The Determinants of Organizational Innovation: An Interpretation and Implications for Research Libraries

Ronald C. Jantz

The research reported here is focused on a specific type of change in an organization: an innovation. In an empirical analysis of research libraries, it was found that five factors had a significant impact on the innovation performance of the library. These factors relate to the strategy, organizational structure, and leadership of the research library. The study sample consisted of 50 libraries that were members of the Association of Research Libraries. This paper will discuss the theoretical model, explain the effects of these five variables, highlight certain additional correlations that are meaningful, and discuss implications for research libraries.

There is a common perception that an innovation is the result of personal creativity, inspiration, and the fortuitous convergence of a variety of external factors, none of which can be predicted or managed. Although some innovations emerge by accident or serendipity, according to Peter Drucker, successful innovations result from a "conscious, purposeful search for innovation opportunities which are found in only a few situations."[1] There are certain attributes of organizational culture that can foster this more conscious, purposeful search. Some 50 years ago, Jesse Shera, a preeminent library scholar, understood this cultural challenge and suggested a librarian mindset for creating a more innovative library: "In a world of mingled menace and promise, the winds of change blow as surely through the library stacks as they do through the corridors of the United Nations… The librarian, therefore, must be both critic and architect—destroyer of that which is obsolete and builder of his own future."[2]

In their study of isomorphic processes, DiMaggio and Powell have suggested that the traditions and norms of the institution create an "iron cage" that restricts change.[3] Given the library's well-established norms, organizational members are typically conditioned to focus on and protect existing practice. To counter this internal resistance, Peter Drucker has argued, based on many years of study, that innovation can be systematically managed.[4] Shera's admonition that librarians become both builders of the future and destroyers of that which is obsolete suggests that major changes will be a part of the research library future. To accomplish these changes, as Kanter has noted,[5] members of the organization will need to challenge beliefs and received wisdom to realize major new innovations.

Ronald C. Jantz is Digital Library Architect at Rutgers University Libraries; e-mail: rjantz@rutgers.edu.

The central question for leaders is whether the positive impact of the research library on scholarly communication and information access can be substantially improved without implementing major innovations and undertaking the requisite organizational changes. If major change is warranted, how then is this change brought about? These questions suggest that library leaders will need to create a culture in which innovation and creativity become accepted norms.

The purpose of this paper is to report and further explicate the findings of a recent in-depth study by the author on organizational innovation in research libraries and to explore important and more subtle bivariate relationships that emerge from the underlying dataset.[6] The in-depth study revealed important determinants of innovation in research libraries. These determinants are related to the strategy, structure, and leadership of the library and can provide suggestions for how to change the culture to become more innovative. Implications for the research library are presented, suggesting that library leaders will need to develop a creative and innovative culture to survive and prosper in the turbulent and rapidly changing environment of the 21st-century research university.

Organizational Innovation and the Diffusion Model

Angle and Van de Ven have succinctly described the generic innovation process as "a purposeful, concentrated effort to develop and implement a novel idea that is of substantial technical, organizational, and market uncertainty."[7] An innovative capability can be attributed to an individual, a group, an organization, or a nation or state. In this discussion, organizational innovation of the research library is examined with specific attention to those attributes that can lead to a more innovative library. For the research library and similar nonprofit institutions, innovations are primarily of two types: administrative and technical. Given this basic typology, innovation can be defined as the introduction into the organization of a technical innovation (a new product, a new service, a new technology) or a new administrative practice; or a significant improvement to an existing product, service, technology, or administrative practice.[8] This study focuses exclusively on technical and service innovations in the research library that are delivered to the end user.

Innovations are created in a series of steps or stages, a process that innovation scholars have defined as the diffusion model.[9] An idea will pass through these major stages in the organization in a transformative process that ultimately yields a successful innovation. Three major stages of innovation diffusion have been defined and are depicted in figure 1: the initiation of the innovation, a decision to adopt, and the implementation of the innovation. Although figure 1 illustrates an orderly and sequential process, there is much feedback, organizational churn, and significant elapsed time before an innovation is successfully implemented.

There are multiple substages for each of these major stages.[10] When the leadership of an organization makes decisions about introducing a change, their choices occur

FIGURE 1
Stages in Rogers' Diffusion of Innovation Model[11]
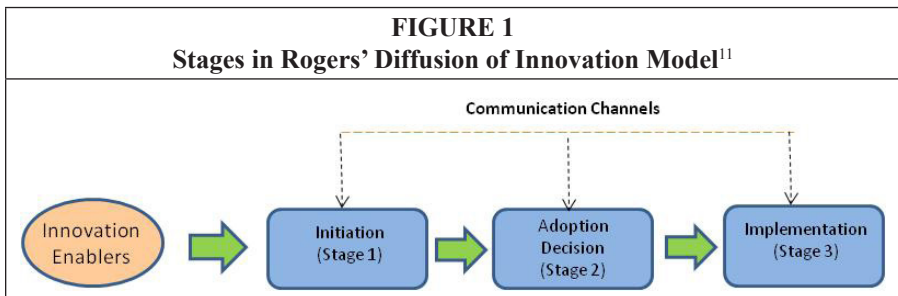
over time in the various stages of the innovation diffusion process. The research library faces challenges in each of the three stages of diffusion.

In the initiation stage, performance gaps or new opportunities become evident through the effects of external enablers. Marcus and Weber cite considerable research suggesting that most innovation stimuli originate from external jolts or trigger events.[12] The emergence of new knowledge, environmental turbulence, a new technology, and competitive threats are examples of enablers that can create opportunities. If leaders have a positive attitude toward change, then initiation of an innovation becomes possible. The second substage of initiation is that of attitude formation. This is a critical stage involving the leader, the leadership team, and the strategy of the organization.

If there is an alignment of the innovation with the strategy of the organization and basic agreement among the leadership of the library, then the diffusion process can proceed to the decision stage. In the adoption decision stage, there is much information gathering and communication within the leadership team to decide to proceed to the implementation stage. If consensus is reached and decision processes are well defined and the decision clearly communicated, then the diffusion process proceeds to the implementation stage.

The implementation stage typically has three substages. In the initial implementation, the innovation is put on a trial basis and evaluated to determine if it is practical for a long-term commitment. The second stage involves a formal commitment in which the organization establishes appropriate processes and policies, possibly making structural changes to support the innovation. In the third stage, full implementation results when a majority of the potential clients have successfully used the innovation. In assessing the extent of implementation, many factors should be considered including the time for diffusion, marketing efforts, the fit of the innovation to the client group, and a possible flawed implementation. It is in the third stage where scholars have identified "implementation failure" as a major reason that an organization does not reap the full benefits of an innovation.[13] An example in the research library world is the institutional repository (IR). Although most libraries in this study indicated that they had implemented an IR, many responded that full implementation had not been achieved.

