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The Venture Creation Process, Entrepreneurial Self-Efficacy and Competitiveness: A Focus on Technology Enterprises

Boris Urban

Venture creation is typically conceptualized in terms of entrepreneurial tasks within a venture creation process, where the transition from one stage to another is often the result of a combination of various skill and belief components. This paper investigates the relationship between the venture creation phase, in terms of entrepreneurial self-efficacy and the competitiveness of small and medium technology enterprises. Correlational and regression analysis are performed where empirical evidence supports that the searching, planning, marshaling resources and implementing people phases of the venture process are significantly associated with the competitiveness of these enterprises.

Using Intranets to Reduce Information Overload

D. Keith Denton, Peter Richardson

Today we are being overcome with enormous amounts of information coming at internet speed. There is plenty of content but little help in making good decisions. Imagine being able to monitor your critical concerns using only a single desktop computer screen. Your typical worker, who uses technology and information within the context of his or her job, spends more than 40 percent of their day processing work-related information. Today’s intranets and supporting software has the capability to delete irrelevant content and add important context information.

Creating a Mindset for Innovation

Paul Skaggs, Richard Fry, Geoff Wright

To stay ahead of the development of new technology, we believe engineers need to understand what it means to be innovative. This research focuses on the developed methods and efforts being implemented to advance the culture of innovation within our college of engineering. The primary method we have developed to help our students better understand the process of innovation is what we call Innovation Boot Camp.

An Estimation of the Elasticity Demand for Tap Water

Russ Kashian, Jeff Heinrich, Brandon Narveson, Eric Cramer

This paper examines the elasticity of the demand for water as well as the household characteristics that influence their demand for water. Two empirical models are estimated employing a panel dataset from South Milwaukee, Wisconsin. The initial model employs a probit model to determine the characteristics that might classify a home as a “high user”. The second model estimates a simple OLS model for estimating elasticity. The findings are twofold, first consumer elasticity demand is dependent on where along the demand curve that consumer is. Second, household characteristics are an important determinant in their demand for water.
GUIDELINES FOR SUBMISSION

Journal of Strategic Innovation and Sustainability (JSIS)

Domain Statement

The Journal of Strategic Innovation and Sustainability takes a multi-disciplinary approach to addressing the many challenges of managing innovation and sustainability, rather than a narrow focus on a single aspect such as technology, R&D or new product development. JSIS is inclusive & practical, and encourages active interaction between academics, managers and consultants. The scope encompasses innovation research, sustainability research, policy analysis and best practices in large and small enterprises, public and private sector service organizations, state and national government, and local and regional societies and economies with special emphasis on linking academic research to future practice. Articles of all nature are published including: quantitative studies, qualitative studies, literature and book reviews, methodology, policy analyses, and case studies.

Focus of the articles should be on applications and implications of business, management and economics. Theoretical articles are welcome.

Objectives

- Generate an exchange of ideas between scholars, practitioners and industry specialists
- Enhance the development of the management discipline
- Acknowledge and disseminate achievement in new approaches to strategic thinking
- Provide an additional outlet for scholars and experts to contribute their ongoing work in the area of applied cross-functional management and organizational topics.

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Articles should be submitted following the American Psychological Association format. Articles should not be more than 30 double-spaced, typed pages in length including all figures, graphs, references, and appendices. Submit two hard copies of manuscript along with a disk typed in MS-Word.

Make main sections and subsections easily identifiable by inserting appropriate headings and sub-headings. Type all first-level headings flush with the left margin, bold and capitalized. Second-level headings are also typed flush with the left margin but should only be bold. Third-level headings, if any, should also be flush with the left margin and italicized.

Include a title page with manuscript which includes the full names, affiliations, address, phone, fax, and e-mail addresses of all authors and identifies one person as the Primary Contact. Put the submission date on the bottom of the title page. On a separate sheet, include the title and
an abstract of 200 words or less. Do not include authors’ names on this sheet. A final page, “About the Authors,” should include a brief biographical sketch of 100 words or less on each author. Include current place of employment and degrees held.

References must be written in APA style. It is the responsibility of the author(s) to ensure that the paper is thoroughly and accurately reviewed for spelling, grammar and referencing.

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Authors will receive an acknowledgement by e-mail including a reference number shortly after receipt of the manuscript. All manuscripts within the general domain of the journal will be sent for at least two reviews, using a double blind format, from members of our Editorial Board or their designated reviewers. In the majority of cases, authors will be notified within 60 days of the result of the review. If reviewers recommend changes, authors will receive a copy of the reviews and a timetable for submitting revisions. Papers and disks will not be returned to authors.

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How does Creativity Complement Today’s Currency of Innovation?

Tyler Lewis
Brigham Young University

Geoffrey A. Wright
Brigham Young University

In this article the authors discuss the definition of innovation, its associated process, and related measurement tools. The definition of innovation is a process of creativity leading to something highly useful and novel. The purpose of this article is to define the difference between creativity and innovation, outline the process of innovation, and discuss measures of innovation. Our research suggests that creativity is a subcomponent of the innovation process, and is focused on divergent ideas. Whereas the purpose of innovation is to use divergent ideas towards a convergent solution that is both highly novel and useful.

INTRODUCTION

In the past few years’ innovation has been a popular topic in various fields of economics and academia. Academics and professionals have written about this topic in great detail. Authors such as Steven Johnson (2010), Clayton Christensen (2003), Michael Michalko (1991), Edward De Bono (1999), Robert Sternberg (2010), Jonathan Littman (2005), Scott Berkun (2010), Peter F. Drucker (2007), and many others have suggested, in not so many words, that innovation is modern day’s currency.

In an effort to further understand this currency: innovation, this paper presents and discusses the misalignment and use of creativity testing for purposes of measuring innovation. Numerous definitions of creativity exist, which have spawned the development of various creativity tests. These tests have been based on accepted definitions of creativity – such as “a behavior that is imaginative and inventive” (Guilford, pp. 444, 1950).

Innovation, in contrast, is not the same as creativity. Innovation is structured creativity focused on producing an innovative product, service, or system. In essence it is a “practical creativity.” Although related, creativity and innovation are distinct and different. Consequently they should use distinct and different assessments. Paradoxically, most efforts to measure innovation are based on creativity definitions and tests, or only focus on production. This paper compares and contrasts the definitions, assessments, and instructional practices of creativity and innovation, in an effort to further clarify how and what should be taught regarding innovation, and how it might be more effectively measured.
INNOVATION DEFINED

Many researchers have made the argument that innovation is not the same as creativity (Amabile, Conti, Coon, Lazenby, & Herron, 1996a; Carr & Johansson, 1995; Van de Ven, Polley, Garud, & Venkataraman, 1999). According to these researchers and others, innovation can be defined as structured creativity, focused on producing an innovative product, service, or system (Amabile, Conti, Coon, Lazenby, & Herron, 1996a; Carr & Johansson, 1995; Van De Ven, Angle, & Poole, 1989). Although related, creativity and innovation are distinct and different (Amabile, Conti, Coon, Lazenby, & Herron, 1996a; Carr & Johansson, 1995).

Innovation has often been inappropriately used to define a person or thing that is simply creative. To be creative, does not mean, to be innovative. Creativity is a subcomponent of innovation. Innovation is a process that involves moving from divergent ideas to a convergent solution. In this definition creativity is a measure that can be applied to divergence. Creativity can be thought of as the starting point for innovation. Consequently, creativity and innovation should be assessed differently. Image 1 further clarifies the divergence to convergence relationship.

**IMAGE 1**

INNOVATION PROCESS – MOVING FROM DIVERGENCE TO CONVERGENCE

---

DIVERGENCE  
[CREATIVITY]

CONVERGENCE  
[PRODUCTION]
According to the definitions of creativity and innovation, creativity assessments only test a segment of the innovation process. The issue with this is that creativity assessments are being used to assess innovation, and in so doing, are only actually assessing the preliminary part of innovation: creativity. This is similar to trying to test a student’s understanding of math by only administering a multiplication test. While the assessment is valuable to understand the student’s grasp of multiplication, it does not provide data on the student’s ability to do math, which involves more knowledge (e.g., subtraction, division, and addition). Creativity assessments are useful but only measure one part of the innovation process; an innovation assessment would need to measure the elements or characteristics of the entire innovation process.

Innovation is a process that is both linear and cyclical. Linear because ultimately the goal of innovation is to create a new product, system, or service, and is best serviced by moving from divergent ideas to a convergent solution. Innovation is cyclical in that the linear movement towards a solution will not happen unless the various principles of the innovation process are continuously revisited. Image 2 diagrams the flow. It presents the idea that the movement towards a new product, system, or service is made up of five components: idea finding, idea shaping, idea defining, idea refining, and idea communicating. Each part is then broken down into three tools. Idea finding incorporates observing, experiencing (e.g., situations or events), and inquiring (e.g., asking questions). These tools guide a person to find ideas by being aware of his or her surroundings through being conscious of what he or she is experiencing and questioning situations or events. Idea shaping incorporates organizing (e.g., categorizing ideas by similarities), simplifying (e.g., finding the central part of the idea), and clarifying (e.g., explaining the idea clearly). This takes the ideas from the previous step and shapes them by organizing the ideas in written form. Writing the ideas down helps to clearly define the idea and simplify it. Once the ideas are written down, idea defining then incorporates viewing (e.g., look at the problem differently), associating (e.g., associate ideas with other situations, topics, or objects) and connecting the ideas.

**IMAGE 2**

**INNOVATION PROCESS**

PROCESS of INNOVATION | a semi-linear process of movement, embedded in a non-linear innovative environment.

INNOVATION ENVIRONMENT: organic leadership, fail early - fail often, defer judgment, intrinsic motivation, prototyping and iteration, role changing and growth, and collaborative autonomy.
Viewing the ideas organized in one way helps a person start associating and connecting the ideas in new ways. Idea refining involves visualizing the ideas to validate them and provide iterations. The last part in the process is idea communicating, which involves showing, demonstrating and describing the idea in various methods (e.g. prototypes, drawings, or role-play).

Image 2 also shows two additional concepts important to understanding innovation. First, that the innovation process involves iterations between the parts. For example, idea shaping through clarification often leads back to idea finding. Also, idea communicating provides feedback for all steps of the innovation process and may start it all over again. Second, it shows that the innovation process takes place in an innovation environment. This environment may provide leadership that encourages innovation, a fail early-fail often mentality, judgment deferral, intrinsic motivation, prototyping, and collaborative freedom. With this environment, the professors believe that the innovation process will better succeed.

CREATIVITY AND INNOVATION MEASURES

A thorough literature review revealed that both creativity and innovation assessments do exist (Cropley, 2000; Hocevar & Bachelor, 1989; Kaltsounis & Honeywell, 1980; Torrance & Goff, 1989), however, we did not discover any assessments that tested for both creativity and innovation. In analyzing the types of questions in the innovation tests, we discovered that most of the questions were asking questions about creativity – not innovation. In our literature review we did not find any tests that assessed both creativity and innovation. However, as we analyzed the purpose, scope and type of questions asked in the assessments we discovered the assessments focused on two primary – yet distinctly different – domains. The creativity assessments focused on divergence, while the innovation assessments focused on quantity of products. For example, the Torrance Test of Creative thinking (TTCT) asks questions focused on measuring divergent ideas. In the TTCT, participants are asked to sketch and explain different objects in response to visual stimuli presented in the test (e.g., circles, lines, abstract drawings) within restricted time limits. Developed from Torrance’s research on creativity and previous theoretical work by Guilford (1967), the TTCT measures the following components of creativity: (1) fluency, the ability to generate large numbers of meaningful ideas, (2) originality, the ability to produce ideas that are statistically infrequent in the normative population (used less than 5 percent of the time), (3) elaboration, the ability to add details to one’s ideas, (4) resistance to premature closure, the ability to maintain an open and flexible mindset, and (5) abstractness of titles, the ability to think abstractly about concepts. The TTCT also assesses other minor aspects of creativity, such as unusual visualization, storytelling articulateness, and fantastical imagery. These minor aspects are called creative strengths. A human scorer scores the five components of creativity and creative strengths in a participant’s test according to detailed instructions and after receiving proper training. Other creativity tests such as Guilford’s Alternative Uses Task equally ask questions focused on the area of divergence by asking questions like “Name all the uses for a brick.” Focusing on the area of divergence is helpful, but it is only one part of the 2-part definition of innovation, and therefore any claims that the TTCT or other creativity tests are valid measures of innovation are inaccurate.

Cropley’s (2000) more recent study examined a smaller number of creativity tests than the previously mentioned researchers. These tests were limited to paper-and-pencil tests - since those “are the most widely used in education and research” (p. 2). He also limited the number of tests discussed to those developed during the modern creativity era introduced by Guilford (1950). Cropley’s study organized creativity tests into four categories. These categories focused on products, processes, motivation, and personality/abilities (pp. 17-19). In analyzing the tests Cropley categorized, we discovered that the tests he grouped into the products and processes categories seemed to be slightly more innovation centric, asking questions related to product development. These tests might measure a product’s usefulness and novelty but do not assess the innovation process as a whole. This finding proves interesting because what Cropley was actually testing was innovation, not creativity. One such test is the Creative Product Semantic Scale (CPSS) developed by Besemer and O’Quin (1987). The CPSS is based on three
dimensions: novelty, resolution, and elaboration and synthesis. Another test is called the Consensual Assessment Technique (CAT). This assessment asks participants to create a product, which is then rated by two or more experts in the field. The criterion for the CAT is appropriateness as evaluated by a community. 

Product creativity tests, as exemplified by the CPSS and CAT, focus on the end result. In contrast, the tests he grouped in the motivation and personality categories had more to do with creative thinking, which asked questions that had to do with divergence, and which typically used questions much like those identified on the TTCT. For example, several of the creativity centric tests required participants to draw as many ideas in a specified amount of time. This type of task tests fluency – which is a measure of divergence.

The literature review showed that although both creativity and innovation assessments exist, the innovation assessments are typically found within business contexts, centered on the end product. For example, Europe uses the Community Innovation Survey (CIS) to assess national innovation performance. This survey measures innovation in terms of input and output (Godin, 2002). Salazar and Holbrook (2004) critique the CIS and suggest that innovation needs to be studied as an activity and not as an end result (pp. 263). An instance in the CIS where this is evident is in the quantification questions regarding the number of how many new products have been developed, and in how much time, and how many new products will be developed, again in a measured amount of time. In addition, the CIS also asks other questions regarding end results: Did your enterprise introduce new or significantly improved goods? Were any of your goods and service innovations new to your market? Did your enterprise introduce new or significantly improved methods of manufacturing or producing goods or services? Did your enterprise engage in the following innovation activities (research and development, acquisition of machinery or software, etc.)? Table 1 compares the more common creativity measures previously mentioned and the innovation measures from the CIS.
<table>
<thead>
<tr>
<th>Personality/Ability</th>
<th>Creativity Assessments (CIS)</th>
<th>Innovation Assessments (ISA)</th>
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<td></td>
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<td>1. Active Imagination</td>
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<td>2. Flexibility</td>
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<td>4. Independence</td>
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<td>6. Tolerance for Ambiguity</td>
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<td>7. Trust in Own Senses</td>
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<td>8. Openness to Sub-conscious Material</td>
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<td>9. Ability to Work on Several Ideas Simultaneously</td>
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<td>10. Ability to Restructure Problems</td>
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<td>11. Ability to Abstract from the Concrete</td>
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<td>13. Fluency of Ideas</td>
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<td>14. Problem Recognition and Construction</td>
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<td>15. Unusual Combinations of Ideas</td>
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<td>16. Construction of Broad Categories</td>
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<td>17. Recognizing Solutions</td>
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<td>18. Transformation and Restructuring of Ideas</td>
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<td>19. Seeing Implications</td>
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<td>20. Elaborating and Expanding Ideas</td>
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<td>21. Self-directed Evaluation of Ideas</td>
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<td>Product</td>
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<td>22. Originality</td>
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<td>28. Elegance/Well-Craftedness</td>
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<td>30. Goal-Directedness</td>
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<td>Motivation</td>
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<td>32. Resistance to Premature Closure</td>
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<td>33. Risk-Taking</td>
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<td>34. Preference for Asymmetry</td>
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<td>35. Preference for Complexity</td>
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<td>36. Willingness to Ask Many (unusual) Questions</td>
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<td>37. Willingness to Display Results</td>
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<td>38. Willingness to Consult Other People</td>
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<td>39. Desire to Go Beyond the Conventional</td>
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<td>Innovation</td>
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<td>40. Research &amp; Development</td>
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<td>41. Acquisition of machinery, equipment, and software</td>
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<td>42. Acquisition of Knowledge</td>
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<td>45. Marketing</td>
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<td>47. Funding</td>
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CONCLUSION

The breadth and scope of this paper was to define the difference between creativity and innovation, outline the process of innovation, and discuss measures of innovation. Our research suggests that creativity is a subcomponent of the innovation process, and is focused on divergent ideas. In contrast the purpose of innovation is to use divergent ideas towards a convergent solution that is both highly novel and useful. Usefulness can be defined as the number of people that will benefit from the product, system, or service. Novelty is defined as being a highly unique, fresh, original and new product, system or service.

In the second part of the paper, innovation is defined as a practical creativity - where creativity is the preliminary part of the innovation process (divergence). The discussion in the second part of the paper then outlines the problems with only using creativity assessments to measure innovation, when creativity is only one part of the innovation process. Although the authors recognize and accept the importance of assessing the creativity component of innovation, there remains a need to create an assessment that assesses the innovation process as a whole. Future research should include developing an assessment that combines issues of convergence and divergence; therefore ensuring both creativity and innovation is being assessed.

REFERENCES


Ethical Response Behavior: A Study of Indian Consumers

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M. Saeed  
Minot State University

Andy Bertsch  
Minot State University

This paper was presented at the International Business Conference sponsored by the Center of Excellence in International Business of Northern State University, Aberdeen, South Dakota, USA. Questionnaires covering issues on the environment and marketing of products were collected from 374 respondents. The study reveals that respondent awareness of the extent of damage done as a result of economic activity is steadily growing. Consumers are becoming conscientious of adverse effects and are willing to pay more for eco-friendly products. Evidence exists that Asian Indians are aware and concerned about the environment but commitment to take proactive individual action is moderate.

INTRODUCTION

“Your planet needs you. Unite to respond to climate change.” is a slogan from the World Environment Day celebrated in India on June 5, 2009. The President of India - Smt. Pratibha Devi Singh Patil on that eventful day at Vigyan Bhawan, New Delhi - said that this slogan “is a reminder of the need for collective effort to tackle the threats emanating from climate change, with a major global environmental concern of our time”. She also said that “this challenge is global. It impacts each one of us in our habitats and affects our way of life. Hence, there is a responsibility of every citizen on the globe to contribute to the efforts to ensure the health and diversity of the planet as well as to protect and conserve its resources for future generations.”

With the steady increase in air, water, and noise pollution came an increase in average global temperature, increased glacial melting, decreasing forests, over extracting of minerals, nuclear testing and armaments, which collectively affect the world’s eco systems, agricultural industrial production, the availability of fresh water level, and forest life. With all this, the struggle of human beings to balance the environment for mere survival increases. In the end, consumers are becoming aware of environmental issues and are trying to change their lifestyles. As consumers are becoming aware of environmental issues, the challenge for business is to develop products and services that deliver environmental benefits, without compromising and even improving on quality, functionality, and performance at reasonable prices. Some industries might be struggling to face the challenge, while many industries in India have already carved out a niche for marketing environmentally friendly products. A number of businesses are
responding to this challenge by redesigning the business model and focusing on the service demanded rather than the product. This is creating new opportunities for the innovative business. The role of governments and media becomes very important. They should provide detailed information to end consumers and should invest in research and development of environmentally friendly products. Consumer behavior has been slow to adapt as there are still consumers buying paper produced directly from trees rather than recycled paper, consumers buying conventional bulbs instead of energy-efficient, consumers preferring to use air travel rather than ground transportation such as train service - even for short distance. The decisions of such consumers are based on utility maximizing behavior but there should be a trade-off between utility derived from preferred characteristics of a product vs. the moral behaviors of buying “green” which is becoming an expected trait of every member of society. So merely chanting mantras ‘Go Green’ will not help. What is required is active participation, especially by consumers.

