

Public Relations and the Path to Innovation: Are Complex Environments Good for Business?

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This exploratory study of 622 small-to-medium sized firms examines the potential role of public relations in helping firms to leverage environmental complexity and gain competitive advantage through innovation. Findings reveal that environmental complexity – defined as the number of publics considered vital to firm growth and survival – appears to be good for business in that it contributes to firm innovativeness and even more powerfully influences organizational structure to better fit the operating environment. Organizational structure has a positive effect on innovation in that firms concerned about multiple public relationships tend to centralize their decision-making and, as a result, become more innovative. Contributions of the study include a revised and reliable scale measure for environmental complexity and a first known attempt at mapping the interrelationships between environmental complexity, innovation, organizational structure, technology, and market factors for the public relations literature. Implications for public relations practice are discussed.

Public relations practitioners facilitate information gathering from an organization's operating environment, thereby helping organizations to adjust and adapt to the demands and expectations of publics (Cutlip, Center, & Broom, 2006). As the number of publics critical to organizational growth and survival grows, so, too, does environmental complexity (Duncan, 1972; Lauzen & Dozier, 1994). Firms able to handle higher levels of environmental complexity have a competitive advantage in that they are better able to adapt to environmental changes through innovation (Tuominen, Rajala, Möller, & Anttila, 2003). From a public relations perspective, to what extent are firms more innovative by virtue of having more public linkages to draw upon for input?

This exploratory study of 622 small-to-medium sized firms examines the potential role of public relations in helping firms to leverage environmental complexity and gain competitive advantage through innovation. It draws upon literature from strategic management, organizational design, marketing, and public relations to investigate whether an association exists between a complex operating environment and a firm's capacity to innovate, among other relevant variables.

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The motivation for this study is similar to that of other scholarly work that seeks to quantify a value of public relations to the firm. This is of particular interest to practitioners who are frequently challenged to demonstrate how their work contributes to a firm's bottom line. Results of this study indicate that environmental complexity, or the number of publics perceived as important to firm prosperity, helps a firm to become more innovative in its product and service offerings and thus provides a competitive advantage. Additional findings underscore the value of centralized decision-making, new communications technologies, and normative publics (e.g., business peers), thereby having relevance for several aspects of organizational management. The author hopes that the broader contribution of this study will be to complement and expand upon other efforts to measure, quantify, and justify the value of public relations through the unique perspective of firm innovation. The specific contributions of this work include a revised and reliable scale measure for environmental complexity that includes all four public linkages described by Grunig and Hunt (1984), and a first-known attempt at mapping the complex interrelationships between environmental complexity, innovation, organizational structure, technology, and market factors for the public relations literature.

Following a literature review of concepts related to environmental complexity and innovation, one hypothesis and four research questions are proposed and examined through survey research. Thereafter, the study's limitations, implications for public relations practice, and suggestions for future research are discussed.

Adjustment and Adaptation

The idea of organizations adapting to their environments is in keeping with the tenets of systems theory that are so prevalent in public relations practice and research. Crable and Vibbert (1986) defined public relations as "the art of adjusting organizations to environments and environments to organizations" (p. 413). Cutlip, Center, and Broom (2006) suggested that the most advanced form of two-way communication involves adjustment on the part of organizations and publics. L. A. Grunig (1992) added, "Organizations must adapt to their environments if they are to increase their effectiveness or even to survive" (p. 473).

Chakravarthy (1982) declared that "the primary purpose of strategic management is adaptation" (p. 35) so that an organization can be better fitted to its environment. Dougall (2005) explained that an ecological view held by strategic management theorists (cf. Lewin & Volberda, 1999) focuses on adaptation as part of internal decision-making. She found that this perspective underscores much of contemporary public relations thinking and assumes that "organizations are highly adaptive, that structural changes can and should occur in response to environmental variation, and that the role of public relations is to support and facilitate the organization as it adjusts and adapts to a changing environment" (Dougall, p. 535; see also Everett, 2001). Everett (2001) stated that public relations perspectives, such as those that focus on two-way symmetrical communication, are referred to as ecological

“because they locate the primary context of public relations practice in the relationship between an organization and its social environment” (p. 311; see also Everett, 1990, 1993).

Everett (2001) took exception to the typical and limited application of adaptation in public relations literature, which he summarized in three key propositions:

Proposition 1 (tight coupling of environmental tracking and organizational change): The relationship between environmental monitoring and organizational change must be tightly coupled to optimize the adaptive state between an organization and its environment.

Proposition 2 (continuous organizational change): Because environmental conditions can change continuously, an organization must be capable of adopting programs of continuous change to optimize the adaptive state between an organization and its environment.

Proposition 3 (increasing amount of organizational-environmental linkages): The linkages between an organization and its environment must increase over time to optimize the adaptive state between an organization and its environment. (pp. 314-315)

He argued that the selection perspective of organizational ecology takes a much different view of organizational adaptation. For example, Hannan and Freeman (1989, as cited in Dougall, 2005) suggested that successful organizations have a limited capacity to adapt to their environments because they are encumbered by structural inertia. If they are able to adapt at all, the process is a slow one and particularly challenging for large, powerful organizations bound by sunk costs, internal resistance to change, and legal barriers, among other constraints (see also Everett, 2001). Rather than conventional adaptation models in public relations that claim organizations have the ability to change *in response to* environmental changes over time, the selection perspective asserts that it is only those organizations that *already possess* the attributes needed for adaptation that will survive (Everett, 2001). In other words, firms lacking the characteristics demanded at the time of the environmental changes are “selected out” of the population.