Literature Review

The literature review discusses the theoretical framework and prior research regarding the major constructs used in this research.

Behavioral Integration. In most organizations, decisions do not emanate unilaterally from the singular leader at the apex of the organization. Rather, leaders and managers—the top management team (TMT)[14]—are constantly communicating and making tradeoffs between meeting current needs and developing capabilities for the future. Building on upper echelons theory, Hambrick proposed the concept of *behavioral integration* in the top management team and linked the concept to organizational outcomes.[15] The leadership of an organization is called upon to make decisions in a complex environment of information overload that is often ambiguous and contradictory and frequently subject to multiple interpretations. According to Hambrick, an integrated team can navigate the complexities of decision making more effectively. However, for many organizations, the concept of a leadership "team" is a misnomer. The group that is nominally the TMT may have little interaction—rarely meeting as a team—and group members may have their own agendas. Even in this less integrated team, the leaders and managers of the organization, with their respective styles, motives, biases, and experience, can significantly affect organizational outcomes.

Behavioral integration is a meta-construct that involves group processes such as collaboration that were previously represented by separate constructs. Behavioral integration should not be confused with social integration or interdependence. The

meta-construct also does not imply consensus; in fact, behaviorally integrated teams may have considerable disagreement—a situation that can create more content-rich discussions. Hambrick theorized that behavioral integration consisted of three important factors: 1) level of collaborative behavior; 2) quantity and quality of information exchange; and 3) emphasis on joint decision making.[16]

Carmeli and Schaubroeck note a behaviorally integrated TMT is characterized by intense interaction that produces open information exchange and collaborative-based decisions.[17] These decisions are typically more complex than those encountered in other work groups. These researchers examined the impact of behavioral integration on organizational decline using a sample of 116 TMTs from various industries. It was found that behavioral integration was negatively related to organizational decline (that is to say, more behavioral integration results in less decline) and was positively related to the perceived quality of strategic decisions. In addition, their in-depth case studies indicate that it is reasonable to impute causality to these hypothesized relationships. In a survey of teams from 96 service organizations, Carmeli found that TMT behavioral integration is positively associated with both human resource performance and economic performance.[18] A component of behavioral integration is the exchange of information in the leadership team. Damanpour and Aravind report that internal communication and "a climate conducive to the dispersion of ideas across the organization" were positively related to innovation in two waves of meta-analyses.[19] Leadership is also seen as a major factor in contributing to organizational creativity—an important antecedent of innovation. Uhl-Bien coined the phrase "enabling leadership" where the formal leaders of the organization are particularly well-suited to stimulate creativity because of their networks, access to resources, and authority.[20] A more behaviorally integrated leadership team may be able to carry out this enabling leadership, resulting in an organization generating more ideas that lead to improved innovation performance.

Organizational Structure. Structural contingency theory suggests that the structure of the organization should change to adapt to and align with various factors in the external environment.[21] According to Burns and Stalker,[22] the organic structure, as opposed to the mechanistic or bureaucratic structure, is appropriate for adapting to changing conditions in the environment. Blau proposed a formal theory of structural differentiation in organizations, and Jansen et al. developed a scale for *structural differentiation* that characterizes the extent to which tasks in an organization are distributed across different units.[23]

Ettlie, Bridges, and O'Keefe have developed a model that focuses on organizational strategy and a structure that leads to both radical and incremental innovations.[24] In their study of the food processing industry, findings suggest that radical innovation is supported by an aggressive technology policy, a centralized decision process, informal structures, and a concentration of technical specialists, whereas incremental innovations emerge from large, complex, decentralized organizations. In contrast to many of the innovation studies, Ettlie found that large size appears to negatively affect radical innovations in that more formal structures are required to manage large organizations. Ettlie and colleagues suggest that the more traditional institutions might offset the size influence by partitioning structurally for radical and incremental innovation—an early hint at an ambidextrous organization. Highlighting bureaucratic effects, Jansen et al. found that a more hierarchical structure negatively affects exploratory innovation, whereas a more rule-based, formal structure will positively affect incremental innovation.[25] The multidimensional complexity of organizational innovation can be seen in these studies where there are different views of the types of organizations that are required in the initiation and implementation stages. Organizational size, a concept that has caused much variation in research results, appears to further complicate the understanding of what structures are best to achieve a more flexible organization.[26] If

major change and radical innovations are desired, these studies seem to suggest that a more complex, informal, decentralized organization is required in the initiation stage and a centralized process for decision making is required in the adoption stage. To manage the complexities of a radical implementation, a further shift to a more formal, less complex organization would be required in the implementation stage.

Ambidexterity. The *ambidextrous orientation* of the organization is characterized by the ability to simultaneously conduct exploratory activities while also supporting and enhancing current services. The benefits of the library professional framework and long periods of success can result in organizational complacency and a limited ability to acquire and apply new knowledge to exploratory work. This ability to acquire and use new knowledge is an integral part of the learning organization. March identified two characteristics of the learning organization, noting "the essence of exploitation is the refinement of existing competences, technologies, and paradigms" while "the essence of exploration is experimentation with new alternatives."[27] In their literature review, Klein and Knight identified a strong learning orientation as a critical factor in the innovation implementation stage.[28] He and Wong demonstrated empirically that exploratory and exploitative strategies have a strong positive impact on product innovation.[29] Tushman and O'Reilly have extended these organizational learning concepts to characterize the ambidextrous organization as one that can simultaneously engage in both exploration and exploitation activities and also cope with the resulting organizational contradictions. These contradictions become important for long-term survival as suggested by these researchers: "Ambidextrous organizations build in contradictions as they operate for today and tomorrow."[30]

The External Environment. Although there is considerable literature on innovation and public institutions, Noordegraaf and Stewart suggest that more attention should be given to the environment in which the institution is embedded.[31] Outside the borders of the university, there are external pressures that are creating environmental uncertainty that affect the university and the university library. These pressures originate, in part, from the political and economic environment and the emergence of for-profit firms that offer competing services. For much of the 20th century, research libraries resided in a stable, predictable environment. However, the external environment of the 21st century appears to be much more unstable, a situation that often favors more radical innovations.

Dess and Beard's model defines three components of the external environment: munificence, complexity, and dynamism.[32] Boyne and Meier clarify the concept of dynamism by explaining that the crucial element of dynamism is not the frequency or magnitude of change that can usually be anticipated, but the unpredictability or uncertainty of the environment.[33] In reporting on public service firms, these researchers indicated that environmental turbulence can have a negative effect on performance and that managers can mitigate these effects from the environment by maintaining structural stability.[34] Koberg et al. found that environmental dynamism positively affects both incremental and radical innovations, although the effect is more positive for radical innovations.[35] In a study of the financial services sector, Jansen et al. conclude that exploratory innovation is more effective in dynamic environments.[36] Andrews used both objective and subjective measures of environmental dynamism and reported that both measures were negatively related to achievements in public organizations.[37] In studying logistics innovation adoption, Germain found that organizational size and environmental uncertainty predict expensive, radical innovations but not incremental innovation.[38] Damanpour reported that the effect of environmental uncertainty is significant for the size-innovation relationship and helps explain variance beyond control variables.[39] In a related study,[40] he also indicated that the relationship between bureaucratic control and innovation is less negative under conditions of high environmental uncertainty.