It is our ethical duty to act properly in order to reduce the threat of climate change even if one assumes there is more scientific uncertainty about the causes and impacts of climate change. Nevertheless, there is a swell of scientific consensus most recently articulated by the Intergovernmental Panel on Climate Change (IPCC). In its fourth assessment in November of 2007, the IPCC made the following key conclusions:

- It is very likely that observed increases in global average temperatures since the mid-20th century have been caused by increases in anthropogenic greenhouse gas (GHG) emissions.
- Warming of the global climate system is clear.
- Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized.
- The probability that this is caused by natural climatic processes alone is less than 5 percent.
- World temperatures could rise by between 1.1 and 6.4 °C (2.0 and 11.5 °F) during the 21st century.
- There is high confidence (greater than 90%) that there will be more frequent warm spells, heat waves and heavy rainfall.
- There is a 66 percent confidence level that there will be an increase in droughts, tropical cyclones and extreme high tides.
- Both past and future anthropogenic carbon dioxide emissions will continue to contribute to global warming and sea level rises for more than a millennium (IPCC, 2007).

In environmental controversies such as global warming where there is legitimate scientific concern, important ethical questions arise when scientific uncertainty prevents unambiguous predictions of human health and environmental consequences. This is so because decision-makers cannot duck ethical questions such as how conservative “should” scientific assumptions be in the face of uncertainty or who “should” bear the burden of proof about the collective harm. To ignore these questions is to decide to expose human health and the environment to a legitimate risk; that is, a decision to not act on a serious environmental threat could have consequences, particularly if waiting until all uncertainties are resolved could increase the overall adverse effects. Science alone cannot tell us what assumptions or concerns should be considered in making a judgment about potentially dangerous behavior. For this reason, environmental decisions in the face of scientific uncertainty must be understood to raise a combination of ethical and scientific questions.

From the standpoint of ethics, those who engage in risky behavior are not exonerated simply because they did not know that their behavior would actually cause harm (e.g. ignorance is not an excuse). As a matter of ethics, a relevant question in the face of scientific uncertainty about harmful consequences of human behavior is whether there is a reasonable basis for concluding that serious harm to others could result from the behavior. Yet, as we have seen, in the case of climate change, humans have understood the potential threat from climate change for over one hundred years and the scientific support for this concern has been building at a quickened rate over the last thirty years. In fact, for more than 18 years, the IPCC, a
scientific body created with the strong support of governments around the world to advise them about the conclusions of peer review climate change science, has been telling the world, with increasing levels of confidence, that the harm from climate change is not only possible but likely.

LITERATURE REVIEW

Various studies conducted on environmental degradation reveal that awareness is steadily growing concerning the extent of damage done through economic activity. Consumers are becoming conscious of adverse affects and are willing to pay more for eco-friendly products. For example, eight in ten Americans consider themselves to be environmentalists and half claim to be strongly so while acknowledging the need to modify their lifestyle (Gutfield, 1991). It appears that consumers are concerned about the environment and are ready to modify their purchasing behaviors (Polonsky et al., 1995) to support a "green" brand (Oyewole, 2001). Environmentally conscious consumers were found to be very much willing to pay premium prices to purchase environmentally friendly products (Dunlap and Scarce 1991; Michael Peters Group, 1991). Many researchers suggest that consumers’ concern for environmental issues is growing (Lee and Holden, 1999; Berger & Corbin, 1992; Lord, 1994; and Schwartz & Miller, 1991). However, there is little evidence that this has led to appropriate changes in pro-environmental consumer behavior (Schwartz & Miller, 1991). Lee and Holden (1999) suggested that in order to change consumer behaviors, it is important that producers understand the determinants of pro-environmental consumer behavior and appreciate the motivations underlying these conscious behaviors by examining ‘attitude-behavior’ consistency. However, using this model alone is not a good predictor of behavior (Heslop, Moran, & Cousineau, 1981; Ritchie, Gordon, McDougall, & Claxton, 1981). Other variables should also be considered including affect (Smith, Haugtvedt, Petty, 1994), cost-benefit (Wasik, 1992), perceived consumer effectiveness (Berger and Corbin, 1992; Ellen, Wiener, & Cobb-Walgren, 1991), faith in others (Berger and Corbin, 1992), and demographic characteristics (Granzin and Olsel, 1991; Soutar, Ramaseshan, & Molster, 1994). In an article titled “Earth Island Journal, Global Marketplace”, (2000), the most prominent environmental problem pertains to disposable diapers and plastic bottles. Diapers not only consume trees but also clog landfills. Chemically treated diapers are also linked to an increase in diaper rash which caused many parents to drop the use of disposable diapers soon after. However, producers like Procter & Gamble and Kimberley-Clark’s improved their products and unleashed strategic advertisements to regain the trust of parents by treating the diapers with yet another chemical. Friends of the Earth (2002) reported that North Americans alone discard 1.5 million plastic bottles a day which mostly end up in landfills. Coca Cola was one of the major contributors to this problem. Coca Cola tried to use recycled plastics but stopped after only a few years and returned to virgin plastic – claiming that it was too costly to use recycled plastic. Innovators of these items seem to forget about environmental deterioration during the product development stage. Producers should consider redesigning their products in order to reduce these problems.

Based on detailed interviews, Wansink (2000) has outlined specific strategies to help consumers shop, use, and dispose of products more carefully and less wastefully. According to Wansink (as cited in Wansink & Despande, 1994), many consumers buy products they never actually use. It has been indicated that as many as 15% of non-perishable products are never used and eventually discarded. This is not an issue of wasting money but it is an issue of wasting increasingly limited resources. Attitudes seem to vary regarding what causes consumers to buy products they never use, and how consumers can change their purchase and usage habits to reduce product abandonment that finally leads to product disposal. This study is an attempt to analyze how attitude influences consumers’ product purchase, use, and disposal (Rosli, Abdullah, Bertsch & Saeed, 2008). Questions germane to this study include: 1. Do Indian consumers prefer eco-friendly products?; 2. Do Indian consumers aware of the dangers of economic degradation?; 3. Are Indian Consumers proactive in solving the environmental problems?
METHODOLOGY

Instrument and Sample

Data was gathered using a questionnaire tested by Rosli, Abdullah, Bertsch & Saeed in their study of environmental awareness of Malaysian consumers; a replication of Lee and Holden (1999) and Wagner (1997). The questionnaire was used after incorporating several local variables suitable for the Indian environment. A convenience sample of 374 respondents included employed and unemployed students and retired people. The sample covered urban and rural areas with respondents ranging between 18 and 70 years of age. The questionnaire included the demographic background of the respondents; awareness variables (5 questions), and behavioral variables (23 items). The behavioral measures included inquiry into the respondents’ participation in any programs that will ensure a safe environment such as the use of biodegradable products, public transportation, safe garbage disposal, or any such activities supporting the environment, a government program, or response to a lobbyist group. A Likert scale (‘1’ = not at all to ‘5’ = very much) was used. The behavioral section also asked respondents whether they agree or disagree to a list of statements concerning steps to be undertaken by individuals, groups, and the government. A Likert scale (‘1’ = strongly disagree to ‘5’ = strongly agree) was used.

Statistical Analysis

Awareness variables and behavioral variables were analyzed separately. A reliability analysis was run on both sets of variables. As discussed in Rosli, Abdullah, Bertsch & Saeed (2008), we have also considered variables deemed appropriate to the Indian context. Reliability and validity were tested.

To begin, factor analysis was applied on those awareness variables representing awareness level as shown in Table 1.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>0.651</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>0.701</td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>0.696</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.525</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems.</td>
<td>0.363</td>
</tr>
</tbody>
</table>

Second, a reliability test was run and illustrated in Table 2. With a coefficient alpha of 0.74, the reliability test for the awareness variables was higher than the 0.70 threshold set Hair et. al., (1998).
TABLE 2
RELIABILITY TEST ON AWARENESS VARIABLES

<table>
<thead>
<tr>
<th>Variables (1 – strongly disagree, 5 – strongly agree)</th>
<th>Item-to-total correlation</th>
<th>Coefficient α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>0.587</td>
<td>0.740</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>0.687</td>
<td></td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>0.642</td>
<td></td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.552</td>
<td></td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems.</td>
<td>0.489</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 illustrates that the coefficient alpha for the behavioral variables was also high at 0.758. Twenty-two items measuring the behavioral variables indicated that the overall internal consistency was high except for items 1 and 20 which both had item-to-total coefficients less than 0.3. When these items were deleted and reliability test rerun, the coefficient alpha showed no significant improvement so these items were retained for the purpose of further analysis.

TABLE 3
RELIABILITY TEST ON BEHAVIORAL VARIABLES

<table>
<thead>
<tr>
<th>Variables</th>
<th>Item-to-total correlation</th>
<th>Coefficient α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale: (1 = not at all, 5 = very much)</td>
<td></td>
<td>0.758</td>
</tr>
<tr>
<td>Behav1: Participate in recycling program during the last year?</td>
<td>0.253</td>
<td></td>
</tr>
<tr>
<td>Behav2: Seek out biodegradable products?</td>
<td>0.464</td>
<td></td>
</tr>
<tr>
<td>Behav3: Car pooled, walked, biked, or taken public transport?</td>
<td>0.512</td>
<td></td>
</tr>
<tr>
<td>Behav4: Consciously avoid Styrofoam packaging?</td>
<td>0.394</td>
<td></td>
</tr>
<tr>
<td>Behav5: Separate garbage for recycling?</td>
<td>0.446</td>
<td></td>
</tr>
<tr>
<td>Behav6: Active member of environmental group?</td>
<td>0.451</td>
<td></td>
</tr>
<tr>
<td>Behav7: Given monetary help to clean up environment?</td>
<td>0.398</td>
<td></td>
</tr>
<tr>
<td>Behav8: Written to the government or lobby group about the environment?</td>
<td>0.305</td>
<td></td>
</tr>
<tr>
<td>Behav9: Attended rallies or demonstration on environmental issues?</td>
<td>0.362</td>
<td></td>
</tr>
<tr>
<td>Behav10: In the interest of protecting the environment, I am willing to pay five cents a liter more for gasoline to decrease air pollution.</td>
<td>0.517</td>
<td></td>
</tr>
<tr>
<td>Behav11: In the interest of protecting the environment, I am willing to pay 10% more for groceries packaged and produced in an environmentally safe way?</td>
<td>0.438</td>
<td></td>
</tr>
<tr>
<td>Behav12: In the interest of protecting the environment, I am willing to pay Rs. 1000 more for a car that emitted less air pollution?</td>
<td>0.373</td>
<td></td>
</tr>
<tr>
<td>Behav13: In the interest of protecting the environment, I am willing to pay 50% more for garbage collection for safe long-term disposal?</td>
<td>0.435</td>
<td></td>
</tr>
<tr>
<td>Behav14: In the interest of protecting the environment, I am willing to buy unbleached paper products such as toilet paper, and paper towels, which are kind of brown in color, in place of the bleached white paper products?</td>
<td>0.355</td>
<td></td>
</tr>
</tbody>
</table>
Variables

<table>
<thead>
<tr>
<th>Item</th>
<th>Total correlation</th>
<th>Coefficient α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behav15: In the interest of protecting the environment, I am willing to pay Rs. 250 a year more taxes to clean up your community’s sewage system?</td>
<td>0.457</td>
<td></td>
</tr>
<tr>
<td>Behav16: In the interest of protecting the environment, I am willing to pay 10% tax on all the energy that you use to promote conservation?</td>
<td>0.449</td>
<td></td>
</tr>
<tr>
<td>Behav17: In the interest of protecting the environment, I am willing to support the environmental campaign? e.g. recycling campaigns.</td>
<td>0.484</td>
<td></td>
</tr>
<tr>
<td>Behav18: In the interest of protecting the environment, I am willing to support the government doubling the amount of land designated as natural wilderness?</td>
<td>0.458</td>
<td></td>
</tr>
<tr>
<td>Behav19: In the interest of protecting the environment, I am willing to support the law requiring all household garbage to be separated into different classes for recycling?</td>
<td>0.446</td>
<td></td>
</tr>
<tr>
<td>Behav20: In the interest of protecting the environment, I am willing to support tax breaks and incentives to industry to encourage development and implementation of clean technology?</td>
<td>0.260</td>
<td></td>
</tr>
<tr>
<td>Behav21: In the interest of protecting the environment, I am willing to support the government control to reduce packaging on consumer goods?</td>
<td>0.384</td>
<td></td>
</tr>
<tr>
<td>Behav22: In the interest of protecting the environment, I am willing to support stiff penalties, jail sentences for polluters?</td>
<td>0.379</td>
<td></td>
</tr>
</tbody>
</table>

The 22 behavioral items were collapsed into four variables as suggested by Rosli, Abdullah, Bertsch & Saeed (2008):
- Personal practice (PRAC): items 1, 2, 3, 4, and 5
- Support group (GRPSUP): items 6, 8, 9 and 17
- Monetary support (MONSUP): items 7, 10, 11, 12, 13, 14, 15 and 16.
- Support government (GOVSUP): items 18, 19, 20, 21, and 22.

The collective reliability test for the above four collapsed variables revealed a coefficient alpha of 0.758. The reliability coefficient for four collapsed variables is given in Table 4. The correlation matrix of the variables for the awareness and behavioral variables are given in Tables 5 and 6 respectively.

**TABLE 4**

**RELIABILITY TEST ON COLLAPSED VARIABLES**

<table>
<thead>
<tr>
<th>Variables (1 – strongly disagree, 5 – strongly agree)</th>
<th>Item-to-total correlation</th>
<th>Coefficient α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal practice (PRAC):</td>
<td>0.513</td>
<td></td>
</tr>
<tr>
<td>Support group (GRPSUP)</td>
<td>0.440</td>
<td>0.758</td>
</tr>
<tr>
<td>Monetary support (MONSUP):</td>
<td>0.555</td>
<td></td>
</tr>
<tr>
<td>Support government (GOVSUP):</td>
<td>0.504</td>
<td></td>
</tr>
</tbody>
</table>

**ANALYSIS AND FINDINGS**

**Profile of Respondents**
Table 5 illustrates the demographics of the sample. Interestingly, 82.4% of the respondents were in the age range of 18-40 years old which is a respectable demographic given the nature of the research. The
respondents were mostly educated with 96.3% having at least a certificate level education. In terms of income, 48.5% of the respondents have a monthly total family income of less than Rs. 20,000 while 51.5% have a monthly total family income of more than Rs. 20,000. There were a similar number of respondents holding managerial and non-managerial positions (43.5% and 41.2% respectively). As was stated earlier, the sample was based on convenience; nevertheless, the authors feel the demographic makeup of the respondents is rather respectable likely allows the results to be generalized to the greater population.

**TABLE 5**

**PROFILE OF RESPONDENTS**

<table>
<thead>
<tr>
<th>Items</th>
<th>Frequency (374)</th>
<th>Percent 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>209</td>
<td>55.9</td>
</tr>
<tr>
<td>Female</td>
<td>165</td>
<td>44.1</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 25</td>
<td>107</td>
<td>28.6</td>
</tr>
<tr>
<td>26 – 30</td>
<td>74</td>
<td>19.8</td>
</tr>
<tr>
<td>31 – 35</td>
<td>46</td>
<td>12.3</td>
</tr>
<tr>
<td>36 – 40</td>
<td>81</td>
<td>21.7</td>
</tr>
<tr>
<td>41 – 45</td>
<td>34</td>
<td>9.1</td>
</tr>
<tr>
<td>46 – 50</td>
<td>19</td>
<td>5.1</td>
</tr>
<tr>
<td>51 – 55</td>
<td>09</td>
<td>2.4</td>
</tr>
<tr>
<td>56 and above</td>
<td>04</td>
<td>1.1</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>153</td>
<td>40.9</td>
</tr>
<tr>
<td>Single</td>
<td>221</td>
<td>59.1</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D.</td>
<td>33</td>
<td>8.8</td>
</tr>
<tr>
<td>Masters</td>
<td>84</td>
<td>22.5</td>
</tr>
<tr>
<td>Graduates</td>
<td>161</td>
<td>43.0</td>
</tr>
<tr>
<td>Primary Education</td>
<td>75</td>
<td>20.1</td>
</tr>
<tr>
<td>Certificate</td>
<td>7</td>
<td>1.9</td>
</tr>
<tr>
<td>Illiterate</td>
<td>14</td>
<td>3.7</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Than Rs. 5000</td>
<td>26</td>
<td>7.0</td>
</tr>
<tr>
<td>Rs.5001 – Rs.10000</td>
<td>65</td>
<td>17.4</td>
</tr>
<tr>
<td>Rs. 10,001 – Rs. 20,000</td>
<td>90</td>
<td>24.1</td>
</tr>
<tr>
<td>Rs. 20,001 – Rs. 30,000</td>
<td>45</td>
<td>12.0</td>
</tr>
<tr>
<td>Rs. 30,001 – Rs. 40,000</td>
<td>43</td>
<td>11.5</td>
</tr>
<tr>
<td>Rs. 40,001 – Rs. 50,000</td>
<td>27</td>
<td>7.2</td>
</tr>
<tr>
<td>Rs. 50,001 – Rs. 60,000</td>
<td>24</td>
<td>6.4</td>
</tr>
<tr>
<td>More than Rs. 60,001</td>
<td>54</td>
<td>14.4</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>37</td>
<td>43.5</td>
</tr>
<tr>
<td>Non-management</td>
<td>35</td>
<td>41.2</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5</td>
<td>5.9</td>
</tr>
<tr>
<td>Student</td>
<td>8</td>
<td>9.4</td>
</tr>
<tr>
<td>Items</td>
<td>Frequency (374)</td>
<td>Percent 100</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Working Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 5 years</td>
<td>108</td>
<td>28.9</td>
</tr>
<tr>
<td>6 - 10 years</td>
<td>48</td>
<td>12.8</td>
</tr>
<tr>
<td>11 – 15 years</td>
<td>49</td>
<td>13.1</td>
</tr>
<tr>
<td>16 – 20 years</td>
<td>85</td>
<td>22.7</td>
</tr>
<tr>
<td>21 – 25 years</td>
<td>42</td>
<td>11.2</td>
</tr>
<tr>
<td>More than 25 years</td>
<td>42</td>
<td>11.2</td>
</tr>
</tbody>
</table>

**Awareness Variables Analysis**

Table 6 includes the means and standard deviations (SD) for the awareness variables.

**TABLE 6**

MEANS AND STANDARD DEVIATIONS OF AWARENESS VARIABLES

<table>
<thead>
<tr>
<th>Items</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>4.2086</td>
<td>0.85978</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>3.6765</td>
<td>1.04824</td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>4.2166</td>
<td>.92255</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>3.8663</td>
<td>.94247</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems.</td>
<td>3.9545</td>
<td>.95786</td>
</tr>
</tbody>
</table>

With the Likert scale of ‘1’ (strongly disagree) to ‘5’ (strongly agree), the results indicate that, taken as a whole, respondents’ awareness on the environmental conditions are quite high. They agree that the environment is being destroyed (Aware1 mean > 4.00) and that environmental groups should be more active (Aware3 mean > 4.00). With a mean of nearly four (Aware mean = 3.955), respondents also feel that they can do something to help save the environment. Regarding the steps that should be undertaken to save the environment (Aware2 mean of 3.676) and that protecting the environment is important (Aware4 mean of 3.866), the response is moderate yet above the midpoint of this one to five scale. Thus Indian consumers have a moderate to high awareness level.