In the strategic management literature, adaptability is associated with the idea of organizational slack, meaning the “resources, or assets and capabilities, which allow an organisation to adapt successfully to internal pressures for adjustment, or to cope with changes in its external environment” (Tuominen, Rajala, Möller, & Anttila, 2003, p. 645; see also Chakravarthy, 1986; Spender, 1989; Weick, 1979). Tuominen et al. further noted that environmental adaptability is a) related to strategic flexibility in terms of knowledge and speed, b) constrained by the firm’s assets and capabilities, c) positively related to the amount of environmental complexity the firm can handle, d) prerequisite for successful product innovation, and e) a source of a firm’s competitive advantage

(see also Baker & Sinkula, 1999; Chakravarthy, 1982; Hurley & Hult, 1998; Oktemgil & Greenley, 1997; Teece, Pisano, & Shuen, 1997; Volberda, 1996). Summarizing the work of other scholars (Miles & Snow, 1978; Teece, et al.; Tidd, Bessant, & Pavitt, 1997; Varadarajan & Jayachandran, 1999), Tuominen et al. asserted that adaptability comprises three dimensions: technology use, market focus (narrow or broad), and organizational design (structure and degree of centralization). In essence, their work suggested that innovativeness is a function of adaptability, and adaptability is a function of technology, market, and organization.

Complexity in Organizations

Complexity refers to not only an organization's operating environment, but also its internal structure. Complexity in one does not necessarily assume complexity in the other. That is, an organization can be operating in a highly complex, or changing, environment, yet be hindered by an adjacent *lack* of complexity in its internal environment. Grunig and Hunt (1984) believed that highly centralized organizational structures suffer from a lack of internal complexity. Such a mismatch of internal-external complexity could render an organization less able to adapt to its relatively more dynamic environment, which can be detrimental to the viability of the firm.

Hage (1980, as cited in Grunig & Hunt, 1984) explained that dynamic, or changing, environments are more complex than static environments. He defined a complex environment as one with a) high levels of knowledge and technological sophistication and b) greater demand for the organization's services (p. 97). By this notion, a firm heavily reliant on technology would find itself in a more rapidly changing environment than a firm specializing in hand-crafted pottery, for instance. Grunig and Hunt argued that firms operating in dynamic environments should employ a two-way model of public relations (i.e., the asymmetric model, which focuses on controlling or changing the environment, or the symmetric model, which focuses more on adaptation and allows the organization to change) whereas those operating in less volatile environments can survive using a one-way model of public relations (i.e., the press agency model, which focuses on publicity, or the public information model, which focuses on truthful information dissemination).

Environmental dynamism is related to environmental uncertainty (Robbins, 1987) in that the greater the potential for change, the greater the likelihood that phenomena such as shifts in market conditions or consumer preferences will be beyond an organization's control and impact the organization in unexpected ways. Tuominen et al. (2003) stated that environmental dynamism is generally regarded as a determinant for organizational adaptability, but proposed a more complex association in that "the relationship between environmental dynamism, dominant business logic, adaptability, and innovativeness as an outcome of business processes is circular; they influence each other in an intertwined fashion" (p. 648; see also Day & Nedungadi, 1994).

Organizational Structure

The decision-making structure within an organization usually emerges as a result of the type of environment the organization faces (Grunig & Hunt, 1984).¹ Grunig and Hunt insisted that organizations with complex environments should have equivalently complex decision-making structures, or what they referred to as vertical structure. A more complex internal structure is one that is characterized by *less* hierarchy and *more* flexibility. Decision-making is decentralized, thereby giving employees more autonomy to act in what they believe are the best interests of the firm. Grunig and Hunt further asserted that organizations with static environments can afford to have more centralized decision-making, noting, “The organization does not have to innovate, because change is not necessary. Innovation can hurt, because it disrupts routine” (p. 100). Firms operating in more complex environments have a different charge, however:

When the environment constantly changes, the organization must innovate to adapt to or control that environment. Generally, the more new ideas an organization can generate, the more likely it will be to adjust successfully to its environment. Thus, it should decentralize to give more people the power to generate new ideas and innovative behaviors. (p. 100)

The idea of an organization becoming more complex by *removing* structures that centralize and formalize decision-making is well aligned with assertions put forth by complexity science. Organizations are viewed as complex adaptive systems in that outcomes resulting from the interactions of heterogeneous agents (e.g., employees, customers) are unpredictable, and firms are better able to adapt to their environments when unnecessary controls are removed (Duhé, 2007). Relevant to public relations practitioners is that “the principles of complex adaptive systems call for creation of more freeing structures that allow both *organizational and stakeholder inputs* to unfold, take shape, and influence the overall system” (p. 70, emphasis added).

Dozier, Grunig, and Grunig (1995) referred to this less structured approach to decision-making as characteristic of a more participative, as opposed to authoritarian, organizational culture. Participative cultures, they found, are “open to outside ideas... [and] these organizations favor innovation and adaptation over tradition and domination” (p. 17). Organizations with participative cultures and complex environments are more likely to have formal scanning systems in place to leverage external information (Lauzen, 1995). Cultures that encourage learning and participative decision-making tend to be more innovative (Hurley & Hult, 1998).

J. E. Grunig (1992; see also Burns & Stalker, 1961; Hull & Hage, 1982) described organizations with decentralized, streamlined decision-making as having an organic

¹ See L. A. Grunig (1992) for a succinct description of several organizational theorists who argued that powerful internal coalitions have more effect on organizational structure than environmental imperatives.

structure. These internal environments tend to be more complex, as compared to mechanical structures that are more centralized and formalized.² Whereas mechanical structures are more efficient, organic structures are more innovative (Hage, 1980, as cited in J. E. Grunig). Early research in organizational structure (Burns & Stalker; Woodward, 1965) suggested that a close match of internal and external complexity (i.e., organic structures during turbulence and mechanical structures during stability) was an appropriate strategy for firm success. However, subsequent work based on contingency theory by Bourgeois, McAllister, and Mitchell (1978) found that managers tend to resort to a mechanical structure during turbulent times and a more organic structure during times of stability.