This prior research indicates that the external environment affects innovation and performance outcomes in organizations in many ways, interacting with size, structure, and bureaucratic processes. Although there are varying results, it appears that organizations in turbulent environments are likely to implement more radical innovations.
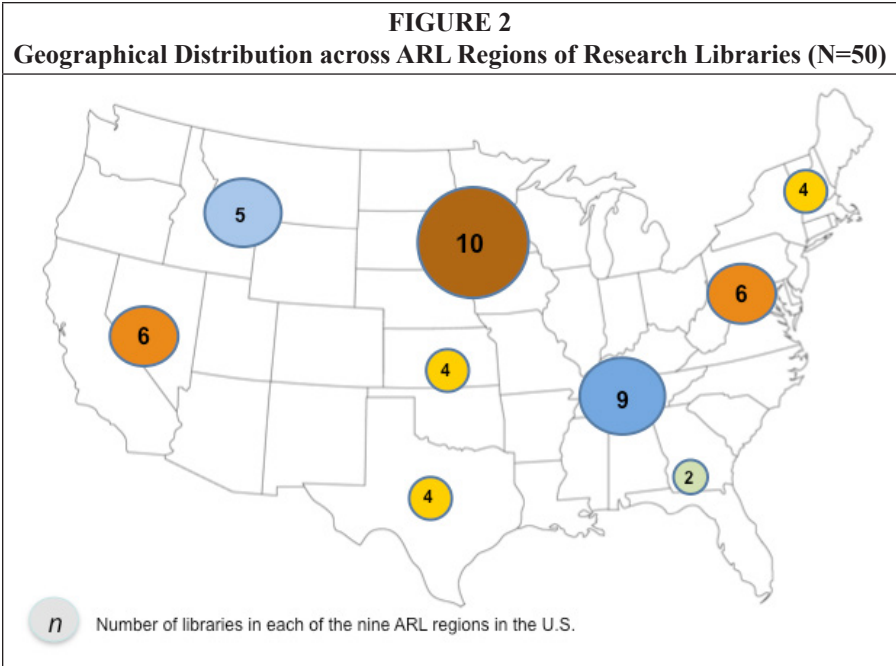
Methods

The Population and Sample. In this research, the unit of analysis is the research library as represented by the views and perspectives of the leadership or top management team of the institution. The population for the current study was the research libraries in the United States that are members of the Association of Research Libraries (ARL). A sample of 50 libraries was taken from this population. To create the sample, university librarians or directors from each ARL institution were contacted to obtain approval for their leadership team to participate in this research.

To obtain data for each institution, the top management team in the library responded to survey questions regarding various aspects of the organizational structure, the external environment, and demographics of the leadership team. The average size of the library team was 3.6 members, and a total of 183 library leaders responded to the survey that included 102 questions.[41] All teams included the university librarian. For the regression analysis, team responses were aggregated to create an organizational response for each library. A summary of TMT demographics is provided in table 1. The size and geographic distribution of each ARL institution in the sample are shown in table 2 and figure 2 respectively.

TABLE 1		
Demographics of the Research Library Top Management Teams (N=50)		
Variable	**Mean**	**Standard Deviation**
TMT Age (Years)	55.5	4.13
TMT Size (Number of Members)	3.6	0.80
TMT Tenure in the Profession (Years)	25.1	6.15

TABLE 2	
Size and Institutional Characteristics of Research Libraries (N=50)	
Size (Total FTE)	**Percentage**
100–199	30.0
200–299	32.0
300–399	16.0
400–499	10.0
>= 500	12.0
Total	100.0
Institutional Characteristics	**Percentage**
Type of Institution (Public/Private)	84.0/16.0
Region—Urban/City	84.0
Region—Suburb	10.0
Region—Town	6.0
Total	100.0

FIGURE 2
Geographical Distribution across ARL Regions of Research Libraries (N=50)

n   Number of libraries in each of the nine ARL regions in the U.S.

For the sample of 50 libraries, potential nonresponse bias was assessed by determining if there was any significant difference in either the size of the library or the geographical region between participating and nonparticipating libraries in the population. For size, an independent samples *t* test was performed to assess whether the mean size of libraries participating in the study differed significantly from the libraries that did not participate. The Wilcoxon rank-sum test was used to test that the distribution of geographical regions among the library participants was not significantly different from that of the nonparticipating libraries. These tests demonstrated that there was no significant difference of size or geographical distribution between participating and nonparticipating libraries.

Innovation Characteristics. There are two important innovation characteristics that were used in this study. First, a fundamental innovation typology distinguishes between administrative and technical innovations. Administrative innovations focus on the internal mechanisms of the organization and the social system (such as recruitment of personnel, allocation of resources, and the reward system) whereas a technical innovation focuses externally on the client and end user to provide new products and services. Primarily because of methodological reasons, this research focuses exclusively on technical innovations since they are much easier to identify and describe. Administrative innovations remain an important area for further research.

In addition to the technical-administrative distinction, this study deals with the extent of change, which varies along a continuum from incremental to radical. According to Zaltman et al,[42] a radical innovation is always "to some extent disruptive of the status quo" and involves changes in the organization's subsystems, values, incentives and power. Radical innovations involve new knowledge that is used to create totally new products and services or to make fundamental changes in an existing product or service. In contrast, an incremental innovation uses existing knowledge to create minor improvements in a product or service. Research has been quite consistent in

demonstrating that radical innovations are riskier than incremental innovations, and they have more profound organizational effects, albeit with the promise of greater returns. Although the incremental and radical concepts represent a continuum, we view these concepts as endpoints or polar opposites on a continuum.[43]

Assessing Innovations. A special panel of librarians and library science scholars was convened to assess the radicalness of specific innovations in research libraries.[44] The online panel survey listed 40 innovations. For each innovation, the panel member was asked to assess radicalness based on five criteria. Candidate innovations were technical, providing new services to library patrons as opposed to administrative innovations. All of the innovations have been implemented in at least one research library in the period 2007–2011. Using the definitions of radical and incremental, panel members identified the extent of agreement or disagreement for each criterion by selecting a number on the nine-point Likert scale. After analysis by the author to remove similar innovations, a final list of 32 innovations was developed. Library leaders answered two questions for each innovation: 1) had a decision to adopt the innovation been made and 2) what was the extent of implementation of the innovation in their institution.[45] The complete list of radical, incremental, and mid-range innovations is shown in table 3, appendix A.[46]