**Behavioral Variables Analysis**

In Table 7, it can be seen that the respondents are very supportive of government’s efforts to solve environmental problems (GOVSUP mean 3.85); while on their own they are less willing to put into practice certain behaviors that could help save the environment (PRAC mean 2.843), less willing to give full support to environmental groups (GRPSUP mean 3.04), and less willing to give monetary support (MONSUP mean 3.60).
TABLE 7
MEANS OF BEHAVIORAL VARIABLES
(all p values where <0.001)

<table>
<thead>
<tr>
<th>Variables (1 – not at all, 5 – very much)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behav1: Participate in recycling program during the last year?</td>
<td>1.9251</td>
</tr>
<tr>
<td>Behav2: Seek out biodegradable products?</td>
<td>2.7674</td>
</tr>
<tr>
<td>Behav3: Car pooled, walked, biked, or taken public transport?</td>
<td>3.1684</td>
</tr>
<tr>
<td>Behav4: Consciously avoid Styrofoam packaging?</td>
<td>3.3021</td>
</tr>
<tr>
<td>Behav5: Separate garbage for recycling?</td>
<td>3.0535</td>
</tr>
<tr>
<td><strong>Personal Practice (PRAC, mean of Behave1 thru 5)</strong></td>
<td><strong>2.8433</strong></td>
</tr>
<tr>
<td>Behav6: Active member of environmental group?</td>
<td>3.0107</td>
</tr>
<tr>
<td>Behav8: Written to the government or lobby group about the environment?</td>
<td>2.9626</td>
</tr>
<tr>
<td>Behav9: Attended rallies or demonstration on environmental issues?</td>
<td>2.3048</td>
</tr>
<tr>
<td>Behav17: In the interest of protecting the environment, I am willing to support the environmental campaign? e.g. recycling campaigns.</td>
<td>3.9037</td>
</tr>
<tr>
<td><strong>Support Group (GRPSUP, mean of Behave6, 8, 9, and 17)</strong></td>
<td><strong>3.0454</strong></td>
</tr>
<tr>
<td>Behav7: Given monetary help to clean up environment?</td>
<td>2.6818</td>
</tr>
<tr>
<td>Behav10: In the interest of protecting the environment, I am willing to pay five cents a liter more for gasoline to decrease air pollution.</td>
<td>3.6417</td>
</tr>
<tr>
<td>Behav11: In the interest of protecting the environment, I am willing to pay 10% more for groceries packaged and produced in an environmentally safe way?</td>
<td>3.7620</td>
</tr>
<tr>
<td>Behav12: In the interest of protecting the environment, I am willing to pay RS. 1000 more for a car that emitted less air pollution?</td>
<td>3.7888</td>
</tr>
<tr>
<td>Behav13: In the interest of protecting the environment, I am willing to pay 50% more for garbage collection for safe long-term disposal?</td>
<td>3.8262</td>
</tr>
<tr>
<td>Behav14: In the interest of protecting the environment, I am willing to buy unbleached paper products such as toilet paper, and paper towels, which are kind of brown in color, in place of the bleached white paper products?</td>
<td>3.8102</td>
</tr>
<tr>
<td>Behav15: In the interest of protecting the environment, I am willing to pay RS. 250 a year more taxes to clean up your community’s sewage system?</td>
<td>3.6364</td>
</tr>
<tr>
<td>Behav16: In the interest of protecting the environment, I am willing to pay 10% tax on all the energy that you use to promote conservation?</td>
<td>3.6658</td>
</tr>
<tr>
<td><strong>Monetary Support (MONSUP, mean of Behave7, and 10-16)</strong></td>
<td><strong>3.6016</strong></td>
</tr>
<tr>
<td>Behav18: In the interest of protecting the environment, I am willing to support the government doubling the amount of land designated as natural wilderness?</td>
<td>3.8128</td>
</tr>
<tr>
<td>Behav19: In the interest of protecting the environment, I am willing to support the law requiring all household garbage to be separated into different classes for recycling?</td>
<td>4.0000</td>
</tr>
<tr>
<td>Behav20: In the interest of protecting the environment, I am willing to support tax breaks and incentives to industry to encourage development and implementation of clean technology?</td>
<td>3.8690</td>
</tr>
<tr>
<td>Behav21: In the interest of protecting the environment, I am willing to support the government control to reduce packaging on consumer goods?</td>
<td>3.9920</td>
</tr>
<tr>
<td>Behav22: In the interest of protecting the environment, I am willing to support stiff penalties, jail sentences for polluters?</td>
<td>3.5829</td>
</tr>
<tr>
<td><strong>Support Government (GOVSUP, mean of Behave18 thru 22)</strong></td>
<td><strong>3.8513</strong></td>
</tr>
</tbody>
</table>
Thus, it can be deduced that the respondents in this study are aware of the worsening condition of the environment and realize that steps should be taken to protect and save the environment; however they are not fully committed to undertaking individual actions to remedy the situations. They would rather expect the government, industries, and environmental protection groups to undertake these responsibilities. The results are almost similar to the study conducted on Malaysian consumers (Rosli, Abdullah, Bertsch & Saeed, 2008) except that in India, there is a higher level of awareness. However, when it comes to behavioral tendencies and ownership of the issue, the Indian consumers are more dependent upon government rather than individual efforts compared to the Malaysian study (Rosli, Abdullah, Bertsch & Saeed, 2008).

Regression Analyses

In order to analyze possible relationships between the various awareness variables (Tables 1, 2, and 6 from above) and the collapsed behavioral variables (Tables 3, 4, and 7 from above), a series of regression analyses were completed. Results are discussed herein.

Awareness Variables to PRAC

A multiple regression analysis was run using all five Awareness variables as independent variables and the single collapsed PRAC variable as the dependent variable. Table 8 illustrates the correlation coefficients and significance of the awareness variables against the dependent variable PRAC. The results revealed three awareness variables that have no affect on the practices (PRAC) of the respondents. The awareness variables that had insignificant p-values (at the 0.05 level) were Aware1, Aware2, and Aware3.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>0.015</td>
<td>0.74</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>0.006</td>
<td>0.88</td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>0.039</td>
<td>0.36</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.079</td>
<td>0.049</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.108</td>
<td>0.005</td>
</tr>
</tbody>
</table>

A second multiple regression was run with the three insignificant variables removed from the analysis. Table 9 summarizes the results of this second regression analysis. The p-values for the two remaining awareness variables improved slightly from the first model in Table 9. This is not surprising as there was significant correlation between several of the five awareness variables.
TABLE 9
REGRESSION ANALYSIS #2: AWARENESS AND PRAC

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.089</td>
<td>0.021</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.116</td>
<td>0.002</td>
</tr>
</tbody>
</table>

As a result of the above regression, it is reasonable to conclude that the two awareness variables (Aware4 and Aware5) influence practices (PRAC) of the Indian respondents. Most importantly may be the correlation between Indian people feeling they are cable of helping to solve environmental problems (Aware5) and actually putting those beliefs into practice (PRAC). However, it is necessary to point out that the relationship described in Table 9 above is very weak (R-squared = 0.04) where the two awareness variables only explain 4% of the variance in practices.

Awareness Variables to GRPSUP

A multiple regression analysis was run using all five Awareness variables as independent variables and the single collapsed GRPSUP variable as the dependent variable. Table 10 illustrates the correlation coefficients and significance of the awareness variables against the dependent variable GRPSUP. The results revealed two awareness variables that have no affect on the environmental group support (GRPSUP) of the respondents. The awareness variables that had insignificant p-values (at the 0.05 level) were Aware1 and Aware3. A rather surprising result of this analysis was the negative correlation between awareness variable #2 and the dependent variable GRPSUP. Discussion of this interesting result will be reserved until the insignificant variables are removed from the model.

TABLE 10
REGRESSION ANALYSIS #1: AWARENESS AND GRPSUP

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>0.066</td>
<td>0.185</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>-0.145</td>
<td>0.000</td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>-0.016</td>
<td>0.725</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.118</td>
<td>0.007</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.130</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 11 summarizes the results of a second multiple regression which was ran after removing the insignificant variables Aware1 and Aware3. The p-values for the three remaining awareness variables remained relatively unchanged from the first model above. As stated earlier, a surprising finding is the negative correlation between Aware2 and the respondents’ support of environmental group efforts. However after closer look, this seems rather reasonable as the Aware2 variable actually queries respondents’ perceptions of things that can be done to help save the environment. If respondents feel there are other things that can be done (indicative of a negative response to this particular survey item), they may seek out environmental groups that are worthy of their support.
TABLE 11
REGRESSION ANALYSIS #2: AWARENESS AND GRPSUP

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>-0.135</td>
<td>0.001</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.122</td>
<td>0.005</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.128</td>
<td>0.002</td>
</tr>
</tbody>
</table>

The ‘Awareness vs. Group Support’ regression analysis illustrates a correlation between Indian respondents feeling there are additional things that can be done to help save or improve the environment (beside those pointed out in Aware2) and a willingness to be supportive of environmental group efforts. Similar to the practices (PRAC) analysis performed earlier, Aware4 and Aware5 are two variables that significantly contribute to the respondents’ willingness to support environmental group efforts. The two significant variables of ‘environmental protection is important’ (Aware4) and respondents seeing themselves as a part of the solution (Aware5) are significantly correlated to environmental group support (GRPSUP). However, like the PRAC model above, it is necessary to point out that the relationship described in Table 11 is very weak ($R^2 = 0.06$) where the three awareness variables only explain 6% of the variance in group support.

Awareness Variables to MONSUP

A multiple regression analysis was run using all five Awareness variables as independent variables and the single collapsed MONSUP variable as the dependent variable. Table 12 illustrates the results of this regression. Results reveal only two significant awareness variables (Aware2 and Aware5) that affect the monetary support variable (MONSUP) of the respondents.

TABLE 12
REGRESSION ANALYSIS #1: AWARENESS AND MONSUP

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>0.070</td>
<td>0.078</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>0.105</td>
<td>0.001</td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>-0.010</td>
<td>0.796</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.057</td>
<td>0.105</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.089</td>
<td>0.008</td>
</tr>
</tbody>
</table>

A multiple regression was run again after removing the insignificant variables from the model above. Table 13 summarizes the results of this second regression analysis.
TABLE 13
REGRESSION ANALYSIS #2: AWARENESS AND MONSUP

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>0.133</td>
<td>0.00002</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.089</td>
<td>0.008</td>
</tr>
</tbody>
</table>

As a result of the ‘Awareness vs. Monetary Support’ analyses, it is reasonable to conclude that feelings of things that can be done to help save or improve the environment (beyond those listed in the Aware2 variable) and being part of the solution do, indeed, result in an increase in monetary support. This finding is similar to the previous two behavioral variables (PRAC and GRPSUP) where respondents feel they are capable of making a difference ( Aware5) and are doing so through practices (PRAC) and group support (GRPSUP). However, the trend of weak yet significant relationships continues as the relationship described in Table 13 above is also very weak ($R^2 = 0.08$); whereby the two remaining awareness variables only explain 8% of the variance in monetary support.

Awareness Variables to GOVSUP

A multiple regression analysis was run using all five Awareness variables as independent variables and the single collapsed GOVSUP variable as the dependent variable. Table 14 summarizes the results of this regression where three awareness variables ( Aware1, Aware2, and Aware5) have statistically significant affect on the respondents’ support of governmental efforts to save or restore the environment (GOVSUP).

TABLE 14
REGRESSION ANALYSIS #1: AWARENESS AND GOVSUP

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware1: We are in serious danger of destroying the world environment in the very near future.</td>
<td>0.078</td>
<td>0.023</td>
</tr>
<tr>
<td>Aware2: Drastic change and reductions in mining and other’s lifestyles are the only way we can save the environment.</td>
<td>0.156</td>
<td>0.00000009</td>
</tr>
<tr>
<td>Aware3: It’s time for environment groups to get more radical/active.</td>
<td>0.015</td>
<td>0.644</td>
</tr>
<tr>
<td>Aware4: Protecting the natural environment should be more important than creating economic growth and employment in poor countries.</td>
<td>0.032</td>
<td>0.293</td>
</tr>
<tr>
<td>Aware5: I am capable of helping to solve the environmental problems</td>
<td>0.077</td>
<td>0.009</td>
</tr>
</tbody>
</table>

A multiple regression was run again after removing the insignificant variables from the model above. Table 15 summarizes the results of this second regression analysis.
As a result of the ‘Awareness vs. Government Support’ regression analysis, it is reasonable to conclude that Indian respondents who feel the environment is in danger (Aware1) and feel that efforts must go beyond changes in mining and lifestyles (Aware2) are supportive of governmental efforts to save and restore the environment. Indians also see themselves as part of the solution through their support of governmental efforts. As has been a common theme to these regression models, the relationship described in Table 16 above, although the strongest of all the final regression models, is also very weak (R-squared = 0.16); whereby the three awareness variables only explain 16% of the variance in governmental support.

**Awareness Variables to All Behavior**

Regression was run on all five Awareness variables and the average of all the Behavioral variables. The only two significant awareness variables in this regression run were Aware4 (p < 0.0005) and Aware5 (p < 0.00002). However, these two variables only explain 8% of the total variance in the collective behavior of the respondents (R-squared = 0.08).

Although the above models were rather week (all R-squared values were below 20%), an encouraging finding can be taken away from this research effort. In all of the regression analyses described above, a significant contributor to each and every behavioral variable is the notion that Indian respondents do, indeed, see themselves as part of the solution. The awareness variable (Aware5) exists as a significant variable in each of the final four models - practices, group support, monetary support, and support of governmental efforts.

**Demographic Variables to Awareness Variables**

A final regression analysis was undertaken to determine if a relationship exists between any of the demographic variables (age, employment status, marital, education, income & working experience) and the four collapsed behavioral variables – Personal Practice (PRAC), Support Group (GRPSUP), Monetary Support (MONSUP), and Support Government (GOVSUP). Table 16 summarizes the significant (yet weak) findings. A weak yet significant relationship (negative) was found to exist between Income and Personal Practice (PRAC) (R square = 0.014, p = .022). This was a rather odd finding due to the counter-intuitive outcome of an increase in income reducing the respondents’ likelihood of modifying their personal practices. Also, a weak negative significant relationship was found to exist (R square = .016, p=.015) between age and Support Group (GRPSUP). This is not surprising as younger generations are more environmentally concerned and likely to find comfort in group support networks. A weak, yet statistically significant relationship was found between Employment status and Support Government (GOVSUP) (R square= 0.014; p = 0.023).
TABLE 16
REGRESSION ANALYSIS: BEHAVIORS AND SELECT DEMOGRAPHIC VARIABLES

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Demographic variable</th>
<th>R-square</th>
<th>Standardized regression coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Practice (PRAC)</td>
<td>Income</td>
<td>0.014</td>
<td>-0.119</td>
</tr>
<tr>
<td>Support Group (GRPSUP)</td>
<td>Age</td>
<td>0.016</td>
<td>-0.126</td>
</tr>
<tr>
<td>Support Government (GOVSUP)</td>
<td>Employment status</td>
<td>0.014</td>
<td>0.117</td>
</tr>
</tbody>
</table>

CONCLUSIONS AND RECOMMENDATIONS

Rise in literacy rates and exposure to the West, satellite television, newspapers, foreign magazines, and newspapers have all led to the accelerated rise of the knowledgeable Indian consumer. Today, more and more of Indian consumers have become choosy and demand quality products at competitive prices. They prefer to purchase from renowned retail stores, where accountability is evident. In India, big brand products are endorsed by celebrities to promote specific products and brands. Known as brand ambassadors, these stars are said to lend personality to products thereby building a perpetual presence in the minds of consumers. As visual media gains more popularity, the number of celebrities being employed in the TV media has also increased significantly. Celebrities help create hot-selling headlines. Their activities and movements are closely monitored by media outlets. Celebrity product endorsements are picked up by the common masses with consummate ease. Using celebrities in advertisements has become common place. Indians love their heroes and heroines. So if a consumer finds their lovable celebrity endorsing a particular brand, it becomes easier for them to relate to the product and therefore have more optimistic feelings towards the advertisement and the brand itself. Moreover, it is an established fact that marketing strategies that include celebrity endorsement has high recall rates. Celebrities also aid in repositioning of products. Products with dropping sales can be rescued by smart selling ads by leading celebrities. Thus, Indian consumers prefer eco-friendly products.

The responses in this study suggest that Indian consumers are concerned about the deteriorating environmental conditions, but they are not doing much to preserve or protect the environment (see the low R-squared values of the four regression models above). The research finds that Indians are very much concerned about environmental degradation but they are doing very little to save the environment. This conclusion is clearly evident from the low R-squared values in each of the regression models. Although they feel there is much that can be done (Aware4) and they also feel somewhat empowered (Aware5), these two variables only account for very little of the variance in the behavior of the sampled Indians (see above regression analyses). It is further established that the topic of environmental awareness is not included in school and college teachings. A regression analysis between the education level and behavior of the respondents shows an insignificant relationship indicating that education has yet to be able to influence the behavior of Indian consumers.

Our study also suggests that Indians are not proactive in taking the initiative to solve the problem of environmental degradation. However, in India’s quest for continued high economic growth, the government is taking steps to ensure that environmental and social considerations are not neglected and are in line with the nation’s philosophy of balanced and sustainable development. Article 21 of the Constitution of India has become an effective tool for preservation of the environment and ecological systems. For the preservation of the environment, the Central Government and State Governments have enacted many statutes such as the Wildlife Protection Act of 1972, the Environmental Protection Act of 1986, the Air (Prevention and control of Pollution) Act of 1981, the National Environment Tribunal Act
of 1995, among others. In hopes of educating the people, the Central Government has launched the National Environmental Awareness Campaign through the Ministry of Environment and Forest every year since 1986 with the objective of increasing the environmental awareness level throughout India. To achieve this, environmental and conservation considerations should increasingly be integrated with development planning.

In recent times, a lot of pressure has been exerted on the environment due to three factors: growing population; increased industrialization; and the persistence of poverty. These pressures have been exacerbated by the recent economic downturn in the region, which has had economic and social consequences on the capacity of some governments to implement planned activities relating to environmental protection and sustainable development. Developed countries are mostly industrial in nature, and have faced environmental problems much earlier. They have pioneered various environmental protection mechanisms to counter environmental problems. They have learned through their grave mistakes. Thus in order to protect their environment, education and information are provided during early childhood. There is much for the Indian government as well as Indian people to learn from the experiences and models of developed countries. Environmental awareness is currently not part of the education curriculum in India, and thus early exposure of environmental awareness does not take place. This contributes to the poor response toward environmental protection in India. Indians feel that it is the responsibility of the government to provide information and to educate the public toward environmental protection.

There is a need to change the mind set of younger generations. Environmental awareness education should be a part of early curriculum. In fact, the Indian Government has already started taking steps in this regard and many Universities are including environmental awareness education in their curriculum. It is hoped that the younger generations will become supportive of preserving the environment and bringing about an awareness revolution. India is predominantly an agricultural country. Green revolution has helped India to be self sufficient in food supply. However, excessive use of pesticides, herbicides, and fertilizers has contributed to a degradation of nature. The underground water supply is contaminated due to the presence of harmful minerals like zinc and magnesium. The consumption of such water can become a significant public health issue.

The Indian people wish to promote sustainable national development. So, the Indian business community should have the objectives to innovate and disseminate the means for creating sustainable livelihoods on a large scale and to mobilize widespread action to eradicate poverty and regenerate the environment. Further, institutional systems should be developed to save the environment from further degradation. The need to preserve and clean the environment must be an integral part of the formal education process. Environmental education must be promoted through existing educational/scientific/research institutions. In addition to formal education, encouragement should be given to non-governmental organizations, mass media, and other concerned organizations for promoting environmental awareness among the people at all levels. Training must be given to school teachers in environmental education, so that they are able to mobilize peoples’ awareness for the preservation and conservation of the environment.

LIMITATIONS OF THE STUDY

As this research study is confined to selected respondents from the Northern Indian region, the findings of this research cannot be generalized. However, this study can be regarded as a starting point for further research in this important area.