Beinhocker (2006) argued that a complex environment, along with inflexible mental models and resource dependency, actually *hinders* a firm's ability to adapt to its environment. The potential of a complexity catastrophe, he warned, is a viable danger for large organizations with multiple interdependencies:

The more interdependencies, the more potential for conflicts that constrain the range of solutions...Conflicting constraints make change difficult because a positive change in one part of the network can ripple through and have a negative impact somewhere else. Highly interdependent systems, such as large software programs, jet engine designs, and international trade agreements, can sometimes become so complex that they go into gridlock and change becomes impossible. (para. 20)

In regard to the other barriers to adaptability, Beinhocker found that the longest standing mental models usually work best in a stable environment because they are based on top executives' experience of what has worked well in the past. He estimated that it is usually quicker to replace those in executive positions than to try and change their mental models when environmental conditions place change pressures on organizations and become more complex. Resource dependency, he explained, refers to an organization being constrained by its current structure, assets, talents, knowledge, brands, reputation, and relationships (the last three of which fall within the purview of public relations practitioners). Beinhocker described the resource dependent organization as having fewer "degrees of freedom" within which to maneuver. For example, an organization that is highly specialized and similarly equipped in dry cleaning would have a difficult time, because of resource constraints, reinventing itself to leverage emerging opportunities in biotechnology.

Borrowing terms from former General Electric chief executive officer Jack Welch, Beinhocker (2006) recommended that companies establish consistent and mutually reinforcing organizational "hardware" (structure and processes) and "software" (norms

² See Chakravarthy (1982) for an informative contrast of how environmental scanning, formal organization, reward system, planning/control/information system, and leadership style differ for mechanical vs. organic structures.

and culture) to overcome these three barriers to adaptability (i.e., complex environment, inflexible mental models, and resource dependency). Of relevant interest to this study are the comments he made regarding organizational structure as it applies to decision-making. Like Grunig and Hunt (1984), Beinhocker recognized the autonomy-enhancing benefits of reducing hierarchy, but he cautioned organizations that such a change in structure, without a concurrent change in norms and culture, could be detrimental to survival. Specifically, he stated:

In the 1990s, many organizations went down this path, chopping out layers of hierarchy and giving business units more autonomy. For some companies, these moves brought greater adaptability, but for many they created execution and control problems that forced the corporate center to reassert itself and often negated gains in adaptability...Flatness, autonomy, and diversity are diametrically opposed to the control, coordination, and consistency that successful execution requires. But the software of norms and culture can help organizations have their adaptive cake and execute it too. (paras. 34, 35)

What becomes apparent, then, is a need for balance in organizational complexity. That is, firms need to loosen controls to allow for variability and autonomy, yet maintain enough of a decision-making structure to avoid a complexity catastrophe. Regine and Lewin (2000) captured the essence of this challenge when they wrote:

Both guidance and open-endedness are needed to lead complex adaptive systems. It's not enough just to sit back and let things unfold – then you enter chaos. It's not enough to have an iron grip – then you enter stasis. The trick is – and it's a challenging one – to find a way to dance in between. The paradox here is freedom with guidance. (p. 20)

Innovation and Strategic Public Relations

L. A. Grunig (1992) recognized the tie between public relations and innovation when she stated, “One important role of the professional public relations practitioner... is that of organizing the information or perceptions necessary for innovation or adaptation in an uncertain environment” (p. 477). In a similar tone, Tuominen et al. (2003) proposed that a firm can handle environmental uncertainties “if its ability to process information is correspondingly improved” (p. 645; see also Galbraith, 1973). By virtue of serving in a boundary-spanning role for organizations, public relations practitioners are ideally positioned to gather intelligence from publics (cf. Lauzen, 1995).

Grunig and Hunt (1984) developed a linkage model to describe the socioeconomic relationships between organizations and their publics. Functional publics are those who are involved with direct organizational inputs and outputs (e.g., customers, employees, suppliers). Enabling publics provide authority and control necessary resources (e.g., shareholders, regulators, donors). Normative publics share

common values or face similar threats (e.g., business peers, trade associations, professional associations). Finally, diffused publics are more loosely organized and issue-specific (e.g., media, activists, special interest groups). Of important note about public linkages is that they are neither static nor mutually exclusive. Within a firm's operating environment, the composition, issues, and level of activism in each public is ever changing, and associations with publics are overlapping. That is, an employee is a functional public but could also be categorized as an enabling public (through an employee stock ownership plan) and a diffused public (as a member of a special interest group placing change pressures on the firm).

Finkelstein (1992) described managers with the ability to effectively garner information from multiple external contacts as having prestige power, which Pritchard, Duhé, and Filak (2006) found to be a significant and positive predictor of tenure in the dominant coalition in their study of senior public relations practitioners. Tuominen et. al (2003) spoke specifically to the importance and value of managing these linkages of information when they said, "[T]he linkages between a firm's external and internal environments are crucial from the point of view of innovativeness, since there is a continuous process of knowledge conversion between a firm and its competitive and technological markets" (pp. 647-48; see also Nonaka & Takeuchi, 1995).

Although publics serve as a vital source of information for organizations seeking to adapt to their environments, scarce resources dictate that stakeholder contact must be prioritized, particularly when the environment becomes increasingly complex (Dougall, 2005; Grunig & Repper, 1992; Heath, 1997). Dougall noted:

In more complex environments, organizations must coordinate many activities, while organizations in less complex situations have fewer demands placed on their resources. Complexity is the heterogeneity of the public opinion environment that an organizational population must negotiate. (p. 537)

Aldrich (1979) recognized an organization's need for strategic activities when faced with a complex operating environment. Grunig and Grunig (2000; see also Grunig & Repper) discussed a theory of strategic management and public relations that involves identification, and then segmentation, of stakeholders into active and passive publics. Active publics, in their opinion, are the most strategic, relevant, and consequential for an organization, and "it is their values that must be incorporated into organizational goals" (p. 307). They advised organizations to partake in cost-benefit analysis (Ehling, 1992) when faced with more strategic constituencies than organizational resources can effectively address. Rawlins (2006) offered a four-step process for prioritizing stakeholders, which includes first identifying them based on their relationship to the organization, then prioritizing them by attributes and relationship to the particular situation, and finally, prioritizing publics according to

communication strategy.³ It seems plausible that prioritization of publics could at least partially offset the potential for the complexity catastrophe Beinhocker (2006) discussed.