Major Constructs. The major constructs for this study are defined as those independent variables that were expected to have the most impact on innovation performance: behavioral integration, structural differentiation, the ambidextrous orientation, and the external environment. Innovation researchers, as noted below, have developed scales and assessed construct validity for each of these concepts. For each major construct, a team score was computed as an average of the scores for each individual respondent. Questions for each construct can be viewed at a PDF version of the survey.[47]

Simsek and colleagues created a scale and validated the construct for *behavioral integration*, a measure that consists of three concepts: collaborative behavior, information exchange, and joint decision making.[48] For this independent variable, a single, overall measure of behavioral integration was constructed from the resulting nine-item measure (survey questions 1–9). Using Cronbach's alpha,[49] the behavioral integration scale appeared to have good internal consistency, $\alpha = 0.93$. Lubatkin et al. extended He and Wong's constructs for exploratory and exploitative orientations, resulting in a six-item scale for each concept.[50] This scale has been adapted for research libraries as an *ambidextrous orientation,* a perspective of the library leaders that their organization is able to conduct both exploratory activities while also supporting current services. A nine-point Likert scale was used to capture responses for each question (survey questions 21–32). The scales for exploration and exploitation appeared to have good internal consistency, $\alpha = 0.90$ and $\alpha = 0.87$, respectively. From a scale developed by Jansen et al.,[51] five questions characterize the *structural differentiation* construct. The resulting scale captures the extent that leaders have partitioned their organization into separate units (survey questions 10–14). The scale for structural differentiation had acceptable internal consistency, $\alpha = 0.66$. In accordance with Milliken and Waldman et al., *environmental uncertainty* was captured as a perception of the external environment.[52] A six-item scale, adapted from Khandwalla,[53] was used to measure environmental uncertainty (survey questions 15–20). The scale for environmental uncertainty had acceptable internal consistency, $\alpha = 0.71$.

The Dependent Variable: Innovation Performance. A unique dependent variable, *innovation performance*, was created to account for three different dimensions that contribute to the innovativeness of the organization. These three dimensions capture more of the innovation context and address methodological issues with previous studies that have focused exclusively on the adoption decision. Innovation magnitude was captured by determining the number of innovations for which there had been a

decision to adopt (figure 1, stage 2). The extent of implementation (figure 1, stage 3) of each of the innovations was determined from the leadership team's view of how much of the implementation had been completed. Finally, the balance between the two main types of innovation, radical and incremental, was assessed. Regarding balance, many researchers have emphasized the need to balance between these two types of innovation activity.[54] Too much focus on incremental innovation sacrifices the future, whereas too much radical innovation can adversely affect current services. Those libraries with larger magnitude, extensive implementation, and a balance between radical and incremental received higher innovation performance scores.

Research Model and Analysis

Research Model. Innovation scholars have demonstrated that the external environment, organizational factors, and leadership characteristics represent the primary antecedents of organizational innovation.[55] From the innovation literature and the author's research, a model was constructed in which the effects of both the external environment and organizational factors on the innovativeness of the research library were taken into account. Innovativeness in research libraries was hypothesized to be the consequence of several major factors including the leadership team, the organizational structure, and the learning strategy of the organization. In addition to the major factors, several additional predictor variables were expected to have causal effects within the unique environment of the research library.[56] From the extant literature, earlier research by the author,[57] and observations within research libraries, the following research questions were formulated:

1. What effect does the behavioral integration of the senior team have on the innovation performance of the research library?
2. How does a more structurally differentiated organization affect the innovation performance of the research library?
3. What is the effect of an ambidextrous orientation on the innovation performance of the research library?
4. Does an ambidextrous orientation mediate the relationship between senior team integration and innovation performance?
5. How do the factors in the external environment affect the innovation performance of the research library?
6. How do contextual factors (demographics and enablers) of the research library affect innovation performance?

The research model with research questions is illustrated in figure 3. In the exploratory analysis, 17 possible predictor variables of innovation performance were identified (appendix B, table 4). The exploratory analysis was conducted using a hierarchical regression approach. In each step, a predictor variable was entered in an order based on theory and evidence from reported research. Predictors adding little or no increment to variation (R^2) were eliminated from the final analysis.[58] The direct effects of the major constructs are illustrated in figure 3 along with the mediating effect of the ambidextrous orientation (RQ4). Beyond these major constructs, the demographics (age and level of education) of the senior team and certain enabler variables were expected to have an impact on innovation in the research library.[59]

Analysis. The hierarchical regression analysis in the current study yielded five variables that were significant predictors of innovation in research libraries and that accounted for 49 percent of the total variance in research library innovation performance. Four of these five variables relate to organizational mechanisms and the leadership team and represent a unifying context for creating a more innovative culture. The fifth variable, organizational size (based on total FTE), did have a significant and positive

FIGURE 3
Research Model with Research Questions
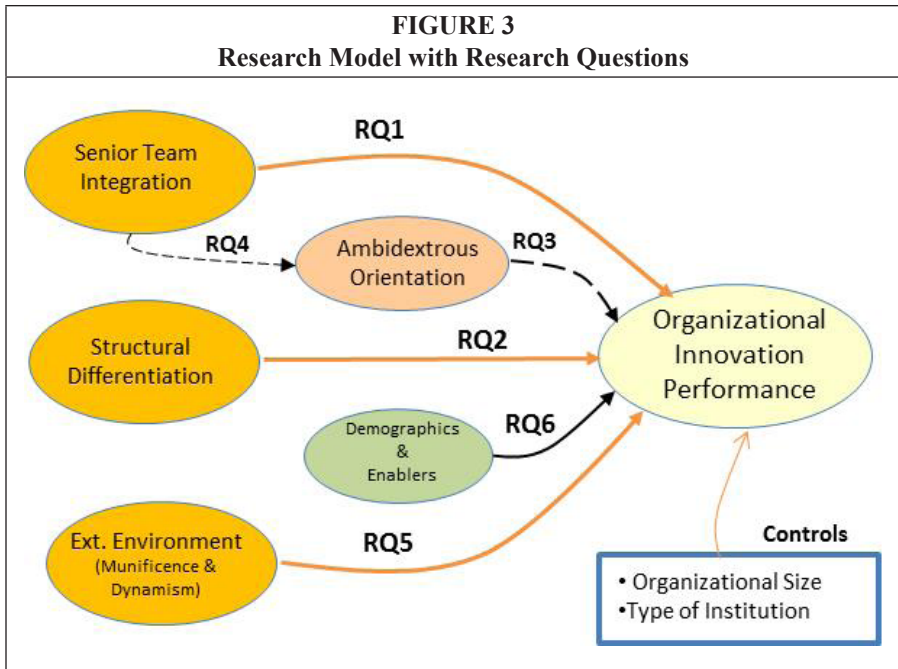
impact on the innovative performance of the library. After controlling for size and type (public or private) of the organization, the factors of primary interest remained significant in impacting the innovativeness of the library. The size variable has been the focus of many innovation studies; however, size may be a proxy for other effects such as slack resources.[60] It is generally understood that small organizations are more flexible, whereas larger organizations typically have additional resources to dedicate to the more innovative projects. In related studies of nonprofit organizations, the size of the organization was typically found to have a positive impact on innovation.[61]