REFERENCES


Teaching Environmental Ethics to MBA Students

Raymond Benton, Jr.
Loyola University Chicago

This essay explains the author’s approach to teaching environmental ethics in the graduate school of business. The approach is based on a religious rather than a philosophical perspective, taking its light not from theology or religious studies but from anthropology. The author discusses the origins of the course, then explains the anthropological model of religion as a cultural system and briefly applies that model to economics, focusing on the worldview that undergirds it. The course then shifts to how others understand the world in which they live, introduces Aldo Leopold’s A Sand County Almanac, and ends by speculating on what might come next if the course were a third longer than it is.

Loyola University Chicago has had an environmentally oriented class in the MBA program since 1988. That course, Business and the Environment, was my course; I always squeezed environmental ethics into the last three weeks of the ten-week quarter, using films (God’s Earth), books (Daniel Quinn’s Ismael), and chapters of books (“The Land Ethic” from Aldo Leopold’s Sand County Almanac). In late spring 2004 I was asked to offer an environmental ethics course. It would be part of our business ethics certificate program but open to all graduate students in business. Thus was born Global Environmental Ethics. It has been offered every spring since and has drawn an average of 30 students each quarter (a high of 35 and a low of 27).

The two most important issues I faced in planning this course were how to make it global and how to make it something I was comfortable teaching. Making it global was easy; making it something I was comfortable teaching was more challenging.

Because I am not a philosopher, nor philosophically trained, I was not comfortable teaching the course as applied philosophical ethics. Besides, my sense is, along with Harold W. Wood, that as far as ordinary people are concerned, “it is religion which is the greatest factor in determining morality” (1985, p. 151). Anna Peterson agrees: “Religion remains the primary way that most people conceptualize the ‘big questions’ of ethics and metaphysics” (Peterson, 2001, p. 5). But neither am I a religious studies scholar. To solve my problem I turned to anthropology, and in particular the anthropology of Clifford Geertz.2,3

A THEORY DRIVEN COURSE

Like all professors, I want my class to be theory driven. Instructors in marketing, finance, and accounting can assume a shared theoretical context that arises from the students’ previous knowledge of and familiarity with economics. They all take a class in economics, and the first chapter of every business text repackages those lessons. My class does not have that luxury.
Since I cannot rely on familiarity with a pre-existing theoretical framework, I have to develop it myself. While I am merely laying the theoretical groundwork, students see it as very philosophical. One student recently wrote on a course evaluation,

For a business discipline to take what appeared to me to be such a purely philosophical approach to environmental ethics was in my mind unpragmatic and therefore of no use to me, and more of the meaningless drivel that I had come to expect from my limited exposure to philosophy in college. After all, we attend business school to learn applicable skills that will ultimately – to continue with bluntness – enable us to increase our earning potential, not pontificate on erudite topics.

Patience prevails, however. The student ended this comment by saying, “Of course, my first impressions were wrong."

The Concept of Culture

Every student is familiar with the term culture, but generally hold a sense similar to the following, taken from my American Heritage Dictionary (1996, p. 454): “The totality of socially transmitted behavior patterns, arts, beliefs, institutions, and all other products of human work and thought characteristic of a community or population.”

As a definition of culture, this comes to us from the first page E. B. Tyler’s 1871 book, Primitive Culture. It has become known as “the complex whole” definition of culture. The concept of culture I employ is borrowed from Clifford Geertz. “Culture” he wrote,

denotes an historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expressed in symbolic forms by means of which men communicate, perpetuate, and develop their knowledge about and their attitudes toward life (1973, p. 89).

As such culture is not a force or causal agent in the world, and it is not a collection of things made. It is a context in which people live out and give meaning to their lives (Geertz, 1973, p. 14). In an alternative and more often quoted formulation Geertz writes,

Believing, with Max Weber, that man is an animal suspended in webs of significance he himself has spun, I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretative one in search of meaning (Geertz, 1973, p. 5).

Culture constitutes “that intersubjective world of common understandings into which all human individuals are born, in which they pursue their separate careers, and which they leave persisting behind them after they die” (Geertz, 1973, p. 92).

I make sure students do not underestimate the importance of this passage because the implication is subtle but critical for this class. To help students fully grasp its significance, we discuss what it is they do when they think. Generally they are unable to describe what it is they do in this most fundamental aspect of our mentality. In part this is because they hold to a vague idea that thinking is some sort of thing going on in their head. So that is where I begin, and I do so by unpacking this passage from Geertz (1973, p. 214):

Thinking, conceptualization, formulation, comprehension, understanding, or what have you, consists not of ghostly happenings in the head but of a matching of the states and processes of symbolic models against the states and processes of the wider world.
I point out that when we teach our courses we present symbolic models—Maslow’s hierarchy of needs, the product life cycle, the BCG Matrix (with its rising stars, dogs, cash cows, and question marks), the balanced scorecard, the intersecting Laws of Supply and Demand, regression equations—with the hope that students learn them (the models) and use them in their analysis of a case so that the unknown (the case) becomes known (in terms of the model). We generally realize, for example, that the rising stars and dogs are metaphors, but what we do not often recognize that the BCG matrix, itself, is a metaphor.

There is an important caution in this. There are living metaphors and there are dead metaphors. Living metaphors are “offered and accepted with a consciousness of their nature as substitutes for their literal equivalents” while dead metaphors “have been so often used that speaker and hearer have ceased to be aware that the words used are not literal” (Nicholson, 1957, p. 340). McCloskey captured this distinction in The Rhetoric of Economics as follows: “Much of the vocabulary of economics consists of dead metaphors taken from non-economic spheres” (1985, p. 76): production functions, business cycles, elasticity, depression, equilibrium. “The metaphorical content of these ideas was alive to its nineteenth-century inventors. It is largely dead to its twentieth-century users, but deadness does not eliminate the metaphorical element” (p. 79).

This gives rise to the caution. We cannot think independently of the buried metaphor in the words we use. We can only be unselfconscious of the metaphorical nature of the thoughts pursued. We take them to be literal, not metaphorical. Metaphor, however, buried or not, conditions our perceptions. Continuing with McCloskey now,

Self-consciousness about metaphor … would be an improvement on many counts. Most obviously, unexamined metaphor is a substitute for thinking—which is a recommendation to examine the metaphors, not to attempt the impossible by banishing them (p. 81, emphasis added).

It is important that students understand that they, too, think with and through metaphors, with and through systems of symbols and meanings, and that, as individuals, they were born into them, they pursue their separate lives in the context of them, and they leave them persisting behind them, however much they may have changed, after they die. And, most importantly, students need to realize that more often than not they are unaware of the metaphors they use and how they condition their perceptions and determine their decisions.

This understanding must be more than simple book learning; the students must really understand it. To do so they must experience it. I perform a thought experiment in class that provides that experiential learning. Since I have described it elsewhere (Benton and Benton, 2004, pp. 230-232) I will here be very brief.

I ask students to imagine that they have been on a trip during which they bought something. During their return travels, they strike up a conversation that eventually turns to that which they have bought and, ultimately, to the price they paid. Upon learning the price paid, the person with whom they have been conversing indicates that they got a real bargain. At this point I ask students to describe how they feel about their purchase and what they might do. The most difficult question is when I ask how they know that is how they should feel and how they know that their course of action is reasonable and realistic.

Almost universally they say they would feel happy, elated, or proud and say they would tell others, sell what they bought to realize a profit, or return and buy more. They can seldom articulate why they should feel that way or why their proposed actions are reasonable and realistic. It is just natural, obvious or self-evident to them.

I then change the intellectual context of the thought experiment. I ask them to transport themselves to a time and place in which the human body is the analogy by which social and economic affairs are described and understood. We exercise this analogy by reading original passages from John Wycliffe, John of Salisbury, and a passage from John Locke and interpretive passages from Tawney (1926) and Mumford (1970). When we revisit the three questions their responses are very different. This time they feel guilty and would do something to get the excess captured back into the hands of the vendor from
whom they took it or back into general circulation by giving the excess to charity. They no longer feel
good and they no longer say they will keep the windfall. Unlike the first pass of this thought experiment,
this time they can explain why they feel guilty and why their course of action is reasonable and realistic
by referencing the analogy of the human body.

I finish this thought experiment by putting it in the rhetoric of today by asking if feeling guilt and
striving to give the excess back is what a rationally self-interested individual would feel and do, given the
reality imagined. They appreciate that what is rational and what is in one’s self-interest is dependent on
cultural context.

The thought experiment illustrates the difference between a living metaphor and a dead metaphor. In
this latter pass of the thought experiment the metaphor, the analogy is living; that in the first pass is
dead—stone dead, as dead as a doornail!

Religion as a Cultural System

Cultural systems can be thought of as models, as sets of symbols whose relations to one another
model relations among entities, processes or what-have-you in physical, organic, social, or psychological
systems by "paralleling," "imitating," or "simulating" them. There are two senses to the term model,
however—an "of" sense and a "for" sense.

What is stressed in the model of sense is the manipulation of symbol structures so as to bring them,
more or less closely, into parallel with the pre-established non-symbolic system. This is what we do when
we grasp how dams work by developing a theory of hydraulics or by constructing a flow chart. The
theory or chart models or describes physical relationships in such a way that those physical relationships
are understood. The theory is a model of reality.

The model for sense stresses the manipulation of the non-symbolic systems in terms of the
relationships expressed in the symbolic. This is what we do when we construct a dam according to the
specifications implied in a hydraulic theory or the conclusions drawn from a flow chart. Here, the theory
is a prescription, a model for reality.

It is this double aspect, models of and models for, that is captured by Geertz when he states, “Religion
is never merely metaphysics” and it is “never merely ethics either” (1973, p. 126). Not merely
metaphysics and not merely ethics, religion brings together, into a coherent whole, both a metaphysic
and an ethic in such a way that one subsists on, is inherent in, the other. Religions demonstrate “a meaningful
relation between the values a people holds and the general order of existence within which it finds itself”
(Geertz, 1973, p. 126).

In anthropological discussions, models for are designated the ethos and models of are designated
the world view.6

A people’s ethos is the tone, character, and quality of their life, its moral and aesthetic
style and mood; it is the underlying attitude toward themselves and their world that life
reflects. … [A people’s] world view is their picture of the way things in sheer actuality
are, their concept of nature, of self, of society. (Geertz, 1973, pp. 126-127)

Religious belief brings together a metaphysic and an ethic, a world view and an ethos, a model of and a
model for, in such a way that

the ethos is made intellectually reasonable by being shown to represent a way of life
implied by the actual state of affairs which the world view describes, and the world view
is made emotionally acceptable by being presented as an image of an actual state of
affairs of which such a way of life is an authentic expression. This demonstration of a
meaningful relation between the values a people hold and the general order of existence
within which it finds itself is an essential element in all religions however those values or
that order be conceived. (Geertz, 1973, pp. 126-127)
In this way morality becomes simple realism, practical wisdom. “Religion supports proper conduct by picturing a world in which such conduct is only common sense” (Geertz, 1973, p. 129).

Taken separately, the normative and the metaphysical are quite arbitrary. When taken together they form a gestalt with a particularly strong sense of inevitability. A French ethic in a Navaho world would lack any sense of naturalness and simple factuality that it has in its own context, as would a Hindu ethic in a French world. This is why the students’ first responses to the thought experiment are universally disallowed in the second pass: they are in the wrong context and, because of that, lack any sense of naturalness, simple factuality, rightness.

It is this air of factuality, of describing, after all, the genuinely reasonable way to life which, given the facts of life, is the primary source of such an ethic’s authoritativeness. What all sacred symbols assert is that the good for man is to live realistically; where they differ is in the vision of reality they construct (Geertz, 1973, p. 130, emphasis added).

The last sentence in the passage just quoted is particularly illuminating. I make sure students fully appreciate it.

The task in this course, as a course in global environmental ethics, is to understand the values that other peoples hold regarding the other-than-human—their environmental ethic—by understanding the world view which supports and undergirds it, and, thereby, gives it an air of factuality and sense of naturalness that it must have if it is to have authoritative appeal and, thereby, be accepted and followed. It is also important that understand the values and attitudes we hold regarding the other-than-human—our environmental ethic—and which we regularly teach as part of our other courses (Benton and Benton, 2004; Wenz, 1997). By understanding the understandings of others, and by understanding our own understandings, we develop a sense of the possible in the area of global environmental ethics.

**TO KNOW ONESELF: ECONOMICS AS RELIGIOUS BELIEF**

At this point I apply Geertz’s model of religion as a cultural system to economics. To consider economics as a religious belief system shocks most MBA students because we teach economics, but we do not teach about economics. As Geertz wrote, “Meanings can only be ‘stored’ in symbols, in a cross, a crescent, or a feathered serpent” (1973, p. 127). To get directly to my point now, the cross can be a Latin Cross, a Maltese Cross, or a Marshallian Cross.

We present economics as a model of our price-directed market economy. What we generally think of as a model of a price directed market economy is, in the present interpretation, better understood as a model for the price-directed market economy as a recommended style of life: an ethos. The model of aspect refers, instead, to the unthinkingly accepted metaphysical aspects that inform it; it refers to the image of nature, of self, and of society that underlie it; it refers to the underlying world view.

**The Ethos**

I begin by asking students to reconsider the Laws of Supply and Demand. We generally present these as laws akin to laws in the physical sciences, like the law of gravity. To grasp the meaning and significance of these laws we must consider them not as symbolic expressions of natural processes, nor even as the representation of statistical regularities, but as a specific set of rules found in a particular society that, if followed, assures the material provisioning of that society.

The Laws of Supply and Demand provide us with a distinctive directive for our decisions and actions. They formulate a social code that, when followed, brings the actions and reactions of discrete individuals into agreement. They thus contain an imperative rather than a description of empirical facts. The meaning of the Laws should be formulated in terms something like the following: “If commercial exchange is to be an effective instrument for want satisfaction, sellers should raise prices when buyers increase their demand,” and so on for its various propositions (Lowe 1942, pp. 439–440). Only in this way does the price system act as the signal system that conveys the information that economists say it conveys.
The laws of physics can never be more than principles of *explanation*; we cannot escape them. Economic laws are better conceived as principles of *action*; though we can evade them, we should not because if we do society will not turn out as imagined. The Laws of Supply and Demand do not “describe what an individual member of the market actually *does*, nor does it *predict* what he will do. It *prescribes* what he should do” (Lowe, 1965, p. 45).

The mere existence of a set or sets of rules does not guarantee they will be followed. People must believe that the tensions, conflicts and injustice that they see around them and may personally experience, are the result of people *not* following them. They must also believe that by adhering to the rules both the conflicts and injustice will be ameliorated, if not eliminated. In the case of economics, and in particular with the Laws of Supply and Demand, it is only if people go along with the rules that the social world will turn out as economists imagine it will. And lest we forget, the social world, as imagined by economists, is perfect and pure.

Social friction has any number of sources: the difference between the young and the old, males and females, rich and the poor, and in our society between urban and rural and as well as between people of different ethnic origins and identities. But there is a single root cause to all of these points of conflict. Nelson discussed the degree and the extent to which the concern with conflict and tension is embedded in economics. He writes (Nelson, 1993, p. 777),

> Economic theology starts with the recognition that through most of history humans have been afflicted by poverty, hunger and disease. These problems are considered the fundamental reasons that human beings have so often killed, stolen, lied, cheated and committed so many other evils. They have simply been driven to these acts by economic circumstances. Original sin, according to economic theology, is material privation, the condition in which most people have lived. . . . If this diagnosis is correct, then the means of abolishing evil is clear: salvation lies in eliminating all shortages of goods and services.

Conflict passes easily and directly to the problem of justice because, if severe enough, it often seems undeserved, especially to the sufferer but to onlookers as well. The problem has to do with the gap between what various individuals deserve, or feel they deserve, and what they in fact get. “[T]o be just,” MacIntyre points out, “is to give each person what each deserves” (1984, p. 152).

The trick is to come up with a definition of justice, and an institutionalization of that definition, that is acceptable to all. One concept of justice is that people should receive in accordance with what they produce: payment in accordance with product; reward in relation to effort. The contemporary institutionalization of this definition is “the market,” and it becomes manifest if the Laws of Supply and Demand are religiously followed.

We believe that actual prices and incomes (incomes being simply a factor price) are ethically just because they are either based on labor effort expended (the labor theory of value) or based on one’s contribution as valued by the consumer (the marginal productivity approach). Topel (quoted in Bennett, 1988, p. 1) expressed it this way: “I am of the opinion, until proven otherwise, that the market is competitive. Competition is going to dictate what people make. The best measure we have of the value of what someone produces is what he was paid.”

That this familiar refrain is a tautology bothers no one. If I am well off, I can explain it to myself and to others with the knowledge that I am productive and valued. If I am poor, I explain it to myself and to others with a similar affirmation; I am either not sufficiently productive or that which I do produce is not valued by others. No other conclusion is possible and it all emanates from the inexplicable working of the Laws of Supply and Demand, if they are being followed.

While there is pain and suffering, and the distribution of spoils is unequal, it is not inequitable. If the mind is not set to rest, it is spurred to action, especially among the poor as they see that they must work more, harder, or differently.

If the gap between what various individuals deserve, or feel they deserve, and what they in fact get is
experienced as just, people accept their suffering in silence; if it is not experienced as just, they do not suffer in silence. Among the faithful, belief is strong that “Adam Smith’s invisible hand, guided by supply and demand in the labor market, equitably signs everybody’s paycheck” (Bennett, 1988, p. 1).

The story that economics tells is that the price-setting market is comprehensible, that the problems and difficulties people experience are sufferable, and that justice prevails. This will all turn out, however, only if we abide by the Laws of Supply and Demand. If we do not, it will not.

The World View

The idea that the ultimate source of and solution to conflict is tied to production levels is part and parcel of the Enlightenment mentality from which economics emerged. Prior to the point that Adam Smith wrote the Wealth of Nations, a nation’s wealth was considered to be the stock of precious metal maintained by the sovereign. Sovereigns often pillaged and plundered in order to increase their own wealth. In the Wealth of Nations Adam Smith redefined the wealth of a nation to be “the necessaries and conveniences of life which [a nation] annually consumes” (1937, p. lvii). The entire point of The Wealth of Nations was to analyze the nature and the causes of growth and expansion of “the necessaries and conveniences of life.”

This is noteworthy because Smith actually considered the pursuit of riches to be meretricious and corrupting (Rotwein, 1973). He was concerned with increasing them because, he wrote, “No society can surely be flourishing and happy, of which the far greater part of the members are poor and miserable” (Smith, 1937). Smith was also aware that wealth was generally acquired by means other than production; most men of luxury gained their fortunes by trading, transporting, or by lending. Smith, therefore, shared with the whole of the Enlightenment, as William Leiss expressed it (1972, p. 30), the notion that “the…inadequate provision for human wants was the source of the instability of society and the internecine battle over the share of spoils that threatened the fabric of civility.”

While general to the Enlightenment, this notion arose most forcefully with Francis Bacon, whom we remember today for having closed the gap between science and technology. Whatever working partnership may have previously existed, “[Bacon] made [it] an even more binding one by linking it to the immediate human desire for health, wealth, and power” (Mumford, 1970, p. 106).

In his Novum Organum Scientiarum, published in 1620, Bacon boldly asserted, “the legitimate goal of science is the endowment of human life with new inventions and riches” (quoted in Mumford, 1970, p. 111). He spoke of himself as “a bell-ringer which is the first up to call others to church.” But more, as a trumpeter who

summons and excites men not to cut each other to pieces with mutual contradictions, or to quarrel and fight with one another; but rather to make peace between themselves, and turning with unified forces against the Nature of Things, to storm and occupy her castes and strongholds, and extend the bounds of human empire, as far as God Almighty in his goodness may permit.

Bacon urged the princes, lords, soldiers, and merchants to give up their personal ambitions to extend their own personal power and riches, or that of their country. As Bacon understood it, the pursuit of personal and national ambition was a zero-sum game because, as John Locke expressed it in an unpublished essay with characteristic medieval understanding,

When any man snatches for himself as much as he can, he takes away from another man’s heap the amount he adds to his own, and it is impossible for anyone to grow rich except at the expense of someone else (quoted in Spiegel, 1971, p. 165).