The 21st century global economy is becoming more complex as a result of revolutionary leaps in computing and communication technologies, as described by Regine and Lewin (2000):

Today, the world is linked in ways that would have been unimaginable just a decade ago. A new kind of economy is emerging – the connected economy, a shift that rivals the onset of the Industrial Revolution in its impact on society and the way commerce is transacted...Where once companies imagined themselves to be masters of their own destiny, in a connected economy they are interdependent players in a fluid and vacillating economic web, where their fate, more than ever, is affected by the behavior of other members. (p. 5)

Although the authors were writing about leadership, the implication of their comments for public relations is clear, particularly in regard to the interdependent linkages managers must steward and the unpredictable public behaviors they must encounter. In their in-depth qualitative study of a dozen companies ranging in industry, size, and geographical location, Regine and Lewin maintained that *relationships* are the key to adaptability and that innovation is critical to survival:

The significance of understanding the deep nature of organizations is that if companies are to survive in a fast-changing business environment, they need to be able to produce on-going innovation, to be continually adapting and anticipating, and to be engaged in continual evolution. (p. 7)

Tuominen, et al. (2003) examined how competence-based adaptability affects the level of innovativeness in firms and how strategic postures, whether internal or external, influence these variables. Their study alluded to the principles of a selectionist perspective in organizational ecology by implying that firms need to be ready to leverage environmental changes when they arise:

Characteristics of the post-industrial era include increasing knowledge and competence, competitive and technological dynamics, and growing environmental complexity. A firm can handle market- and technology-driven uncertainties if its repertoire of knowledge and competencies is expanded continuously, and its ability to exploit such a repertoire is correspondingly improved. (p. 643, from the Abstract)

³ Rawlins (2006) differentiated stakeholders as being defined by their relationship to *organizations* whereas publics are defined by their relationship to *messages*.

The results of their survey research provided strong evidence of a positive association between adaptability and innovativeness as long as firms relied on their existing core competencies to adapt to changing environmental conditions. The authors recognized that continuous changes in technology and market shifts pose significant challenges to firm innovativeness, which they defined as new product development and commercialization. Tuominen et al. left open the potential for a participative, though certainly not exclusive, role for public relations managers in gathering and utilizing internal and external information when they stated, “Our empirical findings manifest that success in innovativeness is strongly affected by the management of the mutually intertwined market, technology, and organization related factors of adaptability” (p. 654).

Hypothesis and Research Questions

In an attempt to ascertain the relationship between innovation, environmental complexity, and the related factors of market, technology, and organization, one hypothesis and four research questions were investigated. The hypothesis originated from the idea that firms adapt to their environments. Although Crable and Vibbert (1986) aptly suggested that organizations and their environments adapt to one another, the bulk of public relations literature focuses on how practitioners can aid firms in making the proper adjustments to better fit within their operating environments (cf. Cutlip, Center, & Broom, 2006; Dougall, 2005; L. A. Grunig, 1992; Grunig & Hunt, 1984; Lauzen, 1995). This assertion of “internal adapting to external” is likewise supported in the business literature (cf. Chakravarthy, 1982; Lewin & Volberda, 1999; Tuominen, et al., 2003). Whereas previous research provided rationale for the direction of the hypothesis, it is Tuominen, et al.’s work in particular that motivated the variables examined. Their research provided convincing support for a model that indicated adaptation occurs through innovation; that is, firms able to handle higher levels of environmental complexity can better adapt to environmental changes through innovation, as indicated in H₁:

H₁: Environmental complexity makes a positive and significant contribution to firm innovation.

Several business scholars (cf. Miles & Snow, 1978; Teece, et al., 1997; Tidd, et al., 1997; Tuominen, et al., 2003; Varadarajan & Jayachandran, 1999) have identified adaptability as a function of market, technology, and organizational factors. Scholars in public relations (cf. Dozier, Grunig, & Grunig, 1995; Grunig, 1992; Grunig & Hunt, 1984) and related fields (cf. Beinhocker, 2006; Bourgeois, et al., 1978; Burns & Stalker, 1961; Hull & Hage, 1982; Regine & Lewin, 2000; Woodward, 1965) have commented extensively on organizational design, environmental complexity, and the capacity to innovate, leading to the first three research questions:

RQ₁: What is the relationship between market factors and firm innovation?

RQ₂: What is the relationship between technology factors and firm innovation?

RQ₃: What is the relationship between organizational factors and firm innovation?

The final research question flowed from Tuominen, et al.'s (2003) finding that there is a complex and overlapping relationship between each of these variables, as posed:

RQ₄: How do environmental complexity, market, technology, organization, and innovation relate to one another?

Methodology

Survey

A link to a Web-based survey was sent via e-mail to the individuals listed as the primary contact for the population of 9,700⁴ unique businesses registered in AccessLouisiana (www.access.louisiana.gov), the state's official economic development portal, in November 2006.⁵ The site allows users to search for Louisiana product and service providers through keyword searches, among other economic development driven functions. Questions for this study were added to an omnibus survey (conducted by a university research center) regarding current and potential technology use (i.e., supercomputing, grid computing, and high performance visualization) among Louisiana businesses. The researchers were particularly interested in how Louisiana firms were using technology to adapt to monumental shifts in the state's economy following the devastating effects of Hurricanes Katrina and Rita in 2005. The e-mail text indicated that the survey should be completed by someone who was familiar with the firm's product/service development, current technology use, and operating environment. Recipients were asked to forward the e-mail to a more appropriate respondent, if needed.