The overall regression, including the two controls and the four predictor variables, was statistically significant: $R = .70$, $R^2 = .49$, adjusted $R^2 = .41$, $F(6,40) = 6.36$, $p < .001$ (the t-values for the best predictors are shown in appendix C, table 5). The R^2 value indicates how much variance in the dependent variable can be explained by variation in the independent variables. The final step in the regression (model 5) indicates that 49 percent of the variation in research library innovation performance can be explained by the controls and the four predictor variables.

Interpretation of Results and Implications for Research Libraries
Behavioral Integration. With respect to RQ1, it was found that behavioral integration had a positive and significant impact on innovation performance. Why is the integration of the senior team an important concept in the management of the research library? First, there is a growing body of literature that suggests that the more integrated TMT, rather than the singular leader, can have a major impact on organizational performance.[62] Tushman et al. report that the strategy emanating from senior leadership and the resulting organizational design are powerful levers that enable an organization to pursue dramatically different types of activities.[63] To successfully innovate, TMT collaboration and active engagement is needed to create supportive structures, strategies, and an innovative organizational culture.[64] A behaviorally integrated team

has the confidence and trust to have open debates on unpopular issues and risky proposals, resulting in a greater likelihood of achieving agreement and concerted action on controversial projects. Through increased quality and quantity of information, more ideas are available for discussion and joint agreement. The collaborative aspect of the behavioral construct suggests that team members will be more willing to discuss unique, nontraditional ideas. The flow of new ideas, the willingness to discuss controversial projects, and the collaborative aspects of the team will lead to more radical innovation proposals flowing into the decision process. By contrast, members of the less behaviorally integrated team are likely to withdraw into their own domains where they have undisputed control. This behavior is typical of the classical manager in which rules and processes become dominant and that lead to support of the status quo and, at best, more incremental innovations.

Decision Awareness. The enabler variable, *decision awareness,* emerged from the dataset of library leaders' responses to survey questions. This variable was constructed by determining when there was a consensus in the leadership team regarding the decision to adopt an innovation. From these responses, it became evident that there was considerable diversity within a leadership team regarding the knowledge or awareness that a decision had been made to proceed with a specific innovation. This uncertainty regarding a decision raised obvious questions about the resultant impact on innovation performance in the library. How were decisions being communicated and documented? If decisions to commit to an innovation were unclear, how would this lack of clarity affect the innovativeness of the library? To capture the decision awareness factor, a score was computed for each team based on the response to the following question for each innovation: "Has the library made a decision to adopt the innovation?"[65] Decision awareness had a significant and positive impact on the innovation performance of the library.

When senior leaders and managers communicate accurately with each other, the innovativeness of the organization is likely to improve. This effect is highly intuitive and perhaps most apparent in the implementation stages of an innovation. During the implementation stage, it may be necessary to move resources between units to support the development of the innovation. If a decision hasn't been properly communicated or if there is confusion about the status of a decision, it becomes difficult for the leadership team to agree to reallocate resources to what might be considered a controversial project. In addition to the significant regression results, *decision awareness* is positively correlated with *behavioral integration* with ($r = 0.38$, $p < .01$) (see appendix B, table 4). The correlation of decision awareness with behavioral integration suggests that the organization has a communication process leading to more clarity and less confusion regarding major decisions. The implications for the organization are that decisions must be clearly communicated, not only within the leadership team, but also to the members of the organization.

Structural Differentiation. Organizational structure is important for innovation insofar as it is designed to facilitate the generation of new ideas and the successful implementation of these ideas. Duncan has identified the persistent dilemma for innovative organizations—different organizational structures appear to be appropriate for the initiation and implementation stages of the innovation process.[66]

For the *structural differentiation* variable, library leaders responded to statements such as 1) in our library, exploratory and production activities are structurally separated; and 2) our library has units that are specialized in specific functions. With respect to RQ2, a more structurally differentiated library had a significant and negative impact on innovation performance, suggesting that a more structurally differentiated library will be less innovative. There are several explanations for this finding. First, an orga-

nizational structure is inherently a stabilizing force that perpetuates the status quo. More structure in an organization can create barriers to communication and the free flow of ideas. This effect is evident in the correlation of the structure variable, *structural differentiation*, and another independent variable, *decision awareness*, which captures the senior team's view of whether a decision to adopt has been made. These two variables are negatively correlated ($r = –0.33$, $p < .05$) (see appendix B, table 4), suggesting that a more structurally differentiated library results in less awareness of decisions and restricts the communication of these decisions. Second, one might speculate that library leaders have not dedicated sufficient attention to integrating more diverse units into the larger library system. In particular, new units for doing exploratory work will require extra effort from leaders to integrate these units into the mainstream of the library. This integration is essential for ideas, especially the more controversial ideas, to be communicated, shared effectively, and transformed into innovations.

The negative impact of structural differentiation appears to conflict with much of the theory; however, there are several possible explanations for this effect. In fact, there is still quite a bit of variation in the empirical studies regarding organizational structure. In contrast to the negative effects of structure, there is a steady stream of research demonstrating that different structures can significantly improve the organization's ability to innovate.[67] Earlier studies and empirical analyses have indicated that different structures are needed in the various stages of innovation. Informal, decentralized organizations work best in the early diffusion stages to create more ideas and initiate potential innovations. As the organization moves through the decision process and into the implementation stage, well-defined processes and an efficiency-oriented culture are needed to meet schedules and to develop a high-quality product or service. These shifting structural requirements highlight the importance of flexibility in the organizational structure and the inherent challenge to library leadership to create optimal organizational structures. Conducting effective exploratory work presents one of the most significant challenges for flexible structures.