Bacon urged, instead, the joining of hands to engage in a species ambition to enlarge the power and the domination of the human race over the universe of things. As a species ambition it was pure because it was not achieved at the expense of others. The assumption, of course, was that nature has no interests.8
This attitude embodies a notion of a desacralized nature, most often associated with Bacon, Descartes, Newton, and other Enlightenment thinkers. This attitude, Kinsley accurately writes, “still dominates modern perceptions of the world” (1995, p. 127). Whatever the precursors, and there were precursors (Dijksterhuis, 1961), it was not until the Enlightenment that we find a thoroughly desacralized and mechanistic view of nature, a view of nature as undeserving of moral consideration in the affairs of human beings. This is the reason so much literature in the area of environmental ethics calls, either directly or indirectly, for a “Post-Mechanistic Philosophy of Nature” (Keller, 2009), or for moving “Beyond the Enlightenment Mentality” (Wei-ming, 1994; see also Hinchman and Hinchman, 2001).

It is the desacralized and mechanistic view of nature that largely determines that we see it as having instrumental value only and as not having intrinsic value, value in and of itself. As Kant (1963) said about animals, “we have no direct duties” because animals “are not self-conscious and are there merely as a means to an end. That end is man….animals must be regarded as man’s instruments.” In short, the other-than-human deserves no moral consideration; we can do with it, and to it, as we please.

The key text here is Carolyn Merchant’s *The Death of Nature: Women, Ecology and the Scientific Revolution* (1980; see also 1998, 2006, 2008a, 2008b). Relevant excerpts from Merchant’s book can be found in many environmental philosophy texts (Armstrong and Botzler, 2004; Foltz, 2003). I have students read excerpts from Merchant’s book as well as excerpts from Descartes (“Animals Are Machines”), Kant (“Duties to Animals”), and a bit of utilitarian philosophy. They see, often for the first time, to what they are heirs. As I repeat several times in the course, what we are trying to do is find a way or ways of extending moral consideration to the other-than-human, and moral consideration is seldom, if ever, given to enemies that must be conquered or vanquished.

### TO KNOW OTHERS

The task of the course up to this point is to bring to conscious awareness what it is students now think about the other-than-human by virtue of the fact that they are part of the tradition to which they are a part. It is with this tradition that other business classes are engaged, including classes in business ethics. But in an increasingly globalized world it is not enough to know oneself; it is important also to know others, to know something about how others understand their world and what it is to live realistically in it.

There are a number of books that can be used at this point (Tuan, 1974; Tucker and Grim, 1994; Callicott, 1997; Foltz, 2003; Gottlieb, 2006). I use Kinsley’s *Ecology and Religion: Ecological Spirituality in Cross-Cultural Perspective* (1995). As a text it treats ecological spirituality from the perspective of indigenous cultures (the Mistassini Cree of Quebec, Australian Aborigines, the Ainu of Japan, the Koyukon of Alaska and the Yukon), Asian traditions (Hinduism, Chinese religions, and Buddhism), as well as from the perspective of both Christianity and several of the contemporary eco-spirituality movements and figures.

Each of these indigenous and Asian traditions view the whole of reality, or at least aspects of the non-human world, as organic, as in some way and in some sense alive. As Hans Jonas (1984, p. 7) notes,

> When man first began to interpret the nature of things—and this he did when he began to be man—life was to him everywhere, and being the same as being alive. … Sole flooded the whole of existence and encountered itself in all things. … That the world is alive is really the most natural view, and largely supported by prima-facie evidence.

Each of the traditional and Asian religions emphasizes the importance of an intense knowledge of the land in which one lives. Kinsley explains: “An underlying assumption...is that human beings can come to know and understand themselves only when they know and understand the land from which they have arisen and in which they live” (1995, p. 227). Often the nonhuman realm is directly related to the human realm. In some cases human beings and other animals are understood as kin; in other cases human beings and animals are seen as descended from the same ancestors, however those ancestors are conceived. This sense of relatedness drives a sense of reciprocity as the framework for relating to the other-than-human...
world. Particularly among the hunters and gathers there is a sense of mutual obligation between game animals and humans.

The embeddedness of human beings in each of these traditions presents a dichotomy that is sometimes quite sharp with contemporary North American perspectives. People are of their land and without their land they could not exist. By contrast, we set human beings apart not only from each other but also from the rest of nature. The following remark, made by Fisher and Peterson (1976, p. 1), could not have been even conceived by these other traditions: "Man," they wrote, “has probably always worried about his environment because he was once totally dependent on it" (emphasis added).

I supplement Kinsley’s short chapters with cases, often drawn from current newspapers and magazines. The point of the case discussions is to give students an opportunity to role play by asking them how, say, a Cree, a Kwakiutl, a Hindu, a Buddhist or a utilitarian would approach each case. I do this in groups where the students confer with each other as they map each tradition’s approach.

My purpose and intent is for them to see that different people, in different places and different times have very different approaches to what appears to be the same situation. I want them to express how, in their understanding, a Cree, Kwakiutl or Buddhist businessperson might approach a situation differently then would a utilitarian businessperson. If a decision is called for in one of these short cases I ask them how they would make that decision, representing whoever it is they are representing, and, most importantly, how they would convince others that might have another perspective that their decision is the ‘right’ decision or course of action.

This portion of the class is typically followed by a series of longer cases. I have used classic cases (Pacific Lumber), contemporary cases (water), and older cases that are in the news again (nuclear energy). I insist they use all the resources at their command and not only the most familiar and comfortable (which still remains the mental baggage they brought with them to class when it began) because the tendency is always to revert back to that with which they are familiar and comfortable.

ALDO LEOPOLD AND THE LAND ETHIC

I end the class with Aldo Leopold’s A Sand County Almanac (1949). I do so for several reasons. First, I don’t want to leave the impression that simply re-enchanting the other-than-human will solve our environmental problems (Hinchman and Hinchman, 2001). Neither do I want to leave the impression that we can go on with “business as usual” without making radical changes. Leopold’s environmental ethic is clearly indebted to Enlightenment ideas and hence represents continuation and growth from within our own scientific tradition. Second, Leopold is a standard feature in any book of readings dealing with environmental ethics, even if it is only the final chapter, “The Land Ethic,” that is included and read. Third, Leopold’s overall orientation is, as I will suggest, consistent with the overall approach to the course as I conduct it. He fits my lesson plan!

To give context to Leopold I draw on a 1920s essay that remained unpublished until 1979. In this essay Leopold explains our ethical issue in characteristic brevity and clarity (Leopold, 1979, all quotations are from pages 138-139). He begins, “A false front of exclusively economic determinism is so habitual to Americans in discussing public questions that one must speak in the language of compound interest to get a hearing.” He goes on to say, “In past and more outspoken days conservation was put in terms of decency rather than dollars,” and then quotes Ezekiel:

Seemeth it a small thing unto you to have fed upon good pasture, but ye must tread down with your feet the residue of your pasture? And to have drunk of the clear waters, but ye must foul the residue with your feet?

Leopold suggests that in these two sentences “may be found an epitome of the moral question involved,” further commenting, “It is possible that Ezekiel respected the soil, not only as a craftsman respects his material, but as a moral being respects a living thing.”

Aware of the pitfalls of language, Leopold continued: “The very words living thing have an inherited
and arbitrary meaning derived not from reality, but from human perceptions of human affairs.” He then
tackles our inherited and arbitrary perception of an inanimate, mechanistic nature by quoting the Russian
philosopher Ouspensky (1922):

Were we to observe, from the inside, one cubic centimeter of the human body, knowing
nothing of the existence of the entire body and of man himself, then the phenomena going
on in this little cube of flesh would seem like elemental phenomena in inanimate nature.

Leopold then indicates that Ouspensky suggested, quoting Leopold now,

[I]t is at least not impossible to regard the earth’s parts – soil, mountains, rivers,
atmosphere, etc. – as organs, of parts of organs, or a coordinated whole, each part of a
definite function. And, if we could see this whole, as a whole, through a great period of
time, we might perceive not only organs with coordinated functions, but possibly also
that process of consumption and replacement which in biology we call the metabolism, or
growth. In such a case we would have all the visible attributes of a living thing, which we
do not now realize to be such because it is too big, and its life processes too slow. And
there would also follow that invisible attribute – a soul, or consciousness – which not
only Oopensky [sic], but many philosophers of all ages, ascribe to all living things and
aggregations thereof, including the “dead” earth.

In short, the moral issue to Leopold is that we approach conservation from a strictly economic point
of view and that our economic point of view rests, in turn, on a perception of the other-than-human as
mechanistic, inanimate, and dead. Leopold was of the same voice as Hans Jonas when he wrote, “We
should keep ourselves open to the thought that natural science may not tell the whole story about Nature”
(1984, p. 8).

A Sand County Almanac is a tour de force in environmental education, but as such it is “more than
just transmitting information about natural history and environmental issues” and it is “more than
transmitting environmental values” (Callicott, 2005, p. 366). Environmental education should be about
redirecting how we experience nature and this can occur only through “a shift from one cognitive nexus
for organizing experience to another” (Callicott, 2005, p. 366). In this sense Leopold, and A Sand County
Almanac, is consistent with the overall theme and approach of the course as I conduct it.

Leopold was convinced that the cognitive shift he saw as necessary requires a direct and sustained
physical experience in and with the other-than-human, one that leads to a genuine and deep “love and
respect” of it. His pronouncement, in Part III, “We can be ethical only in relation to something we can
see, feel, understand, love, or otherwise have faith in,” has become a maxim of the modern environmental
movement. Direct, physical experience of nature is vital. But experiences are always interpreted
experienced, so direct, physical experience must be filtered by an “appropriate” cognitive orientation. To
Leopold, a natural scientist, that orientation is an evolutionary-ecological world view.

Part I of Leopold’s book, entitled “A Sand County Almanac,” attempts to rectify the fact that most of
us spend most of our lives in technological cocoons, insulated from direct contact with nature. It takes the
reader on a vicarious field trip to the Sand Counties of central Wisconsin. The “shack sketches,” as they
are sometimes called, are set in a single place and unfold in the course of a single year. As Callicott
describes it (Callicott, 2005, p. 370), Leopold “simply shares his personal experiences, observations, and
reflections with the reader. The voice is the first person singular (“I,” “my,” “me”) and the tense is
present. The fabric of the narration is perceptual, descriptive, experiential, and sensuous.” He conveys his
conviction that land is a community and as such has a subjective as well as an objective aspect. At
Leopold’s hand, our determination to believe that animals are unconscious automata, or that river valleys,
forests and fields, are perhaps “beautiful but lifeless” (Kant, 1886, p. 259), is exposed as a legacy of pre-
Darwinian—and therefore unscientific—prejudice.

In Part II, “Sketches Here and There,” the language is more elevated and less personal; the voice is
first person plural (we, rather than I); the tense is mostly past; and the tone is mournful, “less celebratory
of what remains and more eulogistic of what is lost, or being lost” (Finch, 1949, p. xx). The location also
shifts from the local (the Sand Counties) to the distant (the continental), thus universalizing the lessons
learned in Part I (Callicott, 2005, p. 373).

The tone, tense and intent of Part III, “The Upshot,” changes once again. Written in the third person it
is more public, less personal; the mood is imperative, nomothetic, and normative. The reader is prodded
to reconsider his or her moral relationship with the world as it has been reconceived in Parts I and II.
Consisting of four essays, the final essay being “The Land Ethic.”

As a natural scientist concerned with moral issues, Leopold is interested in and concerned with the
origins of morality and ethics. He dismisses any notion that God or the gods impose morality on people
and does not accept the almost unanimous opinion among philosophers that the origin of ethics has
somehow to do with human reason: that big brained homo sapiens sat down together around the campfire
and thought their way into a social contract. As a natural scientist he subscribes to an evolutionary
perspective: people accept the constraints placed on individual action by ethical and moral codes because
doing so has survival value!

Leopold implicitly draws on Charles Darwin’s account of the origin and spread of morality in the
third chapter of The Descent of Man, published in 1871. Darwin had, himself, turned to the Scottish
Enlightenment for a moral psychology consistent with and useful to a general evolutionary account of
ethical phenomena. He cites both Adam Smith’s Theory of Moral Sentiments (1759) and David Hume’s
An Enquiry Concerning the Principles of Morals (1751). This is important for an environmental ethics
class in a school of business because a direct line of descent can be shown from Adam Smith to Aldo
Leopold.

The evolutionary and developmental thrust is set out by Darwin in the following passage (pp. 100-
101), quoted at length:

As man advances in civilisation, and small tribes are united into larger communities, the
simplest reason would tell each individual that he ought to extend his social instincts and
sympathies to all the members of the same nation, though personally unknown to him.
This point being once reached, there is only an artificial barrier to prevent his sympathies
extending to the men of all nations and races. If, indeed, such men are separated from
him by great differences in appearance or habits, experience unfortunately shews us how
long it is before we look at them as our fellow-creatures. Sympathy beyond the confines
of man, that is humanity to the lower animals, seems to be one of the latest moral
acquisitions. … This virtue, one of the noblest with which man is endowed, seems to
arise incidentally from our sympathies becoming more tender and more widely diffused,
until they are extended to all sentient beings.

Leopold picks up with this sequence and adds the following: “the land ethic simply enlarges the
boundary of the community to include soils, waters, plants, and animals, or collectively: the land” (1949,
p. 204). The implications are two. First, “the role of Homo sapiens [changes] from conqueror of the land-
community to plain member and citizen of it.” Second, it implies “respect for his fellow-members, and
also respect for the community as such” (p. 204, emphasis added). That is, the community as such
deserves moral consideration.

Why should we extend moral consideration to the other-than-human? We ought to because it has
survival value. Is it inevitable? No! Is it possible? Yes! How do we do it? Again, it requires direct,
physical experience with nature, a physical experience interpreted through an evolutionary-ecological
worldview, and it requires the acceptance that, quite possibly, the other-than-human world which we
inhabit is not mechanistic, inanimate, and dead but, having all the attributes of a living thing may, itself,
be alive. While Leopold does not, to my recollection, say it, the acceptance of the earth as a living entity
may be necessary for a genuine and deep “love and respect” to emerge.

Just as utilitarianism has its maxim (the greatest good for the greatest number), and Kantian ethics has
its maxim (act in such a way that you can will that your actions should become a universal law), The Land Ethic has one, too (1949, p. 224-225): “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends to do otherwise.” To be able to apply this maxim, to know what preserves and what disrupts the integrity, stability, and beauty of a biotic community, requires some degree of ecological literacy, something we do not now have. One doesn’t need a shack and acreage in central Wisconsin, a place in the Colorado or Canadian Rockies, or a house overlooking the Pacific Ocean in order to develop the kind of ecological literacy that may be necessary. All one needs is, perhaps, a backyard (Bass, 2010).

**WHAT WOULD COME NEXT**

The class is a ten-week quarter course with thirty contact hours. If I had an additional five weeks, equivalent to a 45-hour semester course, I would introduce material I do not now introduce for lack of time: Jewish thought, Islamic thought, and a more thorough treatment of Christian thought (separating Protestant, Catholic and Eastern Orthodox). I would have representatives of as many of the traditions come to class as I could to discuss the issues from the perspective of each tradition. I would explore the parallels between Leopold and James Lovelock’s Gaia Hypothesis (Lovelock, 1987, 1988, 2006, 2010; Margulis, 1998; Primavesi, 2000; Turney, 2003; Harding, 2006). Exploring Lovelock, in particular, serves to illustrate that all the issues and questions that students think are scientifically settled are not, necessarily, settled. And Lovelock, having focused not on biology or ecology but on the physics of climate (and not initially on climate change), will provide a stepping off point to explore modern physics and cosmology. This is important in light of Sideris’ comment, “the science of particular interest to many ecotheologians seems to be physics rather than biology” (2006, p. 452).

I would more fully explore the lineage between Leopold’s Land Ethic and Adam Smith. Callicott has proposed this connection several times (1987, 1999, 2005), and it is worth exploring in more detail (Frierson, 2006a, 2006b; Bradley, 2011). If the lineage stands, it will give credibility to The Land Ethic for business students by establishing a direct link between it and the tradition of which economics is a part and to which they adhere.

Finally, since MBA students think of themselves as pragmatic decision makers, I would introduce a discussion of moral pluralism (Norton, 1991; Wenz, 1993) and environmental pragmatism (Light and Katz, 1996; Norton, 1991), ending with a renewed focus on a real-world practical issue using a case of sufficient complexity that requires students to once again role play a specific tradition explored in class. The task would be to have students, grounded in their own or an assigned tradition, grapple with a problem and come up with a solution. This would necessarily involve the sort of practical compromising that is part of the real business world. What will be learned, hopefully, is that a diverse group, each coming at the problem with their own or assigned world view and ethos intact, can actually find common ground. They will learn, hopefully, that there may be many different paths to the top of the mountain, each path laden with its own obstacles, but that there will be but one top of the mountain, one environmental endpoint, at which they can all meet. How each student, in his or her own or assigned tradition, reaches that endpoint is where the struggle will be.

As Leopold might put it, such a coming together may be nothing more than an evolutionary possibility; doing so, however, may be, for us, an evolutionary necessity.

**POSSIBLE DIRECTIONS FOR RESEARCH**

Those of us in the academy are not only teachers. We also conduct research. There are at least two research orientations that emerge from this way of teaching environmental ethics to MBA students. First is research that looks into how decision makers actually decide. The overwhelming bias is to assume that they do so on the basis of rational, logical decision making grounded in the values of economics. But do they? Might they make decisions on the basis of some other mental matrix, and strive after the fact to justify those decisions to themselves and to others by reference to the traditions of economics, our
dominant cultural system? As Leopold noted in *The Sand County Almanac* (1949, p. 210), repeating a point he made in the 1920s article quoted above,

Of the 22,000 higher plants and animals native to Wisconsin, it is doubtful whether more than 5 per cent can be sold, fed, eaten, or otherwise put to economic use. …When one of these non-economic categories is threatened, and if we happen to love it, we invent subterfuges to give it economic importance. At the beginning of the century songbirds were supposed to be disappearing. Ornithologists jumped to the rescue with some distinctly shaky evidence to the effect that insects would eat us up if birds failed to control them. The evidence had to be economic in order to be valid.

The long, in-depth interview would most likely be the methodological approach here as it offers distinct advantages when approaching a problem like this. The long-interview can take us “into the mental world of the individual, to glimpse the categories and logic by which he or she sees the world.” It allows us “to step into the mind of another person to see and experience the world as they do themselves” (McCracken, 1988, p. 9).

It would also be worth investigating how managers in Asian or other cultures navigate these issues. Do they make decisions based on the mental matrix of economics and try to justify it to themselves and their colleagues through their traditional patterns of meaning? After all, one of the significant exports of the West to the rest of the world over the last fifty years has been the economic way of thinking.

There is also a possibility for research into how this approach to teaching environmental ethics, to MBA students or others, translates into technological innovation, a topic that will be of importance to the readers of this journal. It is a mistake to think that technological development will come to an end with a perspective and orientation other than that of modernism. Embracing a world view other than mechanism would not be the end of technological development; it would be the beginning of a different technology, a restorative technology rather than a destructive technology. And this, a restorative economy,\(^\text{18}\) will move us beyond preservation vs. conservation, and it will leapfrog sustainability, a concept whose time, I believe, has already past (Benton 2009).

ENDNOTES

Title: A shorter version of this paper was first presented at the Third Annual International Conference on Business & Sustainability, November 5-6, 2009, Portland State University, Portland, Oregon.

2. I draw particularly on “The Impact of the Concept of Culture on the Concept of Man,” “The Growth of Culture and the Evolution of Mind,” “Religion As a Cultural System,” and part of “Ethos, World View, and the Analysis of Sacred Symbols,” all in *The Interpretation of Cultures* (1973). These are each assigned reading in this class.

3. Although anthropological in orientation, my approach is, I feel, akin to that of Iris Murdoch (*The Sovereignty of Good*), Stanley Hauerwas (*Vision and Virtue*), Peter Levine (*Living Without Philosophy*) and Anna Peterson (*Being Human*).