Dependent Variable

The definition for innovation was taken from Tuominen et al's (2003) use of new product development and commercialization. Specifically, respondents were asked to provide an estimate of the number of new products or services their company had

⁴ Businesses registered in AccessLouisiana represent about one-tenth of businesses in the state. As of 2004, the Census Bureau (<http://www.census.gov/prod/2006pubs/04cbp/cb0400ala.pdf>) counted 103,067 firms in Louisiana.

⁵ The author gained access to the list as an associate director of the university research center that developed the portal and as a co-investigator for the NSF grant that funded this research.

developed over the past five years, and, of that number, how many were successfully commercialized for profit over the same time period.

Independent Variables

Lauzen and Dozier's (1994) definition of *environmental complexity* was used in this study with a few modifications. They defined the concept as the number of publics important to the growth and survival of an organization, suggesting that the more publics vital to firm prosperity, the more complex the environment. Their initial list of publics included top management, staff/employees, government regulators, consumers, society/local community, environmental groups, investors/creditors, union officials, special interest groups, and the media. Following factor analysis, Lauzen and Dozier removed environmental groups and union officials from the scale ($\alpha = 0.63$) used for their study.

The list of publics was modified for this study, as follows: regulators, customers, suppliers, local community, activist groups, investors, union officials, news media, business peers in your industry, and business peers in other industries. Because this study focused primarily on how external publics contribute to environmental complexity, top management and employees were not included in the list of publics. The two groups of business peers were added to Lauzen and Dozier's (1994) list in order to include representatives from the normative public linkage (Grunig & Hunt, 1984). This change allowed the researcher to test the reliability of an updated scale that included all four linkages Grunig and Hunt presented in their model. Respondents were asked to indicate how important their company's relationship with each of the publics was to survival and growth using a Likert-type scale ranging from 1 (not important at all) to 5 (very important).

For *market* factors, two items were included in the survey. Based on Tuominen et al.'s (2003) assertion that a broad market can affect adaptability and that innovation can provide a competitive advantage, respondents were asked to indicate their level of agreement with each of the following statements using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree): *My company targets a very broad market of customers/clients*, and *My company is in a highly competitive market*.

Technology factors were included in five survey items. Respondents were asked to indicate which among a list of communication tools (i.e., Web site, blog, podcasts, online discussion forum, e-mail, cell phone, Blackberry or other PDA, intranet, or other) they used in their business. Using the previously mentioned five-point Likert scale, respondents were asked to indicate their level of agreement with the statement: *Technology is essential to my company's competitive advantage*. Lastly, respondents were asked to indicate their level of agreement in regard to their willingness to learn more about how supercomputing, grid computing, and visualization each could be used in their business if training were available.

Three survey items addressed *organizational* factors. To determine the degree of centralization in decision-making (cf. Grunig & Hunt, 1984), respondents were asked to indicate their level of agreement with the following statement: *Decisions must be approved by several managers before they can be implemented*. Resource dependency (Beinhocker, 2006) was assessed with the statement, *My company's resources (machinery, workforce, expertise, etc.) limit our ability to expand into new business opportunities*, and reliance on past decisions (as a mental model) (Beinhocker) was investigated with the statement, *When my company encounters a new challenge in our business, we rely heavily on what has worked in the past to address the challenge*. For each, the same five-point Likert agreement scale was used.

Data Analysis

SPSS 14.0 was used to organize and analyze the data for this study. Pearson's correlational analysis, Cronbach's scale reliability test, and ordinary least squares (OLS) regression were utilized for statistical testing.

Results

Sample

Of the 9,700 e-mails sent, 2,783 were returned because of incorrect or inactive e-mail addresses. From the 6,917 delivered e-mails, 622 surveys (from 592 unique IP addresses) were completed. Respondents were from each industry (as indicated by NAICS codes) operating in Louisiana, and the proportion of respondents from each category closely matched the proportion of the population operating in each business sector.⁶ On average, firms had operations in more than one county (i.e., parish in Louisiana) ($M=1.34$, $SD=1.68$) and 40 employees ($M=39.61$, $SD=198.75$). Over two-thirds (68.70%) of respondents identified themselves as the owner/founder of the firm, followed by 18.20% as senior executives, and the remainder as a middle manager (7.70%), IT professional (1.30%), or other (4.00%).

On average, respondents developed seven ($M=7.09$, $SD=25.81$) and commercialized six ($M=5.44$, $SD=18.78$) new products and services over the past five years. Customers ($M=4.96$, $SD=0.36$), suppliers ($M=4.24$, $SD=1.08$), and industry peers ($M=4.20$, $SD=0.99$) were the most important publics in the sample, with union officials ($M=1.84$, $SD=1.16$) being perceived as having the least amount of consequence upon firm viability.

⁶ Information, manufacturing, and professional services were slightly overrepresented in the sample; health care and retail trade were slightly underrepresented. The most recent Census Bureau statistics available were retrieved March 2, 2008, from <http://www.census.gov/prod/2006pubs/04cbp/cb0400ala.pdf>

Respondents saw themselves as operating in a broad ($M=4.08$, $SD=1.21$) and highly competitive ($M=4.36$, $SD=0.97$) market. On average, they used about half ($M=3.73$, $SD=1.29$) of the eight new media communication tools listed in their business and recognized technology as being essential to their competitive advantage ($M=4.37$, $SD=0.89$). Respondents expressed a slightly greater interest in learning more about grid computing ($M=3.06$, $SD=1.19$) and high performance visualization ($M=3.07$, $SD=1.18$) than supercomputing ($M=2.91$, $SD=1.26$).

For the organizational variables, respondents indicated they were operating in a relatively flat, or organic, organizational structure ($M=2.24$, $SD=1.41$), were slightly resource dependent ($M=3.46$, $SD=1.28$), and relied on past successes to address current challenges ($M=4.01$, $SD=0.94$).

H₁: Environmental complexity makes a positive and significant contribution to firm innovation.