Exploratory activities are candidates to be located in separate units. The benefits of exploratory work—the generation and use of new knowledge—cannot be overstated. In a classic paper, Cohen and Levinthal observe that an increased R&D investment creates a capacity to assimilate and exploit new knowledge that, in turn, enhances the innovativeness of the organization.[68] As Tushman and O'Reilly have pointed out, incremental innovation can be managed within a traditional functional organization.[69] For the library to produce more radical innovations, increased exploratory activities and cross-functional teams provide opportunities for increasing innovation performance. Tushman and O'Reilly describe the entrepreneurial unit that is needed to generate discontinuous innovations: "these units are relatively small, have loose, decentralized product structures, experimental cultures, loose work processes, strong entrepreneurial and technical competencies, and relatively young and heterogeneous employees."[70]

In a recent ARL SPEC kit, German and Namachchivaya investigated how research libraries are supporting R&D activities. For their sample, 69 percent of the libraries were investing in R&D activities; however, many of these libraries indicated that R&D is diffused throughout the organization.[71] This diffuse approach makes it very difficult to manage and track R&D activities and is likely to produce incremental innovations that reflect the immediate needs of the specific unit. Research into R&D processes has found that the more autonomous exploratory teams are more effective.[72] A relatively small exploratory unit can evaluate external knowledge, transfer technology into the library, prototype, and demonstrate possible new products and services, thus providing the leadership team with alternatives for making innovation adoption decisions. Members who engage in these exploratory activities will use different vocabulary and

different processes and perhaps be viewed as inefficient or unproductive—a significant challenge in managing R&D. Leaders will need to consider how to structure the organization of the library to support these entrepreneurial members and the related R&D activities.

Ambidextrous Orientation. With respect to RQ3, the *ambidextrous orientation* was shown to have a positive and significant impact on innovation performance (model 5, appendix C, table 5). The ambidexterity of the organization is characterized by the ability to simultaneously conduct exploratory activities while also supporting and enhancing current services. There are two very important results regarding the ambidexterity of the library. First, in reference to RQ3, the ambidextrous orientation has a significant and positive impact on innovation performance. Second, as illustrated in figure 3, the ambidextrous orientation mediates the relationship between *behavioral integration* and *innovation performance.* In the study, it was shown that two-thirds of the impact of behavioral integration and the ambidextrous orientation is achieved through this mediation effect. Thus, library leadership teams that are highly integrated and support both exploratory efforts and existing services are more likely to have innovative organizations. In the ambidextrous organization, the challenge of managing contradictions will become more evident as technology provides opportunities for many new services. For example, while the library continues to conduct in-class bibliographic instruction, an exploratory team might be working to eliminate this type of instruction by providing sophisticated online tutorials that are delivered to the student at the time of need.

The effect of an *ambidextrous orientation* is most relevant for the mission, vision, and strategy of the organization. Elenkov et al. report that leaders who want to change the status quo "should formulate and articulate a shared and inspiring vision of the future."[73] Similarly, Sarros et al. found that the behavior attribute "articulates vision" was the factor most strongly related to an organizational climate that fosters an innovative culture.[74] An ambidextrous library operates in multiple modes simultaneously—focusing on existing services while also experimenting, prototyping, and incurring risk in undertaking these activities. These quite different activities can be restricted by the natural barriers in the organization—structural, social, and psychological. Thus, an ambidextrous orientation imposes a requirement on leaders to articulate and support the resulting inconsistent organizational architectures and processes.[75] Organizational contradictions will emanate from many dimensions: focus and flexibility, autonomy and democracy, individual and the group. Managing in this more innovative environment is based on processes in which leaders recognize and embrace contradiction.[76] These contradictions have practical consequences in the way the library supports traditional services such as bibliographic instruction, reference desk queries, and print book collections.[77]

Unexpected Results

This section highlights the results regarding leadership demographics that were unexpected and appear to be in conflict with much of reported theory. There is extensive research that examines the demographics of both the singular leader and the leadership team; the research reported here focuses exclusively on the leadership team.

Demographics of the Senior Team. Leadership demographics can have a major impact on the creation of an innovative library. Overreliance on leaders who have spent their professional lives in the library will likely result in a dependence on traditional management approaches and a focus on current products. Within the framework of upper echelons theory, Hambrick and Mason have proposed that the demographic characteristics of a leadership team such as age and tenure can be used

to predict organizational outcomes such as performance and innovativeness.[78] In this research, the hypotheses related to the demographics of the library leadership team were not supported. This section provides further insight and interpretation of these unexpected results.

In addition to Hambrick's original conceptualization,[79] there is considerable empirical research on the impact of TMT characteristics such as education and age on innovativeness, R&D intensity, and strategic choices.[80] For example, Bantel and Jackson have shown that innovative banks are managed by more educated teams who have diverse functional areas of expertise.[81] Wiersema and Bantel report that firms most likely to undergo changes in corporate strategy had TMTs characterized by lower average age and shorter organizational tenure.[82] Earlier theoretical propositions by this author suggested that leadership age and tenure would negatively impact the more radical innovations in research libraries.[83] In the current research, there were no significant correlations between the leadership team's average age or tenure in the profession and innovation performance (AGE and TEN variables, appendix B, table 4). Much of the innovation literature suggests that older leaders are risk-averse and tend to preserve the status quo, characteristics that can restrict major change in the organization. However, the negative aspects of age appear not to have had an impact on innovation performance in the sample of 50 ARL libraries. An interesting correlation analysis provides additional insight for this finding. By dichotomizing the average age of the leadership team and innovation performance, the effect of age on innovation is partitioned into four quadrants as illustrated in the following table:

TABLE 6			
The Number of Innovative Libraries Associated with Young and Mature TMTs (N=50)			
	Innovative Libraries	Non-Innovative Libraries	Total
Young TMTs	15	11	26
Mature TMTs	12	12	24
Total	27	23	50

There is almost an equal distribution across the four cells of table 6, suggesting that the mature teams are as innovative as the young teams. This phenomenon is somewhat counterintuitive and deserves further explanation in light of the previous discussion of ambidexterity and team integration. A team will need to work together for several years before it can become more integrated. Further, several more years of collaboration would be required for the team to support the more controversial and conflict-laden ambidextrous orientation. These effects tend to positively affect the mature team's impact on innovation and reduce the impact of the young team. There are, however, some remaining caveats. First, it is likely that an inverse U-shaped relationship actually exists between age of the leadership team and innovation performance, suggesting that the middle years are perhaps the most innovative. Second, from a methodological perspective, there was little variation in the age of the library leaders (Mean = 55.52, SD = 4.13), making it more difficult to discern any significant impact of age on the innovativeness of the library. Finally, in proposing a situational approach to the study of leadership, researchers point out that demographic characteristics are imperfect proxies for psychological constructs and do not take into account the dynamics of the decision process in complex social organizations.[84] Many leaders are quite flexible and able to adapt their management styles to the situation, suggesting that a fixed construct does not adequately model leadership behavior.