4. They subscribe to a notion similar to how, again, my *American Heritage Dictionary* defines the term. Thinking, it says, is “To have or formulate in the mind” (p. 1864).

5. Sometimes I tell student this is based on Medieval Europe, sometimes I cast it as a people recently discovered by anthropologists, and sometimes as a future or as an alien society. It makes no difference in the outcome of the thought experiment.

6. The convention today is to spell this as a single word, *worldview*. Geertz consistently spelled it as two words, *world view*. I adopt his convention throughout this paper.

7. There is no room for a complete account of economics as a religion. I simply mention the main points of such an analysis and direct the reader to sources where the argument is more fully developed (Benton, 1982, 1986, 1987, and 1990; Cox, 1999; Foltz, 2007; Loy, 1997; Nelson, 1993, 2001).

8. Alfred Marshall was the 19th century British economist that brought the separate ideas of a Law of Supply and a Law of Demand together, illustrating it with the now familiar graph depicting a downward sloping demand curve and an upward sloping supply curve. Being the first to so illustrate these two laws
This standard illustration of the intersection of supply and demand is known today as the Marshallian Cross.

9. This attitude, this aesthetic, is commonly expressed and re-expressed today, but perhaps seldom as plainly as in William James’ 1906 speech, “The Moral Equivalent of War” (James, 1910). James, a pacifist, was looking for an alternative to war. His moral equivalent of war was to enlist all youth in “warfare against nature.”

10. This is an attitude held, as well, by Aldo Leopold (1949), as I will point out below.

11. I have to give credit and thanks to Ron Dulin, a former graduate student, for insisting that I more fully integrate decision oriented cases into this class. He kept reminding me, both when he took the class and subsequently when we would meet, that business students want to make decisions.

12. Students read the entire book and not only the final essay, “The Land Ethic.” If, for some reason, time is short I omit only Part II.

13. We cannot reincarnate the worlds of the past, however enchanted and enchanting they may be. But, as Jonas (1984, p. 23) puts it, “It is moot whether, without restoring the category of the sacred, the category most thoroughly destroyed by the scientific enlightenment, we can have an ethics able to cope with the extreme powers which we possess today and constantly increase and are almost compelled to wield. … Only awe of the sacred with its unqualified veto is independent of the computations of mundane fear and the solace of uncertainty about distant consequences.”

14. This is the time to weave a field trip into the course. In the past I have included a voluntary Saturday day trip to Volo Bog, an Illinois State Natural Area (http://dnr.state.il.us/lands/landmgt/parks/r2/volobog.htm). In spring 2011 I took the class for a weekend retreat to Loyola University Retreat and Ecology Campus (http://www.luc.edu/retreatcampus/).

15. I am using a reprint of the first edition. In the second edition of The Descent of Man this is chapter four.

16. Another of Kant’s maxims is that one ought not treat people only as a means to an end but rather as having an end in themselves. This, too, will require reformulation. Jonas wrote (1984, p. 8, emphasis added), “It is at least not senseless anymore to ask whether the conditions of extrahuman nature, the biosphere as a whole and in its parts … has become a human trust and has something of a moral claim on us not only for our ulterior sake but for its own and in its own right. If this were the case … [it] would mean to … extend the recognition of ‘ends in themselves’ beyond the sphere of man [to] include [things extrahuman].” We would no longer be able, ethically, to treat extrahuman nature only as a means to our ends, but would have to treat it as having an end in itself.

17. “A land ethic,” Leopold wrote, “reflects the existence of an ecological conscience” (p. 221). He adds, “One of the requisites for an ecological comprehension of land is an understanding of ecology,” but “ecological training” under whatever label we choose to present it, “is scarce” (1949, p. 224). This is as true today as it was in the 1940s.

18. Robert Rodale (Rodale Press) first introduced me to the notion of a “restorative economy” at a conference in 1983. Rodale’s notion of a restorative economy may be related to that of Cunningham’s The Restoration Economy (2002), but I have not read the book. Other books that are relevant to this orientation include McDonough and Braungart’s Cradle to Cradle (2002), Benyus’ Biomimicry (1997), and Chiras’ Lessons from Nature (1992).

REFERENCES


Tyler, E. B. (1871). *Primitive Culture*. Boston:


Knowledge management approaches and tools in the Nuclear Energy Industry: Evidences and Implications from Italian Ansaldo Nucleare Spa

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Companies operating in the nuclear energy sector are recently facing many challenges. Great attention is emerging about the phase of decommissioning nuclear facilities. It depends more and more upon how effectively and efficiently their knowledge management approaches, processes and tools are applied to codify, protect and use knowledge to guarantee security and enhance process performance. Among them, particular relevance is assuming the Integrated Decommissioning Management Tools (IDMT). The aim of this paper is to present the experience – in terms of evidences and managerial implications – of the adoption of IDMT for decommissioning nuclear facilities by the Italian Ansaldo Nucleare SpA.

INTRODUCTION

Energy sector currently faces great changes. These are mainly related to the increasing world population, demands for higher standard of living, a need for less pollution, and a possible end of fossil fuels. Without energy, the world’s entire industrialized infrastructure would collapse: agriculture, transportation, waste collection, information technology, communications and much of the prerequisites that developed nations take for granted. A shortage of the energy needed to sustain these infrastructures could lead to a world catastrophe. This translates into developing energy technologies that are cost-efficient, have practical applications, provide greater safety and are environmentally sustainable.

Accordingly, companies operating in the nuclear energy sector are facing many challenges related to the regulatory requirements as well as to technological and managerial issues. In particular, recently great attention is emerging about the phase of decommissioning nuclear facilities (Chou and Fan, 2006; Iversen, 2001; Lund, 2006; Nayliss and Langley, 2003).
The effective and no-risk management of this specific phase and the related operational mechanisms depend more and more upon the way companies manage their know-how and how effectively and efficiently their knowledge management (KM) approaches, processes and tools are applied to accumulate, articulate, codify, protect and use knowledge to guarantee security and enhance process performance (Edwards, 2007; Marr and Schiuma, 2001).

Among the KM approaches and tools developed in the nuclear energy sector, in the last years, great relevance is assuming the development and the implementation of Integrated Decommissioning Management Tools (IDMT)

The aim of this paper is to present the experience – in terms of evidences and managerial implications – of the adoption of IDMT for decommissioning nuclear facilities by the Italian Ansaldo Nuclear Division (Ansaldo Nucleare SpA). It is part of the Ansaldo Group, one of the most important conglomerates operating in the energy sector.

The paper is organized in the following parts. After a brief overview of the challenges in nuclear energy industry and the best practices of KM traced in energy industry, the experiences of KM developed by Ansaldo Nuclear Division (Ansaldo Nucleare SpA) is presented. In particular, functions, operations, characteristics and applications of the specific IDMT are described and discussed according to a managerial perspective.

A BRIEF OVERVIEW OF THE CHALLENGES IN NUCLEAR ENERGY INDUSTRY

The energy industry comprises all companies historically operating in oil refining, oil and gas exploration and development, power generation, power transmission, nuclear materials plus companies involved in the emerging alternative and renewable energy sector. In the last five years, the industry has enjoyed high levels of growth, due to structural and contingent factors. Traditionally, this industry is capital-intensive, and characterized the presence of few relevant global players.

The energy industry is closely tied, historically, to politics since the days of the industrial revolution. Although there has been recent liberalization in the energy market, most companies continue to have strong ties with government. The International Energy Agency stated that energy use “is on an unprecedented increase, with most coming from developing countries, led by China and India (….) and this makes a significant contribution to meeting future road-transport energy needs, helping to promote energy diversification and reducing emissions”.

At the same time, there is an increasing debate about how to better exploit new energy sources, as well as how to avoid the starting or the reinforcement of nuclear-based national energy production programmes. Accordingly, different countries are developing actions to decommission nuclear facilities located in their territories.

Decommissioning is the final phase in the lifecycle of nuclear facilities. Nuclear power plant decommissioning requires a number of dismantling activities related to civil works and nuclear island systems as well as the construction of temporary facilities used for treatment and conditioning of the dismantled parts. Dismantling activities must be designed, planned and analyzed in detail during an evaluation phase, taking into account different scenarios generated by possible dismantling sequences and specific waste treatments to be implemented. The process of optimizing the activities becomes very challenging when taking into account the requirement of minimizing the radiological impact on exposed workers and people during normal and accident conditions (Chou and Fan, 2006; Iversen, 2001; Lund, 2006; Nayliss and Langley, 2003).

More specifically, information is needed within all the phases of the decommissioning project, in order to ensure technical quality and safety during decommissioning project, provide detailed dismantling process records useful for project quality assurance and radioactive waste tracing inspection, provide a distributed information database, actual cases and documents for various dismantling process, to extract information from the procedure, manage explicit knowledge and make it accessible for decision making, provide a friendly user interface to disseminate tacit knowledge, and even knowledge discovery. As far as general information on decommissioning nuclear facilities is concerned, it can be obtained from a plenty
of sources. The main one should be considered the IAEA library which provides a big variety of freely available publications ranging from booklets to specialized technical reports. One of these clearly asserts that “It is agreed that planning for decommissioning begins during the design of the facility and continues during its construction and throughout its operational life (...) Along with other objectives, this earlier planning would provide a sound basis for decommissioning cost estimation and funding provisions” (IAEA, 2000).

Nonetheless, for nuclear facilities built at the early stage of the nuclear era, this criterion can be satisfied only at a limited extent. This is the reason why one challenging task for today decommissioning professionals is to reconstruct the plant design package in terms of modern design technologies.

According to the great attention about the phase of decommissioning nuclear facilities (Chou and Fan, 2006; Iversen, 2001; Lund, 2006; Nayliss and Langley, 2003), nuclear energy industry companies are increasingly seeking to effectively manage this kind of processes. In the light of this attention, academic and technical literature argue more and more about the role and the relevance of effectively manage tacit and explicit knowledge background to respect regulatory requirements and to enhance processes performance over time (Edwards, 2007). Specifically, they sustain that the effective and no-risk management of this specific phase and the related operational mechanisms depend more and more upon the way companies manage their know-how and how effectively and efficiently their knowledge management (KM) approaches, processes and tools are applied to accumulate, articulate, codify, protect and use knowledge to guarantee security and deliver processes.

Knowledge Management (KM), then, is recognized, as above outlined, one of the challenges facing nuclear energy industry. In the following sections we present some basics of a literature review focused on the investigation of the position of KM practices in the energy industries in order to better frame the development and the application of a specific KM tool by the Italian Ansaldo Nuclear Division (Ansaldo Nucleare SpA) for decommissioning some of its nuclear facilities.

**BASICS OF KNOWLEDGE MANAGEMENT AND BEST PRACTICES IN ENERGY INDUSTRY**

The management of knowledge and intellectual assets has, in the last two decades, been the object of research of the Knowledge Management (KM) field. Over the years, this research stream has evolved, including many different research topics and areas ranging from organizational to technological issues. However, fundamentally, the attention of KM is focused on the processes of employing, deploying, developing and handling knowledge and intellectual assets with the aim to solve business problems and support organizational business performance improvement.

The KM field was originally founded the work of Polanyi (1966) and his fundamental distinction between tacit and explicit knowledge. David Teece (2000) defines knowledge management as “the panoply of procedures and techniques used to get the most from a firm’s knowledge assets”. According to Wiig (1997), knowledge management has two main objectives: (i) to make the organization act as intelligently as possible in order to secure its viability and overall success, and (ii) to otherwise realize the best value of its knowledge assets. Three major schools of thought on knowledge management can be identified (Bollinger and Smith, 2001): the first school suggests that knowledge management is primarily an information technology issue; the second school suggests that knowledge management is more of a human resource issue; and the third school promotes the development of processes to measure and capture an organization’s know-how.

To date, a major focus of scholars has been on the process aspect of knowledge management. In fact, knowledge management has been widely considered as consisting of processes that facilitate the application and development of a firm’s knowledge assets. One of the most recognized and comprehensive frameworks of knowledge asset management was developed by Nonaka (1994) and then refined by Nonaka et al. (2000). They state that knowledge management includes three primary activities: knowledge generation, which describes the way employees improvise and organizations innovate; knowledge integration, which describes how employees transform their tacit knowledge into explicit knowledge by codifying their ideas into the systems of the organization; and, knowledge sharing, which
describes the socialization process through which employees share knowledge with one another. More broadly, Marr and Schiuma (2001) identify seven processes to manage knowledge assets: (1) knowledge generation, (2) knowledge codification, (3) knowledge application, (4) knowledge storing, (5) knowledge mapping, (6) knowledge sharing, and (7) knowledge transfer. These processes are based on an understanding that knowledge is dynamic in nature, and on this basis they provide guidelines of how to use, transfer, share, develop, and renovate the knowledge assets of an organization. Knowledge assets are dynamic in nature, interact and depend on each other to create value (Barney, 1991; Roos and Roos, 1997). This interconnectivity is enabled by learning mechanisms and knowledge management processes (Carlucci et al., 2004; Marr and Schiuma, 2001; McGaughey, 2002).

According to this frame, it is possible to state that the energy industry is characterized by a technology-based approach to the knowledge management initiatives, enriched by a growing attention towards complementary dimensions focused on sharing best practices and routines (Edwards, 2007). This is due to the issue that, in the last decade, the energy industry has experienced rapid changes, many mergers and acquisition processes, advancement on technology, an extension of offshore drilling, the growing reliance on foreign oil sources and a focus on environmental issues and for these reasons KM initiatives have played a relevant part in making operations more effective and efficient.

Companies like Chevron, Texaco, Schlumberger and ExxonMobil represent good examples of energy industry organizations that have improved their efficiency by institutionalizing technology dimensions with a knowledge-sharing culture. When oil and gas companies have been faced with new technology, outsourcing, new partnerships, and government regulation, their KM teams have provided significant support through technology and knowledge transfer practices.

Moreover, many companies have been fine-tuning their best practices transfer process using content management systems to further minimize downtime at field sites across the globe. Since energy organizations collect large amounts of data, content accessibility and organization become pressing issues. Content management systems of people, processes and technology provide meaningful and timely information to end users by creating processes that identify, collect, categorize and refresh content using a common taxonomy across the organization. Users can access internal and external content from the same system and with the same queries. The adoption of content management systems reflects the growing strategic importance given to online services and delivery systems within the energy industry, and in particular within oil and gas and nuclear companies.

A very specific area of application for technology-based KM initiatives is in managing radioactive nuclear materials. Stoneham (2002) analyses the importance of computer modeling, pointing out that the nuclear industry and the computer industry have grown up together, and mentioning particularly the importance of modeling the lifecycle of nuclear fuel, and its implication for nuclear plant life management. Seddon (2001) looks at KM in the long-term storage of nuclear materials, where knowledge needs to be retained far beyond the lifespan of a single human being.

A further area of interest about KM in energy sector regards Decision Support Systems (DSSs) and several papers mention DSS for the strategic and operations management in the energy sector (Corben et al., 1999; Hesthammer and Fossen, 2000; Landryova and Irgens, 2006; Menal et al., 2000; Porcheron and Ricard, 1999; Prassl et al., 2005)

Davenport et al. (1998) and Barrow (2001) present successful KM projects in British Petroleum (BP), highlighting its “virtual teamwork” approach to corporate culture and knowledge sharing which enabled global expertise to be brought to bear on local problems, such as trouble-shooting equipment failures and explaining how the principles that had already been established at BP were used when some merger operations took place.

Another relevant issue emerging from the literature review concerning KM in energy industry is the importance of communities of practice. Energy industry companies consider communities of practice as the emergent step in the evolution of the modern, knowledge-based organization (Amin et al., 2001; Ash, 2005; Behounek and Martinez, 2002).

Finally, Carroll et al. (2002) examine organizational learning in high-hazard environments, of which nuclear plants are a good example. They found that teams do not have the responsibility to implement
change, and as a result the managers and team members disagree. Moreover, they underline that in nuclear plants, top management have concentrated mainly on the technical aspects of the plant, but neglect people factors. Also Strater et al. (2004) focus on KM and human reliability assessment. Their paper is based on the argument that existing human reliability assessment methods do not tackle error of commission. Especially, important for KM is the authors’ observation that the errors of commission are generally not errors as such, but based on an incomplete or wrong understanding of the situation, or even result from employees having been trained to do the wrong thing. There is a tension between the well-defined world of the plant itself and the human world of the operators.

The development and the implementation of integrated knowledge management tools may be considered one of the main and recent applications to improve relationships among technical aspects and people factors. In the following, the specific case of the development and the use of Integrated Decommissioning Management Tools (IDMT) for decommissioning nuclear facilities by Ansaldo Nucleare Spa is presented and analysed.

INTEGRATED DECOMMISSIONING MANAGEMENT TOOLS (IMDT) FOR DECOMMISSIONING NUCLEAR FACILITIES: THE CASE OF ANSALDO NUCLEARE SPA

Main Functions of the IDMT Implemented in Ansaldo Nucleare Spa

Ansaldo Nucleare Spa has been strongly involved in development of a qualified and certified software environment to managing the most critical activities of a decommissioning project. The system, called “IDMT” system (Integrated Decommissioning Management Tools), is a set of software modules associated with a package of engineering activities. The software modules, each of them dedicated to a specific decommissioning phase, are designed according to OLE architecture. IDMT supports the choice and implementation of strategies inside the decommissioning project (Alemberti et al., 2005).

The basic concept of IDMT is setting up a CAD 3D Plant Model, and using it as a central repository for gathering almost all required information, based upon the “as built” configuration of plant systems and equipments, the history of modifications and accident events, and the accumulation of radioactive nuclides across the facility. After that or concurrently, validation of the information contained in the Model must be carried out. Additional database tools and appropriate user interfaces integrate with the Model to provide information management functions not available within the CAD system itself. This practice can be considered a good response to the criterion set forth by reference (Alemberti et al., 2005), since its goal is to restore all required information and put it in a form adequate to “state of the art” technologies.

The logical flow of operations and the usage of IDMT in a generic decommissioning project are represented in Figure 1. In the figure, the upper part of each rectangle represents the single decommission activity, while the lower part shows the IDMT software module that supports that activity. As shown in the figure, the IDMT system is a set of integrated tools, based on Intergraph and Microsoft technologies, designed to manage a large amount of data in a safe and centralized way. Each module is provided with a functional and user friendly interface.
In particular, the models have the following functions:

- **3D Model** of the plant, based on PDS technology (Plant Design System by Intergraph). All plant components and systems are modelled: civil structures, pipes, metal constructions, electric and ventilation systems;
- **MiRad**, developed for the management of the radiological inventory of the plant. It stores the radiological measurements and predicts the radiological inventory at specified dates. The main purpose of MiRad is to give a realistic estimate, area by area, of the level of radiological contamination and/or activation, referred to a specific system or component before dismantling;
- **StraDe**, devoted to the study of the possible decommissioning strategies that includes a database for the storage of engineering and radiological data related to the materials of the site and for the definition of applicable treatments;
- **SeqMan**, supporting the analysis of the dismantling sequences, taking into account the radiological impact on exposed workers;
- **SmartPlant Review** strictly associated with PDS and provides a graphical presentation of the plant model. It allows the simulation of cutting and displacement of the spools, i.e. of the dismantling sequences;
- **DeCom**, the IDMT module responsible for the central management of the decommissioning activities. DeCom imports the spool data from the 3D model and stores all the documentation related to the dismantling operations, i.e. isometric view (when referred to “piping”), global drawing (when referred to “equipment”), dismantling report with details about cutting
technologies and work location, operational procedure, the document accompanying the spool during all the decommissioning phases reporting the operations;

- **TRAWS**, allowing the tracking of the construction, storage, organization of conditioned containers of radioactive waste. A database provides the identification and traceability of all information related to each container to be stored at the final repository site.

In terms of characteristics, the IDMT saves in electronic format different types of data (photos, videos, measured data, procedures, as well as physical, chemical and radiological data); it allows an easy recovery of stored data and a simple selection by setting specific access keys; it permits a simulation of the real operating conditions in order to support the study of plant procedures and identify problems related to work optimization; it simplifies the process analysis through the organization of data in tables, reports and cards; it provides all needed documentation for waste, as required by national regulation; it allows simultaneous work and multiple access to the database, depending on the complexity of the activities, on the project features and on the user profile; it allows a simple customization depending on the specific need of customer and project.