To examine how environmental complexity contributed to firm innovativeness, scale reliability tests were first run on each of the variables. The combined list of ten publics (regulators, customers, suppliers, local community, activist groups, investors, union officials, news media, business peers in the same industry, and business peers in other industries), which added normative publics to Lauzen and Dozier's (1994) original measure, provided a reliable scale for environmental complexity ($\alpha = 0.75$), as did the two measures (new product/service development and commercialization) for innovation ($\alpha = 0.95$). Both scales met acceptable Cronbach's alpha thresholds for scale reliability (Field, 2005). Pearson correlation analysis revealed a positive, significant relationship between the variables ($r = 0.11$, p (one-tailed) = 0.02). Thereafter, a bivariate OLS regression model indicated that environmental complexity makes a positive, and significant, contribution to firm innovation ($\beta = 0.38$, $p = 0.05$, $R^2 = 0.01$). Therefore, H_1 was supported.

RQ₁: What is the relationship between market factors and firm innovation?

The two market items (broad, competitive) did not provide a reliable scale, nor were they expected to. Pearson correlation analysis showed no significant relationship between the innovation scale and either of the market items. The non-directional, exploratory nature of the research question necessitated two-tail tests be run; consequently, no linear relationship was found to exist between market factors and innovation. However, closer examination of the results revealed that a one-tailed Pearson correlation analysis between the broad market variable and the innovation scale would have produced a positive, significant result (r (one-tailed) = 0.09, $p = 0.03$).

RQ₂: What is the relationship between technology factors and firm innovation?

The three technology training interest variables (supercomputing, grid computing, visualization) formed a reliable scale ($\alpha = 0.87$), but the two remaining technology variables (use of new media communication tools, recognition of technology as essential to competitive advantage) were examined individually. Pearson correlation analysis provided no significant linear relationships between the innovation scale and any of the technology variables.

RQ₃: What is the relationship between organizational factors and firm innovation?

The three organizational variables (centralized decision-making, resource dependency, and reliance on past) were not expected to form a reliable scale, and they did not. Therefore, each was examined via bivariate correlation analysis. Results revealed that of the three variables, only centralized decision-making had a positive, significant relationship ($r = 0.11$, $p = 0.02$) with innovation. Had resource dependency been run as a one-tailed test, it would have been significant and negative in its association with innovation (r (one-tailed) = -0.08 , $p = 0.05$).

RQ₄: How do environmental complexity, market, technology, organization, and innovation relate to one another?

Pearson correlation analysis revealed a positive, highly significant relationship between environmental complexity and a broad ($r = 0.25$, $p < 0.001$) and highly competitive ($r = 0.11$, $p = 0.02$) market. Likewise, highly significant and positive relationships were found between environmental complexity and an interest in technology training ($r = 0.33$, $p < 0.001$), recognition that technology is essential to competitive advantage ($r = 0.26$, $p < 0.001$), and the number of new media communication tools utilized by the firm ($r = 0.22$, $p < 0.001$). From an organizational perspective, environmental complexity was positively and significantly correlated with centralized decision-making ($r = 0.26$, $p < 0.001$).

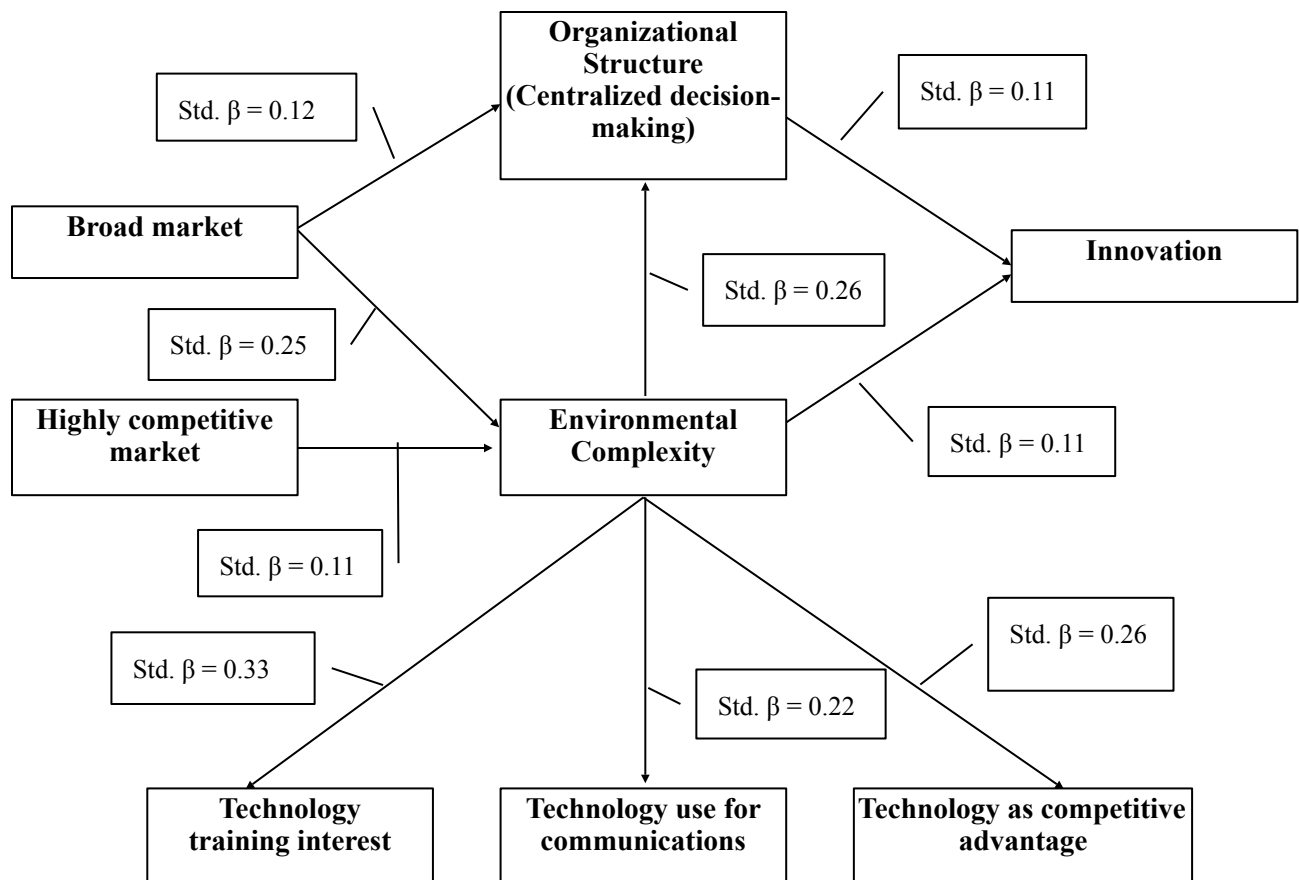
Regression analysis indicated that in addition to making a positive and significant contribution to firm innovation (per H_1), environmental complexity makes a positive, highly significant contribution to centralized decision-making structures ($\beta = 0.05$, $p < 0.001$, $R^2 = 0.07$). In turn, these centralized structures make a positive and highly significant contribution to innovation ($\beta = 3.35$, $p = 0.02$, $R^2 = 0.01$). Standardized beta coefficients revealed that the effect environmental complexity (Std. $\beta = 0.26$) has on centralized decision-making is greater than the effect either environmental complexity (Std. $\beta = 0.11$) or centralized decision-making (Std. $\beta = 0.11$) has on innovation.

