkage ambiguity provides the only possibility for inimitability. In these circumstances, linkage ambiguity sustains competitive advantage and contributes to firm performance. **Considering both linkage and characteristic ambiguity, therefore, elucidates the causal ambiguity paradox.**

The findings also suggest that senior executives should work to develop resources that have high characteristic ambiguity and low linkage ambiguity. They reveal that managers may experience causal ambiguity differently. On the one hand, middle managers, whose responsibilities are more focused on the transfer and execution of key competencies, may require stability and confidence in the value of key competencies. The results indicate that managers in high-performing organizations, particularly middle managers, understand the relationship between

their actions and competitive advantage (i.e., low causal ambiguity). They agree on the competencies that lead to competitive advantage, suggesting that senior managers want middle managers to appreciate, to share, and to exploit consciously these competencies. The benefits of this factor mobility appear to offset the potential harm associated with imitation. In fact, a relatively clear understanding of important competencies may encourage middle managers to refine and to extend the execution of these competencies in ways that make imitation more difficult.

On the other hand, top managers may take primary responsibility for allocating resources to support current competencies and providing a vision for future competencies. The results suggest that senior managers want to encourage the development of competencies that are tacit and located in an organization's culture. Although the results regarding TMT perceptions of culture location and firm performance were not significant, middle managers believe that competitive advantage is derived from competencies that are difficult to articulate. Interviews with CEOs also suggest that culture is an important and challenging characteristic to manage in the face of changing competitive environments. Over time, a determined organizational focus on critical competencies may allow managers to understand them and share them, but it may be difficult, if not impossible, to replicate this environment outside the organization, thereby limiting the potential for imitation. Managing culture, therefore, involves an ongoing tension in efforts to embed knowledge within an organization in ways that protect competencies from imitation (Badaracco, 1991), and efforts to ensure that the knowledge has value in a changing environment.

Research directed to these issues and others will continue to inform our understanding of these important relationships.

Appendix

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,747
Bartlett's Test of Sphericity	Approx. Chi-Square	942,507
	df	253
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,219	27,040	27,040	6,219	27,040	27,040	3,516	15,289	15,289
2	2,009	8,737	35,776	2,009	8,737	35,776	2,165	9,411	24,700
3	1,897	8,249	44,026	1,897	8,249	44,026	2,151	9,352	34,052
4	1,454	6,322	50,348	1,454	6,322	50,348	2,058	8,946	42,999
5	1,368	5,947	56,295	1,368	5,947	56,295	2,022	8,793	51,791
6	1,301	5,655	61,950	1,301	5,655	61,950	1,729	7,515	59,306
7	1,045	4,544	66,494	1,045	4,544	66,494	1,653	7,188	66,494
8	,915	3,980	70,474						
9	,892	3,878	74,352						
10	,811	3,528	77,880						
11	,774	3,365	81,245						
12	,641	2,786	84,031						
13	,537	2,333	86,364						
14	,494	2,149	88,513						
15	,490	2,129	90,642						
16	,426	1,853	92,496						
17	,315	1,369	93,864						
18	,305	1,326	95,190						
19	,293	1,274	96,464						
20	,258	1,123	97,587						
21	,224	,972	98,560						
22	,177	,771	99,330						
23	,154	,670	100,000						

Extraction Method: Principal Component Analysis.

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