Leadership Education. Bantel and Jackson have observed that TMTs with higher levels of knowledge and significant cognitive diversity will perform better.[85] In a study of banks, these researchers found that the more innovative banks are managed by more educated teams with diverse areas of functional expertise. One of the interesting and unexpected results from the current study was the finding regarding the senior leadership's level and diversity of education. Correlations of educational level ($r = -.10$) and educational diversity ($r = .08$) with innovation performance were small and not significant. These variables model the impact of knowledge accumulation and the low correlations raise interesting questions. One possible explanation for the low correlations relate to the type of innovation. The research reported here focused on technical innovations in contrast to administrative innovations. Leaders and managers, especially in large organizations, are primarily involved with the administrative aspects of the organization and have relatively little time to dedicate to technical aspects, thus reducing their influence on technical innovations. In a further exploratory analysis, it was expected that those TMTs in which members had science backgrounds might have a positive impact on innovation performance. In their study of Fortune 500 companies, Wiersema and Bantel found that TMTs with science backgrounds were more positively oriented toward change in their organizations.[86] Given that innovations frequently require organizational change, leaders with science backgrounds might be more favorably disposed toward major technology-based innovations in the library. In the current study, a dummy variable was created in which 1 indicated the presence of science degrees within the TMT and 0 indicated no science degrees. The correlation of this variable with innovation performance was positive ($r = .11$) but not significant (EDS variable, appendix B, table 4).

Environmental Uncertainty. In the research model of figure 3 (RQ5), the uncertainty of the external environment was the only major factor that was not significantly related to innovation performance. The mean for team responses on environmental uncertainty was 4.47 on a nine-point Likert scale (SD = 0.72, N=50), suggesting that most TMTs did not view their environment as all that uncertain. From these scores, one can speculate that library leaders felt reasonably confident that they can predict the effects of budget allocations, government control, and political attitudes on their library (survey questions 15–20).

There are some rather subtle explanations for this effect. The general definition of environmental uncertainty is "the individual's perceived inability to predict something accurately."[87] However, as Milliken notes,[88] even though the environment might be changing dramatically, leaders may be confident that they can predict the volatility or variability in the environment. It is the turbulent and *unexpected* changes that can lead to a perception of environmental uncertainty. However, related to innovations, there is one remaining important observation. For whatever reason, if leaders do not view their environment as uncertain, there will be less motivation to make major changes and the institution is more likely to continue on a track of incremental innovation.

Limitations

Because of the small population (99 research libraries) and the sample of 50, structural equation modeling (SEM) could not be used in this study. However, SEM provides a powerful tool to examine multiple latent factors and to more effectively model the causes and effects of mediators. A future study could use SEM and the larger population of academic libraries to undertake a more comprehensive path analysis.

Respondent bias is always an issue in a survey-based study. In this study, it was very important to obtain responses from the leadership team as opposed to the singular leader. By considering the responses of all of the TMT members, respondent bias

has been minimized. This aspect was especially important when the library leaders were asked to assess the extent of implementation for each innovation. There is little convincing research that either contradicts or supports the generally accepted belief that top administrators can provide reliable information about their organizations.[89] Although self-assessment measures can be prone to bias, they are the most commonly used approach, given that other measures are difficult to obtain and can also be biased.

Regarding the underpinnings for upper echelons theory, demographics are, at best, imperfect proxies for psychological constructs, the major problem being that demographic characteristics do not co-vary perfectly with psychological attributes. This stability and lack of precision in demographic characteristics can lead to conflicting empirical results. This limitation may, in part, help explain the unexpected results regarding the age and educational level of the library leadership team. It should be noted that effective leaders are able to modulate their styles based on the situation at hand. TMT effectiveness can vary from situation to situation, whereas demographics remain relatively constant for extended periods of time.

In a cross-sectional study, it is difficult to account for how innovative capability increases over time. For example, research libraries may be achieving ambidexterity by partially overlapping exploratory and traditional activities over time rather than conducting these activities simultaneously. As Piao points out,[90] too much or too little overlap in these activities tends to reduce firm longevity, whereas moderate overlap will extend firm longevity. Longitudinal studies will provide a more complete picture of how research libraries create both incremental and radical innovations.

Further Research

Assessing innovation performance in complex social organizations presents many subtle complexities. The 17 indicators used in this research covered diverse aspects of the research library, some revealing significant effects on innovation performance while others lacked the expected correlation with each other or with the dependent variable. Additional research is warranted, not only to better understand the unsupported hypotheses but to also explore other dimensions of the research library.

The predictors of management or administrative innovations can be quite different from those affecting technical innovations and are more specific to the organization in which they are created.[91] Many innovations are initiated because there is leadership dissatisfaction with some condition in the organization (such as loss of customers or clients) or leaders perceive an external threat such as loss of budget. How do administrative innovations originate in the research library and do they follow or lead a major new technical innovation? Is overall innovative performance related to having a balance of both technological and administrative innovations? Understanding these questions will help leadership create and sustain an innovative capability in their organizations.

It must be acknowledged that the research library is embedded in a larger institutional framework that is also undergoing change. Bass summarizes the condition in the modern university as one embedded in a state bureaucracy, complicated by union contracts, faculty norms, and traditions.[92] The parent institution can restrict or promote the innovativeness of the library. The policies of the university can either impede or facilitate the research library's ability to innovate. What does it mean for a university to be innovative and how does the innovative university contribute to the success of library innovations and vice versa?

Conclusion

Organizational innovation is a complex process that involves creativity, risk taking, trial and error, coping with failure, and dealing with an increasingly turbulent exter-

nal environment. Most would agree that leaders and managers can have a significant impact on the culture and innovativeness of the organization. This study has found that there are important determinants related to the leadership team, decision making, and organizational structure that can affect innovation. These determinants suggest that successful innovation will require a mix of collaborative leaders who can put in place a strategy and organizational structure for conducting exploratory work while also supporting current services. Articulating vision, mission, and strategy to inspire and motivate organizational members requires a lot of time and energy from leaders. A starting point is a simple, emotionally engaging vision statement that characterizes the library's commitment to innovate. Such a mission statement will help create the climate in which major innovations can be initiated and passed through the diffusion stages to successful implementation.

Innovation almost always involves an encounter with the unknown. Many scholars have reported that innovation can be successfully managed and sustained over time. Innovation is not dependent on individual creativity and can be systematized anywhere "because it has everything to do with organization and attitude and very little to do with nurturing solitary genius."[93] The most important lesson from this research is that library leaders can affect positive and major change in their institutions, but this change will require them to embrace the inherent conflict and paradox of an innovative strategy. To become more innovative, library leaders will need to acknowledge this paradox, articulate its relevance, and promulgate a vision throughout the organization that will enable the creation of new services for the 21st century information society.

Appendix A.