Environmental complexity likewise has an impact on technology variables. That is, environmental complexity makes a significant, positive contribution, of roughly the

same degree (as indicated by standardized beta coefficients), to a firm’s interest in technology training ($\beta = 0.17$, std. $\beta= 0.33$, $p < 0.001$, $R^2 = 0.11$), its use of new media communication tools ($\beta = 0.04$, std. $\beta= 0.22$, $p < 0.001$, $R^2 = 0.05$), and its recognition that technology is essential to competitive advantage ($\beta = 0.04$, std. $\beta= 0.26$, $p < 0.001$, $R^2 = 0.07$).

Highly competitive markets appear to have a positive, significant impact on environmental complexity ($\beta = 0.79$, std. $\beta= 0.11$, $p = 0.02$, $R^2 = 0.01$) but no significant direct impact on centralized decision-making. Existence of a broad market of customers/clients, however, makes a positive, significant contribution to environmental complexity ($\beta = 1.42$, std. $\beta= 0.25$, $p < 0.001$, $R^2 = 0.06$) and, to a lesser degree, centralized decision-making ($\beta = 0.14$, std. $\beta= 0.12$, $p < 0.01$, $R^2 = 0.01$). The interrelationships found between the variables studied, including standardized beta coefficients, are illustrated in Figure 1.

Figure 1
Relationships Between Environmental Complexity,
Organizational Structure, Technology, and Innovation
(Std. β = Standardized beta coefficients)



Discussion

This study of the intertwined relationships between environmental complexity, innovation, and related variables reveals that environmental complexity does, in fact, make a positive contribution to firm innovation. That is, the more publics that are important to a firm's growth and survival, the more innovative the firm is expected to be. Organizational structure, defined as centralized decision-making, makes a positive contribution to innovation that is equivalent to the one made by environmental complexity. In other words, the impact made by environmental complexity and organizational structure on firm innovation is roughly the same. Environmental complexity has a comparatively larger impact on organizational structure, supporting the premise put forth in the literature (cf. Chakravarthy, 1982; Cutlip, Center, & Broom, 2006; Dougall, 2005; L. A. Grunig, 1992; Grunig & Hunt, 1984; Lauzen, 1995; Lewin & Volberda, 1999; Tuominen, et al., 2003) that a firm's internal environment will adapt to its external environment.

Findings regarding organizational structure conflict with the proposition made by J. E. Grunig (1992) that the streamlined decision-making process offered by organic structures will result in a more innovative firm. Herein, it was discovered that more centralized decision-making structures are actually better contributors to innovativeness. This finding more closely aligns with Bourgeois, McAllister, and Mitchell's (1978) work that proposed managers will resort to a more mechanical structure during turbulent times (as would be the case for Louisiana businesses recovering from two natural disasters in the same year) and Beinhocker's (2006) argument that the autonomy-enhancing benefits of reducing hierarchy can be counterproductive to the control and coordination required for successful business plan execution. Whereas organic structures may be beneficial for the *generation* of innovative ideas, this study suggests that successful *execution* of those ideas is better served by a more mechanical, centralized decision-making structure.

No direct linkage was found between the technology variables and innovation. However, environmental complexity (which contributes to innovation) was found to have a positive, and roughly equivalent, impact across several measures of a firm's use of technology. In particular, firms operating in more complex environments tend to be more interested in learning how new technologies can improve their operations, use more new media communication tools in the conduct of their business, and recognize that technology is essential to their competitive advantage.

Although market-related variables were not found to have a direct impact on innovation, they were found to have a significant impact on environmental complexity and centralized decision-making, both of which contribute to innovativeness. Specifically, a broad market of customers/clients will lead a firm to centralize its decision-making to some extent, but, relatively speaking, the impact of a broad market on environmental complexity is twice as strong. This is intuitively pleasing in that a broader market of consumer publics would be expected to make the environment more

complex by virtue of increasing the number and type of publics with which the firm must be concerned. A highly competitive market was not found to have any bearing on centralized decision-making but was shown to increase environmental complexity, though not to the extent a broad market will. This, too, makes intuitive sense in that increased competition enhances the importance of several publics (e.g., customers, peer firms) to the organization.

Tuominen, et al.'s (2003) proposition that there is a complex and overlapping relationship between environmental complexity, innovation, technology, market, and organizational factors is strongly supported by these findings. For example, although a direct linkage could not be established between technology or market factors and innovation, environmental complexity, which makes a direct contribution to innovation, was found to be significantly related to both technology and market conditions.