Moreover, IDMT allows the daily monitoring of the decommissioning activities and the continuous traceability of the data: the safety of database information is assured by a controlled accessibility, with different responsibility levels assigned to specific users. IDTM works in an integrated configuration to guarantee waste identification, traceability during treatment and conditioning process as well as location and identification at the final repository site. Additionally, the system can be used to identify, analyze and compare different specific operating scenarios to be optimized in terms of both economical and radiological considerations.

A limited survey of similar documented products suggests that each software project arises from a decommissioning project or from a decommissioning agency/company: for example CORA-CALCOM by Nukem, DECOMIT by UKAEA, or VNIIAES developing a custom support system for Russian NPP decommissioning. This is the case also for IDMT. Perhaps there is a strong requirement that these tools reflect the underlying vision of the decommissioning, usually strictly linked to country-specific regulations and standards or to company-specific procedures and practices. Moreover, a software toolset should be considered as a part of a global solution rather than a **stand alone** product.

**IDMT Applications**

Table 1 reports how IDMT modules have been supplied to different Italian nuclear facilities. Actual usage depends on actual progress of decommissioning at each site.

<table>
<thead>
<tr>
<th>Facility/Module</th>
<th>3D-Model</th>
<th>Mirad</th>
<th>Strade</th>
<th>Decom</th>
<th>Seqman</th>
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For Caorso NPP, 3-D model of Turbine Building has been constructed and has been used to derive important information for populating the various database sections. The module MiRad population was completed by December 2003 and includes 8362 assemblies. The module DeCom is currently used at
Caorso NPP to support decommissioning of turbine building: up to now the relevant database section has been populated with about 5000 spools: all of them have been removed from the plant.

For Garigliano NPP, only a specialized version of DeCom is used to manage the “work permits” documentation.

For Trino NPP, module DeCom has been adopted and it is going to be used mainly for removal of activated/contaminated item.

For the Galileo Galilei RTS1 experimental facility of CISAM (Pisa - Italy), an IDMT application with empty database has been supplied in 2004. As per Table 1, all the elements of the software package have been supplied to the Site. During the year 2006, the phase of an overall preliminary study was completed: the result was the population of the database and the preliminary design of decommissioning approach: cutting technology, plant layout re-arrangement for decommissioning, waste treatment strategies, selection of a reference dismantling sequence based upon doses evaluation. The system supplied to the site includes a Server computer equipped with operating system Microsoft Windows XP, Microsoft SQL Server (Desktop Engine version) including the IDMT database objects. The IDMT software is installed on the client computers that connect to the server over a local network. During the year 2008, the secondary system and the decocationization system have been dismantled, as a first application to test and to setup the overall approach, in view of the ongoing full plant dismantling.

The integrated work of 3D Model with the rest of the IDMT toolset impacts in many aspects of the project. For example, Figure 2 depicts a sample of operational documentation produced for CISAM dismantling project as a support for unambiguous identification of the spool to be dismantled in terms of both visual information and part list. Everything is stored in the database and can be retrieved with simple queries: from a query a document can be generated automatically.
Final Remarks

Concluding, we believe that the notions and the practical insights discussed in this paper may represent a good research contribution for enriching the conceptual and empirical frameworks on how an effective knowledge management may affects processes and overall business performance within energy industry.

Accordingly, it has been underlined how successful decommissioning in nuclear energy industry depends on careful and organized planning, consistent with regulatory requirements and how decommissioning planning should ideally be fed continuously with information starting already at the first stage of facility design since it may be seen an ‘evolutionary process’ peculiar and specific for each facility.

It has been presented the IDMT system, developed by Ansaldo Nucleare SpA as a toolset of integrated software modules addressed to govern the dismantling operations in nuclear power plants as well as to manage operational and post-dismantling wastes in treatment facilities. The basic concept of...
IDMT is setting up a CAD 3D Plant Model, and using it as a central repository for gathering almost all required information. The software modules, each of them dedicated to a specific decommissioning phase, are designed in order to guarantee high flexibility, high updatability, and high interoperable architecture by the use of a set of integrated tools, based on Intergraph and Microsoft technologies, aimed to manage a large amount of data in a safe and centralized way. Moreover, the paper has highlighted the advantages of using a structured approach to follow the waste from its early phase of dismantling until its final storage into specific containers throughout all its phases of characterization, treatment and conditioning.

Future directions for the research of KM in the nuclear energy industry can be addressed. The first one is the need for holistic, systemic and integrated approaches to deal with the ever-increasing complexity and differentiation of nuclear energy industry companies. Another challenge for researchers and practitioners is to work to unify the still-divergent theoretical base of KM in the energy industry. In particular, more and more energy companies will require different approaches to KM, in terms of the growth of awareness of the importance of KM initiatives, of the importance of codifying knowledge related to new processes and technologies, and the new role of human resources often differently trained and educated to work with experienced staff. For this purpose, we encourage further research to disentangle the complexities in the relationship between knowledge management and business performance.

More empirical inquiry and in-depth case studies are needed to define the modalities and procedures that help companies to identify their knowledge background and implement appropriate knowledge management practices ensuring the effectiveness of their business processes and in turn the value of their products and services. Finally, there is much to be gained from looking at what has been tried in other industries, in the particular the evidence-base with respect to KM initiatives and organizational learning.

REFERENCES


Leavitt, P. (2002). *Applying knowledge management to Oil and Gas industry challenges*. American Productivity and Quality Center, Houston, TX.


The Venture Creation Process, Entrepreneurial Self-Efficacy and Competitiveness: A Focus on Technology Enterprises

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Venture creation is typically conceptualized in terms of entrepreneurial tasks within a venture creation process, where the transition from one stage to another is often the result of a combination of various skill and belief components. This paper investigates the relationship between the venture creation phase, in terms of entrepreneurial self-efficacy and the competitiveness of small and medium technology enterprises. Correlational and regression analysis are performed where empirical evidence supports that the searching, planning, marshaling resources and implementing people phases of the venture process are significantly associated with the competitiveness of these enterprises.

INTRODUCTION

New venture creation is typically conceptualized in terms of broad stages or as entrepreneurial tasks within a venture creation process model (Clouse, 1991; McGee, Peterson, Mueller & Sequeira, 2009; Stevenson & Jarillo, 1990; Timmons, 2002; Vesper, 1996). Extant literature demonstrates that new firm formation is a specific, identifiable organizational process that has been subjected to previous empirical research (Newbert, 2005). Of particular research interest has been the identification of factors, characteristics, and conditions which foster entrepreneurial processes, new venture creation and contributing successes factors (Grimaldi & Grandi, 2005; McGee, et al., 2009; Urban, 2010a). By positioning the new firm formation process as a dynamic capability (Newbert, 2005), a common set of gestation activities emerge for successful entrepreneurship, where entrepreneurs typically emphasize different venture creation steps to outperform the competition (Goel, Gonzalez-Moreno & Saez-Martines, 2003). Such an approach can provide a novel paradigmatic way of appreciating an enterprise or industry (Holloway & Sebastiao, 2010; Jiang & Zhou, 2010), and its vicissitudes from the beginnings to ensuing developments.

The transition of individuals from one stage of an entrepreneurial process to another is often the result of a combination of various motivational and cognition components where environmental conditions and opportunities also play a role (Baum & Locke, 2004; Shane, Locke & Collins, 2003). However, environmental factors being held constant, Shane et al. (2003) argue that human motivation plays a critical role in the entrepreneurial process.

Recent research finds that although motivation is implied, or assumed, in papers on intentions, scripts, and cognitive maps to entrepreneurial behaviors, it remains largely under researched despite its critical importance to predicting and explaining entrepreneurial behaviors (Carsrud & Brannback, 2011). This paper responds to calls for research in this direction by investigating the venture creation process and possible links to the competitiveness of small and medium technology enterprises.
Evaluating regional transformation through technological entrepreneurship, Venkataraman (2003) analyses how in a modern economy universities and research and development laboratories are the incubators of novel technical ideas; it is not an accident that areas around Boston and Silicon Valley have produced a significant amount of wealth. Infusing an enterprising sprit into technical endeavors and the promotion of inventive skills has been implemented as an impetus to promote technopreneurship (Guan & Liu, 2007; Lee & Wong, 2004). Both entrepreneurs and technopreneurs have similar qualities, such as, determination, willingness to take risk, capacity to mobilize resources, and perseverance to overcome setbacks.

Although substantial research exists interrogating links between start-up motivations and entrepreneurial intentions (Edelman, Brush, Manolova & Greene, 2010); Hmieleski & Corbett, 2006) there is still limited understanding of entrepreneurial behavior, operationalized as self-efficacy in this paper, in the new venture’s performance after start-up. Research finds those with higher entrepreneurial self-efficacy (ESE) as perceiving their environment as more opportunistic rather than fraught with risks, and they tend to believe in their ability to influence the achievement of goals (Chen, Greene & Crick, 1998; De Noble, Jung & Ehrlich, 1999). Since ESE refers to cognitive evaluations of personal capabilities with reference to specific tasks of entrepreneurship, it achieves the entrepreneurial distinctiveness that is both individual and contextual (Chen et al., 1998; De Noble et al., 1999); McGee et al., 2009). Examining ESE across venture creation phases is pertinent as research indicates that once small businesses begin to be sustainable their reported management challenges converge (Chan, Bhargava & Street, 2006). ESE can influence how well existing entrepreneurs discharge their responsibilities during each of the venture creation phases. The behaviors to which ESE corresponds are largely concerned with new-venture management and as such are required of entrepreneurs well beyond the point of founding (Forbes, 2005; Ulhøi, 2005). Competent functioning requires both skills and self-beliefs of efficacy, as both are required for continuously improving multiple sub-skills to manage ever-changing circumstances in entrepreneurial environments; most of which contain ambiguous, unpredictable and often stressful elements (Chandler & Jansen, 1992). Moreover ESE has been found to have relevance for technology applications (Lucas et al., 2009).

Given the recognized need for data-based and integrative process studies of the venture creation phases, this paper makes a contribution to the field of innovation, technology and entrepreneurship by empirically investigating the different venture creation phases in terms of the competitiveness of small and medium technology enterprises. In line with existing research (Kuratko, Hornsby & Goldsby, 2004) this study hypothesizes that venture competitiveness is contingent upon individual members undertaking innovative activities, which corresponds to ESE across the venture phases. Specifically it is proposed that the competitiveness (outcome) of the venture is influenced by the ESE (antecedents) of individuals undertaking the venture creation process. The self-efficacy construct is invaluable to understanding entrepreneurship and plays an important role as an antecedent for promoting the perceived feasibility and competitiveness of ventures (Krueger, Reilly & Carsud, 2000). Covin and Slevin’s (1991) conceptual model of entrepreneurship as firm behavior, indicates that entrepreneurial intensity has a direct and positive influence on venture performance. Consequently ESE, as an antecedent to venture competitiveness refers to an owner’s self-perception of the firm, since their self-perception will be closely related to the behavior of the firm. This firm level approach is consistent with the classical economics perspective in which the individual entrepreneur is regarded as a firm (Filion, 1997).

The paper proceeds by first accessing a relevant theoretical base to support the hypotheses which are formulated on existing theory from a range of disciplines. Next the research approach and measurement issues related to the constructs are discussed. This is followed by specific analytic methods best suited to test the hypotheses. Results and implications follow, and the study’s limitations are addressed and future research directions are suggested.
LITERATURE REVIEW

Competitiveness of Ventures

Competitiveness is a concept often related to long-term performance of firms and economies. Many governments believe that new ventures can contribute towards the promotion of more equitable development, as well as the enhancement of the competitiveness of local industries within a global economy (Bygrave & Minniti, 2000; Hipkin & Bennett, 2003; Preece et al., 1998; Wright et al., 2007).

At the firm level, existing studies suggest that a sustainable competitive advantage is derived from how a firm approaches strategy formulation (Dess, Lumpkin & McGee, 1999). Strategic management in entrepreneurial firms has gained prominence in recent years as organizations compete in volatile environments (Entrialgo, Fernandez & Vazquez, 2000). The venture creation environment is characterized by complexity and dynamism, with ventures having to anticipate future scenarios and develop proactive strategies in an ambiguous and unstructured surrounding (Allen & Stearns, 2004).

Competitiveness, with a focus on small and medium enterprises (SMEs), have shown how the interaction of the scope for action or growth in the business environment, together with the degree of access to capital resources and the intrinsic ability of the firm, are all necessary factors required to improve the performance of the firm (Chan, Bhargava & Street, 2006; Ireland, Covin & Kuratko, 2009; Qureshi & Mian, 2010). For any venture, consequences primarily concern the degree to which results lead to acceptable (or better) current performance and to the possibility of acceptable (or better) future performance. Literature has emphasized several organizational-level outcomes of entrepreneurship, where two principal types of such outcomes are: (1) capability development, and (2) strategic repositioning (Ireland, Covin & Kuratko, 2009).

Competitiveness is the capacity of ventures to create and sustain economically viable industry positions (Nelson, 1991; Teece, Pisano & Shuen, 1997). Competitive development is created as ventures use entrepreneurial initiatives to explore new technologies or product-market domains or exploit existing technologies or product-market domains. Enhanced competitiveness, in particular, is often the result of exploitation of entrepreneurial opportunities. In terms of strategic repositioning, entrepreneurial behaviors can (1) place the venture, or portions thereof, in a new position within its pre-existing product-market domain(s), (2) alter the attributes of that domain(s), and/or (3) position the venture within a new product-market domain(s) (Ireland et al., 2009).

Rather than rely on typical performance measures such as sales and profit growth, assessing the competitiveness of SMEs is important, particularly as differences in growth measures have led to different relationships among constructs, with a reduction in the appropriateness of accumulating knowledge across studies (Shepherd & Wiklund, 2009). Building in this direction of SME competitiveness the focus of this study is on outcomes resulting from entrepreneurial action during the venture creation process.

Venture Creation Process

In a recent study McGee et al. (2009) demonstrate the multi-dimensional nature of entrepreneurial self-efficacy by testing it within a four-phase venture creation process framework. This framework builds in the direction of new venture creation being conceptualized in terms of broad stages or as entrepreneurial tasks within a process model (Stevenson & Jarillo, 1990; Timmons, 2002). These stages are labeled (1) searching, (2) planning, (3) marshaling, and (4) implementing (Kickul, Gundry, Barbosa & Whitcanack, 2009; McGee et al., 2009; Mueller & Goic, 2003).

(1) The searching phase involves opportunity identification and development. Lumpkin, Hills and Shrader (2004) argue that the creation of successful businesses follows successful opportunity development and also involves entrepreneur’s creative work.

(2) The planning phase consists of activities by which the entrepreneur converts the idea into a feasible business plan. Here the idea or business concept is evaluated in terms of various market and profitability criteria.
The marshaling phase involves assembling resources to bring the venture into existence. To bring the business into existence, the entrepreneur gathers (marshals) necessary resources such as capital, labor, customers, and suppliers without which the venture cannot exist or sustain itself.

The implementing phase requires that the entrepreneur grow the business and ensure the sustainability of the venture. To this end, the successful entrepreneur applies management skills and principles, particularly in implementing people management and financial management.

Although venture performance is influenced by a host of factors including the sector in which the firm operates, firm age and size, as well as cultural and environmental contexts, it is specifically argued for purposes of this paper that the competitiveness of the firm is influenced by the ESE of individuals undertaking the venture creation process. The self-efficacy perspective is highly appropriate for the study of the entrepreneur, since as a task specific construct rather than a global disposition, it helps address problem of lack of specificity in previous entrepreneurial personality research, and as a belief of one’s venture capabilities, ESE is relatively more general than task self-efficacy (Chen et al., 1998).

Previous studies on entrepreneurial motivation have focused on basic concepts such as achievement need, risk taking, tolerance of ambiguity, and locus of control, all of which have yielded mixed results. However, findings have been more consistent for the self-efficacy construct when applied to entrepreneurial behavior (Bradley & Roberts, 2004; Forbes, 2005; Lucas et al., 2009). Previous research on ESE has been related to the pursuit of entrepreneurial activity in various ways, for instance, where general self-efficacy (GSE) is related to perseverance in difficult fields and greater personal effectiveness (Chen, Gully & Eden, 2001; Markman, Balkin & Baron, 2002), and where ESE is influenced by the way in which entrepreneurs make strategic decisions (Forbes, 2005). Since self-efficacy beliefs are domain specific, it is important to consider what is being measured and how. Some measures of ESE, while multi-dimensional, are based on general management tasks such as marketing, strategic planning, and business decision-making. These more generalized measures of ESE however do not assess confidence in performing specific tasks associated with planning, launching, and growing a new venture. While the ESE construct is quite promising it remains empirically underdeveloped and many scholars have called for further refinement of the construct (for example, Forbes, 2005; Lee & Bobko, 1994; Kolvereid & Isaksen, 2006; Urban, 2006). Another way of measuring self-efficacy of a broader domain, such as entrepreneurship (Chen et al., 1998) is to develop a conceptual framework of task requirements on the basis of which self-efficacy of a domain is aggregated from self-efficacy of various constituent sub-domains. Many studies have conceptualized self-efficacy as a task specific or state like construct, while others (De Noble et al., 1999) use a measure of ESE consisting of various sub-scales tailored specifically to the venture creation process.

Following McGee et al (2009) the hypotheses take into account the multidimensional and sequential nature of entrepreneurial tasks. The theoretically grounded four-dimensional structure of ESE, include the modification that the dimension of ‘implementing’ has two sub dimensions (one representing the ‘people aspects of implementation’ and the other representing the ‘financial aspects of implementing’). Attitude toward venturing is included in the set of hypotheses, as the theory of planned behavior (TPB) (Ajzen, 1991) identifies attitudinal antecedents of intentions, which reflect the perceived desirability and the perceived feasibility of intentions and is thus related to perceptions of self-efficacy. Furthermore path analysis confirms that the correlation between attitudes and behavior is explained by attitude – intentions behavior links (Kim & Hunter, 1993). Intentional behavior helps explain why many entrepreneurs decide to start a business long before they scan for opportunities (Krueger, Reilly & Carsud, 2000). Recognizing the importance of ESE within the four-phase venture creation process framework and given the lack of empirical evidence of how technology SMEs navigate through this process, it is hypothesized that a positive relationship exists between each of the venture creation phases and competitiveness. The expected relationships are:

**H1:** There will be a strong positive relationship between the searching phase of the new venture process and competitiveness.
H2: There will be a strong positive relationship between the planning phase of the new venture process and competitiveness.

H3: There will be a strong positive relationship between the marshaling phase of the new venture process and competitiveness.

H4: There will be a strong positive relationship between the implementing people phase of the new venture process and competitiveness.

H5: There will be a strong positive relationship between the financial management phase of the new venture process and competitiveness.

H6: There will be a strong positive relationship between attitude toward venturing and competitiveness.

METHODOLOGY

Sampling and Data Collection

The population of this study was based on several membership lists representative of businesses operating in the greater Johannesburg area. Johannesburg is situated in the Gauteng province, the economic hub of South Africa, which has the highest number of businesses (South African Business Guidebook, 2005/6). This is indicative of the relative wealth of the Gauteng Province, and the extent to which the future economic growth of the province will determine growth for the entire South African economy (Gauteng Provincial Government, 2008).

The sampling frame was identified from the Small Enterprise Development Agency (SEDA) and Johannesburg Chamber of Commerce affiliates such as the Progressive Business Alliance, and Business Unit South Africa database of businesses operating in the greater Johannesburg area, which collectively represent a population of approximately 4600 businesses.