	TABLE 3		
	The Final List of Innovations Used in the Survey (N = 32)		
Innovation Number	Radical	Incremental	Midrange
1.	Provision of a service to publish e-journals	The sharing of a technology platform (such as, an OPAC or institutional repository) with another library	A collaboration with another library to share collection development
2.	The provision of a GIS (Geographical Information System) service to students and faculty, including access to GIS software, training, and consultation	A device and associated service to allow students and faculty to check out their own books	A service for the submission, access and preservation of ETDs (electronic theses and dissertations)
3.	Provision of a service to faculty and students for multimedia production including instruction, software and equipment platforms to support multimedia creation and publication	The use of live chat and instant messaging for reference service	The offering of a Wi-Fi service to the local community (that is to say, not members of the university community)
4.	Provision of a science data service including archiving, preservation, and access to research data and liaison support to researchers	Installation of a coffee bar/restaurant/café in the library	The provision of digital exhibits for special collections or other unique materials that are owned by the library
5.	Replacement of stack book storage and preservation with digital book storage and digital preservation	Provision of a service to inexpensively print, bind and trim bookstore-quality paperbacks from digital book files that are out of copyright	The embedding of library liaisons with students and the instructor in course management systems
6.	Made the transition to a bookless (that is, no print books) library for certain disciplines (for example, engineering)	Provision of a mobile device lending service (laptop, netbook, iPad and so on)	Provision of federated searching across the library OPAC, the institutional repository, and other open repositories

7.	Implemented a liaison service to provide assistance to faculty researchers for managing their copyrights (for instance, to fulfill article deposit requirements from the National Institute of Health and other institutions)	Use of RSS feeds (or similar technology) to provide library news and event descriptions to library patrons	Use of digital object identifiers (such as, DOIs or Handles) to create long-term, stable links to digital resources that are locally owned or created (digitized resources, dissertations, special collections, and so on)
8.	The creation of an institutional repository to contain the research output of the university (such as, faculty research or dissertations)	Delivery of bibliographic instruction using online tutorials	Provision of mobile access to the library website and online catalog
9.	Provided a dynamic mapping application for the OPAC to provide patrons directional information to find a shelved item	Reconfiguration of physical space and redesigned services to provide information or learning commons (a central location for workstations, information resources, and librarian assistance)	Creation of a website or portal for faculty that provides services and assistance for article deposit into the institution's repository
10.		A service to digitize and provide online access to historic, print course catalogs	The development of a flexible bibliographic instruction course structure that gives students the option of attending sessions in the classroom, participating online, or doing both
11.		Outsourced reference service to another organization (for example, another library, nonprofit, or a commercial organization)	Implementation of faceted browsing for the library OPAC
12.		Provided for the digitization and access to historic university yearbooks	

Appendix B

	Var	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	17	18
TABLE 4 — Bivariate Correlations with Innovation Performance for all Predictor Variables (N=50)																			
IP	1	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BI	2	.33ᵃ	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DA	3	.42ᵃ	.38ᵃ	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LDR	4	.24ᵇ	.26ᵇ	-.09	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AO	5	.42ᵃ	.63ᵃ	.36ᵃ	.54ᵃ	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-
AOB	6	-.36ᵃ	-.17	-.13	-.50ᵃ	-.41ᵃ	1.0	-	-	-	-	-	-	-	-	-	-	-	-
SZ	7	.35ᵇ	.30ᵇ	-.07	.19	.15	-.19	1.0	-	-	-	-	-	-	-	-	-	-	-
STR	8	-.22	-.08	-.33ᵇ	.17	.05	-.03	.12	1.0	-	-	-	-	-	-	-	-	-	-
STF	9	.08	.09	.07	-.28	-.10	.27ᵇ	.14	-.04	1.0	-	-	-	-	-	-	-	-	-
AFL	10	.00	-.07	-.23	.06	-.09	-.03	.46ᵃ	.13	.17	1.0	-	-	-	-	-	-	-	-
ENM	11	.22	-.03	.02	-.14	-.14	-.12	.31ᵇ	.03	.33ᵇ	.10	1.0	-	-	-	-	-	-	-
ENU	12	.11	-.23	.21	-.20	-.10	0.0	-.10	.06	-.05	.03	.19	1.0	-	-	-	-	-	-
AGE	13	.03	.12	.22	-.13	.06	.08	-.14	-.09	-.06	-.20	0.0	-.09	1.0	-	-	-	-	-
TEN	14	-.02	.26	.22	-.13	-.02	.22	-.12	.01	.20	-.27	.13	-.15	.66ᵃ	1.0	-	-	-	-
TNP	15	-.04	.23	.03	.08	.20	-.02	-.30ᵇ	-.05	-.04	-.28ᵇ	-.21	-.14	.19	.21	1.0	-	-	-
EDL	16	-.10	0.0	-.02	-.25	-.08	.18	-.07	.06	-.23	.03	-.22	.25	-.08	-.08	.03	1.0	-	-
EDD	17	.08	-.21	-.13	.13	-.10	.02	.11	.23	.01	-.29ᵇ	-.23	.17	-.24	-.13	-.13	.14	1.0	-
EDS	18	.11	.01	-.01	.29ᵇ	.08	-.23	.09	.10	-.10	.19	-.01	.16	-.22	-.23	-.28ᵇ	-.04	.60ᵃ	1.0

[a] Significant (2-tailed) at .01 level, [b] Significant at .05 level

Key to Variables: IP=Innovation performance, BI= Behavioral integration, DA=Decision awareness, LDR=Singular leader attitude, AO=Ambidextrous orientation, AOB=Ambidexterity (balance), SZ=Organizational size, STR=Structural differentiation, STF=Staff/professional profile, AFL=Affluence, ENM=Environmental munificence, ENU=Environmental uncertainty, AGE=TMT average age, TEN= TMT average professional tenure, TNP=TMT average tenure in position, EDL=TMT level of education, EDD=TMT educational diversity, EDS=TMT science background.

Appendix C

TABLE 5 *t-Values* for the Five Best Individual Predictors (N=47)[94]						
Independent Variable	**Unstandardized Regression Coefficient**	**Standardized Regression Coefficient**	**t-Value**	**p-Value**	**$R^2_{increment}$**	**R^2**
Organizational Size (model 1)	25.67	.42	$t(44) = 3.11$	.003**	.184	.184
Behavioral Integration (model 2)	4.59	.32	$t(43) = 2.26$	.029**	.087	.271
Structural Differentiation (model 3)	−4.88	−.29	$t(42) = -2.29$	.027**	.081	.351
Decision Awareness (model 4)	0.37	.33	$t(41) = 2.20$	.033**	.069	.420
Ambidextrous Orientation (model 5)	2.62	.35	$t(40) = 2.30$	.027**	.068	.488
p < .10, **p<.05, ***p< .01						

Notes

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46. Midrange innovations are those rated by the special panel as falling between the radical and incremental endpoints.

47. See the following questions on the innovation survey for each major construct: behavioral integration (1–9), an ambidextrous orientation (21–32), structural differentiation (10–14), and the external environment (15–20): http://dx.doi.org/doi:10.7282/T37D2S88.

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