Limitations of the Study

There are several limitations to the generalizations that can be drawn from this study. First, the group of firms surveyed represents a fraction of businesses operating in one particular state, and a relatively small number of firms from that group chose to respond to the survey. Although the low response rate hinders an ability to draw conclusions about the behavior of other firms, it does not diminish the reliability of the scales tested and their potential use in subsequent research. Even though respondents were spread both geographically and industry-wise throughout the state, it would be imprudent to apply these findings to firms in other states without further research. Furthermore, firms that register on an online portal could be more technologically oriented than their unregistered counterparts, which could have inflated the associations found with technology variables.

Louisiana firms are unique because of a significant economic shock imparted on the state by Hurricanes Katrina and Rita only 15 months before this survey was administered. Although many American states have suffered shocks in the forms of unemployment, outsourcing, and economic downturns, Louisiana's business climate became even more turbulent in the wake of these natural disasters, and its potential bias on these results must be acknowledged.

Because survey questions for this study were part of a broader omnibus study, the researcher was limited in the number of items that could be included. Ideally, constructs to describe the market, technology use, and organizational structure should be drawn from multiple questions and tested for scale reliability to ensure their validity.

Finally, small effect sizes provided by some correlation coefficients and low coefficients of determination (i.e., R^2) on some regression models indicate that some of the models tested are explaining relatively little variance between variables. Although these findings are statistically significant, the large sample size could lead to spurious results (Field, 2005).

Conclusions

Environmental complexity, defined herein as the number of publics considered vital to firm growth and survival, appears to be good for business in that it contributes to firm innovativeness and even more powerfully influences organizational structure to better fit the operating environment. Organizational structure, in turn, has a positive effect on innovation. That is, firms in this study that are concerned about multiple public relationships tend to centralize their decision-making and, as a result, become more innovative.

The relationship between environmental complexity, organizational structure, technology, market factors, and innovation is multi-faceted, overlapping, and complex. Environmental complexity is beneficial to the firm in that it helps a firm adjust and adapt to its changing environment. Public relations managers have a role to play in helping firms to navigate complex environments in that public relationships serve as vital sources of information (e.g., emerging trends, complaints, and change pressures) for organizations seeking to innovate, but this input must be balanced and prioritized. The same is true of complexity within the organization. Firms must strike the proper balance between a mechanical structure that is too restrictive for idea generation and an organic structure that is too loose for successful execution of innovative ideas. It seems reasonable that the proper level of internal complexity would be unique to the needs of each firm. Although organizational design is outside of the conventional purview of public relations managers, practitioners can nevertheless help firms to assess and manage environmental complexity by providing firms with environmental intelligence gathered from strategic publics on an ongoing basis. This presumes, however, that practitioners have the necessary external and internal relationships in place to help the firm become more innovative in its product and service offerings. Whereas external relationships are needed to gather relevant information, practitioners must have sufficient organizational knowledge and contacts in place to be able to effectively share that information internally (e.g., with research and development) so that it may be put to competitive use. Practitioners need business acumen to help internal publics sort the “wheat from the chaff” and prioritize input from a myriad of publics.

The role of technology as it relates to environmental complexity is particularly relevant to public relations practitioners. Firms in complex environments tend to recognize the role technology serves in competitive advantage and more readily employ new media tools, such as blogs, podcasts, and online discussion forums, in the conduct of business. Practitioners are becoming increasingly well suited to facilitate electronic communication for organizations. In a complex environment composed of multiple, strategic publics, new media are needed to handle the volume and variety of inputs received.

Industry peers (a normative public linkage) ranked third behind only customers and suppliers as the external public most important to the prosperity of firms included in this study. Statistically speaking, the addition of industry peers to Lauzen and

Dozier's (1994) original measure produced a reliable scale that now includes all four public linkages proposed by Grunig and Hunt (1984). Practically speaking, the increasing reliance on organizational peers who share the same values and face the same threats better reflects the interconnected realities (Regine & Lewin, 2000) of the modern economy, particularly in times of turbulence. In light of the economic shocks (e.g., immediate mass exodus of businesses and residents) experienced by Louisiana firms in the wake of Hurricanes Katrina and Rita, this finding makes logical sense. It likewise supports public relations' role in building relationships with business peers, as is commonly facilitated through active affiliation with professional and trade associations.

Innovation provides a bottom-line benefit to firms through competitive advantage. For practitioners and scholars interested in quantifying how public relations adds value to an organization, this line of research is promising and worthwhile.

Suggestions for Future Research

The updated scale for environmental complexity developed in this study, as it relates to normative publics, should be further tested. Likewise, the hypothesis and research questions need to be examined in other business environments in the U.S. and abroad before more definitive conclusions can be drawn about the relationship between environmental complexity, organizational structure, technology, and innovation. Structural equation modeling would be helpful in refining the antecedents, effects, and circularity of these variables.

Multiple measures should be used to develop scales and thus enhance the reliability of constructs describing organizational structure and technology use. Furthermore, constructs regarding organizational culture and norms should be developed to provide a more complete picture of how these variables affect and inform decision-making structures.

The idea of organizations finding the right balance for public engagement and organizational decision-making as they apply to innovativeness needs to be further explored. That is, at what point do the number of publics important to firm growth and survival become too many? When is an organic structure too autonomous? At what point do firms begin to face what Beinhocker (2006) referred to as a complexity catastrophe? What, if any, symptoms of such a catastrophe exist, and what can public relations managers do to become better attuned to them and help to offset such an occurrence? It is probable that the relationship between the number of publics critical to firm prosperity and the ensuing level of innovativeness produced is curvilinear, rather than linear, in nature. The same is likely true of the relationship between the number of organizational layers required for decision-making and firm innovation. A nonlinear analysis of these relationships could reveal the point at which public engagement and

centralized decision-making are optimum, beyond which complexity and control become counterproductive to the firm.

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