As emphasized earlier the focus of this study is on small to medium-sized enterprises in technology industries. More specifically the sample for this study was based on a previous conceptualization of ‘early stage technology-based firms’ (ESTBFs), which have been described as being technology-based, and are in early-stage of their business development, and have potential to compete internationally (Preece, Miles & Baetz, 1998). Based on sampling frames 377 potential respondents were surveyed. The qualifying criteria for being considered a technology venture were based on the firm’s level of technology orientation (TO) (Allen & Stearns, 2004; Urban & Barreria, 2010). These selection variables included the following questions: (1) will all, some, or none of your potential customers consider this product or service new and unfamiliar; (2) are there many, few, or no other businesses offering the same products or services to your potential customers; (3) were the technologies or procedures required for this product or service generally available more than a year ago; (4) will spending on research and development be a major priority for this new business; (5) would you consider this new business to be hi-tech. Respondents who answered yes on three or more questions were included in the final sample. Based on these eligibility criteria and in line with the global entrepreneurship monitor (GEM) studies’ operational definitions (Bosma & Levie, 2007)\(^1\) for small and medium firms, a non-probability judgmental sampling technique was used. Sample parameters, which served as control variables, included: (a) sex, (b) age, (c) education level, (d) ethnic group, (e) work experience, (f) technology business sector; (g) employment size class, divided into four groups; (h) firm age, divided into five categories (less than three months, 3-42 months, 5-10 years, 11-20 years, more than 20 years). The target respondent was the ESTBFs owner-manager or chief executive officer (CEO). Owner-managers and CEO’s are typically well positioned in respect of overarching operational and strategic endeavors of the entire firm (Zahra & Covin, 1995). Top-level managers are responsible for putting into place pro-entrepreneurship organizational architectures, i.e., where the workplace exhibits structural, cultural, resource, and system attributes that encourage entrepreneurial behavior, both individually and collectively (Schindehutte, Morris & Kuratko, 2000). Addressing ESE within the four-phase venture creation process at the firm level corresponds to similar studies sample characteristics (Kreiser et al., 2002). As ESE refers to an owner’s self-perception of a firm’s strategic orientation, their self-perception will be closely related to the behavior of the firm.
Consequently ESE measures the owners’ self-perception and accordingly serves as a relevant proxy for measuring the entrepreneurial tasks within a venture creation process.

The survey was solicited physically with periodic reminder telephone calls. Based on this research procedure, 199 usable responses (an effective 52 percent response rate) was generated as the final sample.

Independent Variables

Venture phases: Instruments utilized in previous studies were scrutinized for construct validity and reliability. In a previous study the items for the venture creation factors and for the attitude toward venturing construct produced values for Cronbach’s alphas all above 0.8 (McGee et al., 2009). Following a confirmatory factor analysis approach and using covariance analysis to rigorously evaluate the factor structure of the venture phases items, the factor analysis model provided evidence of convergent validity in the original study (the items included in the model share a relatively high degree of the variance of their respective underlying constructs, as indicated by the factor loadings being statistically significant at \( p = 0.05 \)). Moreover the internal consistency of each construct was also evidenced by the face validity or conceptual relatedness of the items. This relatedness may be attributed to the theoretical grounding of the scales that were developed for the original study. Evidence for discriminant validity for the constructs in the final model has been previously established by the items for each construct having factor loadings which are not statistically significant at \( p = 0.05 \), with conceptually similar, but distinct constructs. Given the evidence supporting the application of these scales confirms that their further use is justified. Based on the a priori inclusion of compelling theory, as well as evidence for discriminant and convergent validity of the proposed measures, the present study only tested the internal consistency of items measuring the four-phase new venture creation process, as well as attitudes towards venturing.

Five dimensions are used which were previously conceptualized in the hypotheses section, and are labeled as: (1) searching, (2) planning, (3) marshaling, (4) implementing-people, and (5) implementing-financial (McGee et al., 2009). Three items were used to measure the search dimension, four for planning, three for marshaling, six for people, and three for financial, and three items for attitude toward venturing. All items were measured on a 5-point Likert scale where respondents were asked to indicate their confidence on their ability to perform ESE dimensions (1 = very little to 5 = very much).

Cronbach’s Alphas were calculated indicating relatively high reliability (Nunnally, 1978) across dimensions: (1) searching \( \alpha = 0.77 \), (2) planning \( \alpha = 0.71 \), (3) marshaling \( \alpha = 0.65 \), (4) implementing-people \( \alpha = 0.81 \), (5) implementing-financial \( \alpha = 0.88 \) and (6) attitude toward venturing \( \alpha = 0.85 \).

Dependent Variables

Competitiveness was measured in terms of two venture outcomes: (1) capability development, and (2) strategic repositioning. Seven items in total were used to measure these two indicators of competitiveness, where respondents were asked to what extent they agree or disagree (1 = strongly disagree to 5 = strongly agree), with statements indicating levels of attaining capability and positioning. The following items measured competitiveness: ability of venture to develop capabilities in order to exploit entrepreneurial opportunities; venture capacity to create and sustain an economically viable industry position; venture use of entrepreneurial initiatives to explore new technologies or product-market domains; venture use of entrepreneurial initiatives to exploit existing technologies or product-market domains; strategic positioning of the venture to be in a new position within its pre-existing product-market domains; strategic positioning of the venture to alter the attributes of their product-market domains; and the ability of venture to assume a new strategic position in relation to its competitors (Ireland et al., 2009). An overall Cronbach’s Alpha of 0.83 was obtained for these two combined sets of measures representing competitiveness. 4.4

Control Variables

Consistent with previous studies demographic information was collected in the questionnaire. Variables measuring gender, education, ethnic group affiliation, work experience, and a question pertaining to relatives or friends who either are or have been entrepreneurs were included. Secondly firm
control variables were included and data sought on business size and age as previously mentioned in terms of sampling parameters (all measured as interval variables). Although all control variables have a prior theoretical basis for expecting the variable to have a systematic relationship with either the dependent or independent variable, or both (Minniti & Bygrave, 2003), for instance Chen et al. (1998) showed that prior education and gender were related to ESE, and Drnovsek and Glas (2002) showed that prior entrepreneurial experience was related to ESE, only firm age and size were included, to ensure a manageable number of variables are used in the correlation and regression analysis. Due to unbalanced categories, the range of employee numbers and firm age were collapsed to represent two categories for further analysis, that is firm size (less than 10 and 10-50 as ‘small’, and 51-200 and more than 200 as ‘medium’). The categories for firm age were, (3-42 months, 5-10 years, and 11-20 years).

Common method response bias was controlled for by safeguarding respondent anonymity, as well as ensuring that the questions relating to the dependent variables were located away from the independent and control variables in the instrument. Furthermore, all items relating to independent, dependent and control variables were explored in a single principal component analysis (PCA), using Harman’s one-factor test (Podsakoff et al., 2003) to check if one component accounted for most of the variance. Six components with eigenvalues greater than 1.0 were detected, which accounted for 63% of the variance. The largest component accounted for only 15%. Consequently no evidence of common method bias was identified.

Moreover archival sources were used where firm size and age were compared with non-responding firms by using secondary data obtained from the “Technology Top 100” survey (Financial Mail, 2006). Results of t-tests comparing these firms with the current study sample’s mean scores on select ESE variables revealed no differences (p >.10), suggesting that the sample appears to be representative of the population from which it is based (Cooper & Emory, 1995).

RESULTS

Sample Characteristics

The profile which emerges from the sampling procedure is that the typical respondent is male, 41 years old, college graduate, with more than six years work experience (refer to Table 1). Additionally several respondents indicated they had parents (51.3 percent), friends (85.4 percent) or relatives (75.6 percent) who are or had been entrepreneurs.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>FREQUENCIES</th>
<th>PERCENT</th>
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<td><strong>Gender</strong></td>
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<tr>
<td>Female</td>
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<tr>
<td><strong>Education level</strong></td>
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<td>5.5</td>
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<tr>
<td>High school completed</td>
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<tr>
<td>Short course certificate</td>
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<td>12.1</td>
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<tr>
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Descriptive Statistics and Correlations

Mean scores, standard deviations and correlation coefficients are displayed in Table 2. Descriptive statistics indicate that mean scores are leaning towards the mostly agree end of the scale. These high average scores across all the dimensions, suggests that individuals have high levels of confidence in performing tasks through the different venture stages. On competitiveness the mean score is 3.78 suggesting a well-positioned and capable technology SME.

To evaluate the hypothesized relationships between the variables, correlation and regression analyses were performed. For the correlation matrix, refer to Table 2, the Pearson Correlation Coefficients are reported with levels of significance denoted. According to Cohen and Holliday (1998), a multiple correlation coefficient of 0.7 or above is considered a high enough to be statistically significant at the 0.05 and 0.01 levels. The interpretation of these correlations and the corresponding levels of significance allowed for acceptance or rejection of the hypotheses, as follows:

1. The searching phase was positively and significantly correlated with competitiveness ($r = 0.45$, $p < .01$), providing support for hypothesis 1.
2. The planning was positively and significantly correlated with competitiveness ($r = 0.37$, $p < .01$), providing support for hypothesis 2.
3. The marshaling phase was positively and significantly correlated with competitiveness ($r = 0.35$, $p < .01$), providing support for hypothesis 3.
4. The implementing people phase was positively and significantly correlated with competitiveness ($r = 0.20$, $p < .05$), providing support for hypothesis 4.
5. The implementing finance phase was not significantly correlated with competitiveness ($r = 0.28$),
not providing support for hypothesis 5.

(6) Attitude toward venturing was positively and significantly correlated with competitiveness ($r = 0.19, p < .05$), providing support for hypothesis 6.

(7) The control variables of firm age and size were not significantly correlated with competitiveness or any of the venture phase dimensions.

To further evaluate the relationship between the venture creation dimensions and competitiveness, multiple regression analysis was conducted. Refer to Box 1 for the full results. Multiple regression analyses using ordinary least squares regression were performed to determine the predicted relationship between the specified variables. The use of multiple regressions allows for the partitioning of variance with correlated predictors, thereby reducing the likelihood of making a Type 1 error (Cohen & Holliday, 1998). Although no rule exists regarding what fraction of variance needs to be explained to make relationships strong many researches consider a squared multiple correlation of 0.3 or greater to be at least moderately strong (Sudman & Blair, 1998). It is worth noting that although the coefficient of determination (R-squared) does not exceed 30 percent, the relationships determined through the regression analysis, while they may be weak, are nevertheless statistically significant, the R-square and adjusted R-square is given in Box 1. Model 1 has an R-square of 0.221, which is interpreted as the predictors (dimensions in the venture phases) explaining 22 percent of variance in the dependent variable (competitiveness). This means that there may be other variables that influence this relationship. In the ANOVA section an F-value of 5.991 is highly statistically significant (0.000). The constant coefficient provides a t-value of 3.908, significant at the 0.001 level ($p < 0.001$). The highest beta weight (0.305) and only significant t-value (4.320, $p < 0.001$) is for the search dimension. The second highest beta was for the plan dimension, with a borderline level of significance at $p = 0.012$. Since other coefficients are not significant, the predictive and explanatory power of this model is reduced. To try and determine if the predictive power of the regression could be improved by only entering the significant coefficients another model was tested where the dimensions of searching and planning were entered together with the dependent variable. The adjusted R-square was 0.228 in this instance suggesting a very small improvement and that these two dimensions could explain greater variance in competitiveness.

An examination of the collinearity diagnostics reveal relatively low variance proportions for the various dimensions and control variables. These diagnostics when read in conjunction with collinearity statistics, not shown due to space limitations, indicate variable inflation factor (VIF) values between 0.274 and 0.022. These figures are well below critical values and deemed as acceptable, indicating no incidence of multicollinearity. When the values are 10.0 or more the regression coefficients can fluctuate widely from sample to sample, making it risky to interpret the coefficients as indicators of the predictors (Cooper & Emory, 1995).

Comparisons by Firm Age and Size

To test for differences between groupings of firm age and firm size, initially the descriptives were interrogated in terms of lower bound and upper bound values, followed by test for homogeneity of variances. The levene statistic was significant and greater than 0.05 across all venture creation dimensions for both firm age and size. A one-way analysis of variance (ANOVA) was used to compare ESE means scores on first firm size and then firm age. ANOVA results are displayed in Table 3 indicating the sum of squares, mean square and F-statistic for each dimension. These statistics were interpreted as follows: for the search dimension there is a 0.288 probability of obtaining an F-value of 1.488 or higher if there are no differences among group means in the population. Since this probability exceeds 0.05 one can conclude that for this dimension as well as for all the other dimensions there are no significant differences among the mean scores across firm sizes. Further post-hoc robust tests of equality of means were calculated and the Brown-Forsythe statistic indicates that there were no significant differences on mean scores across firm size (not shown). The same procedure in terms of ANOVA and post-hoc comparisons were conducted for firm age, with no significant results detected (not shown).
## TABLE 2
DESCRIPTIVES AND CORRELATIONS FOR VENTURE CREATION PHASES, COMPETITIVENESS AND FIRM AGE AND SIZE

<table>
<thead>
<tr>
<th>MEAN</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Searching</td>
<td>4.18</td>
<td>.65</td>
<td>.48**</td>
<td>.50**</td>
<td>.40**</td>
<td>.14*</td>
<td>.27**</td>
<td>.45**</td>
</tr>
<tr>
<td>2. Planning</td>
<td>3.98</td>
<td>.60</td>
<td>.48**</td>
<td>1</td>
<td>.52**</td>
<td>.48**</td>
<td>.33**</td>
<td>.27**</td>
</tr>
<tr>
<td>3. Marshaling</td>
<td>4.08</td>
<td>.59</td>
<td>.50**</td>
<td>.52**</td>
<td>1</td>
<td>.52**</td>
<td>.16*</td>
<td>.36**</td>
</tr>
<tr>
<td>4. People</td>
<td>4.33</td>
<td>.50</td>
<td>.40**</td>
<td>.48**</td>
<td>.52**</td>
<td>1</td>
<td>.31**</td>
<td>.40**</td>
</tr>
<tr>
<td>5. Financial</td>
<td>3.99</td>
<td>.84</td>
<td>.14*</td>
<td>.33**</td>
<td>.16*</td>
<td>.31**</td>
<td>1</td>
<td>.19*</td>
</tr>
<tr>
<td>6. Attitude to venturing</td>
<td>4.53</td>
<td>.54</td>
<td>.27**</td>
<td>.27**</td>
<td>.36**</td>
<td>.40**</td>
<td>1</td>
<td>.19*</td>
</tr>
<tr>
<td>7. Competitiveness</td>
<td>3.78</td>
<td>.65</td>
<td>.45**</td>
<td>.37**</td>
<td>.35**</td>
<td>.20*</td>
<td>.28</td>
<td>.19*</td>
</tr>
<tr>
<td>8. Firm size (small)</td>
<td>.52</td>
<td>.50</td>
<td>-.13</td>
<td>-.08</td>
<td>-.04</td>
<td>-.07</td>
<td>-.10</td>
<td>.01</td>
</tr>
<tr>
<td>9. Firm size (medium)</td>
<td>.34</td>
<td>.47</td>
<td>.09</td>
<td>.06</td>
<td>-.01</td>
<td>-.01</td>
<td>.02</td>
<td>.00</td>
</tr>
<tr>
<td>10. Firm age (3-4 months)</td>
<td>.37</td>
<td>.48</td>
<td>.05</td>
<td>.10</td>
<td>.08</td>
<td>-.00</td>
<td>-.02</td>
<td>.07</td>
</tr>
<tr>
<td>11. Firm age (5-10 years)</td>
<td>.28</td>
<td>.45</td>
<td>-.00</td>
<td>-.01</td>
<td>-.09</td>
<td>.01</td>
<td>-.07</td>
<td>.01</td>
</tr>
<tr>
<td>12. Firm age (11-20 years)</td>
<td>.18</td>
<td>.38</td>
<td>.06</td>
<td>-.05</td>
<td>.03</td>
<td>.06</td>
<td>-.06</td>
<td>.01</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

### Box 1. Regression analysis results for venture creation dimensions

#### Model summary

<table>
<thead>
<tr>
<th>MODEL</th>
<th>R</th>
<th>R-SQUARE</th>
<th>ADJUSTED R-SQUARE</th>
<th>STD. ERROR OF ESTIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.515(a)</td>
<td>.265</td>
<td>.221</td>
<td>.51517</td>
</tr>
</tbody>
</table>

(a) Predictors: (Constant), search, plan, marshal, implement people, finance, attitude, firm age and size
(b) Dependent Variable: Competitiveness

#### ANOVA (b)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SUM OF SQUARES</th>
<th>df</th>
<th>MEAN SQUARE</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>17.490</td>
<td>11</td>
<td>1.590</td>
<td>5.991</td>
<td>.000(a)</td>
</tr>
<tr>
<td>Residual</td>
<td>48.569</td>
<td>183</td>
<td>.265</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>66.059</td>
<td>194</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) Predictors: (Constant), search, plan, marshal, implement people, finance, attitude, firm age and size
(b) Dependent Variable: Competitiveness

#### Coefficients

<table>
<thead>
<tr>
<th>MODEL</th>
<th>UNSTANDARDIZED COEFFICIENTS</th>
<th>STANDARDIZED COEFFICIENTS</th>
<th>T</th>
<th>SIG.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>STD. ERROR</td>
<td>BETA</td>
<td></td>
</tr>
<tr>
<td>1 (Constant)</td>
<td>1.623</td>
<td>.415</td>
<td>3.908</td>
<td>.000</td>
</tr>
<tr>
<td>Search</td>
<td>.305</td>
<td>.071</td>
<td>.341</td>
<td>4.320</td>
</tr>
<tr>
<td>Plan</td>
<td>.208</td>
<td>.082</td>
<td>.214</td>
<td>2.538</td>
</tr>
<tr>
<td>Marshaling</td>
<td>.112</td>
<td>.084</td>
<td>.113</td>
<td>1.323</td>
</tr>
<tr>
<td>Implement people</td>
<td>-.091</td>
<td>.095</td>
<td>-.080</td>
<td>-.960</td>
</tr>
<tr>
<td>Implement finance</td>
<td>-.064</td>
<td>.048</td>
<td>-.094</td>
<td>-1.334</td>
</tr>
<tr>
<td>Attitude</td>
<td>.061</td>
<td>.077</td>
<td>.057</td>
<td>.789</td>
</tr>
</tbody>
</table>


Firm size (small) | .146 | .130 | .126 | 1.128 | .261
Firm size (medium) | .096 | .131 | .078 | .738 | .461
Firm age (3-42 month) | -.134 | .129 | -.112 | -1.045 | .297
Firm age (5-10 years) | -.102 | .129 | -.079 | -.792 | .429
Firm age (11-20 years) | -.047 | .133 | -.031 | -.354 | .724

(a) Dependent Variable: Competitiveness

DISCUSSION AND CONCLUSION

The purpose of this study was to build on research in terms of the venture creation process as conceptualized through the four phases of the venture creation. In this regard the present study adds to the growing knowledge base on the venture creation process and competitiveness of small and medium technology firms. Specifically it was hypothesized that each of the phases will be significantly associated with the competitiveness of these technology enterprises. The empirical evidence ensuing from this study supports these propositions, where the dimensions of searching, planning, marshaling resources, and implementing people, as well as attitudes toward venturing were significantly associated with competitiveness of the firm.

These findings translate into the following entrepreneurial actions that are desirable during the venture creation phases: planning in terms of opportunity identification and development, evaluating the business concept in terms of various market and profitability criteria, gathering (marshaling) necessary resources such as capital, labor, customers, and suppliers without which the venture cannot exist or sustain itself, growing the business and ensuring the sustainability of the venture through implementing people management practices. The study further demonstrates that entrepreneurs discharge their responsibilities during the venture creation phases and that these behaviors to which ESE corresponds are largely concerned with new-venture management and as such is required of entrepreneurs well beyond the point of founding. The results also resonate with the suggestion that how entrepreneurs think in the course of managing their ventures can have important implications for firm success long after the founding event (Forbes, 2005).

Based on the regression results the different dimensions in the venture creation phases explain a modest, albeit significant amount of variance in the competitiveness of the technology venture. Competitive development has been recognized as important as ventures use entrepreneurial initiatives to exploit or exploit new technologies or product-market domains, particularly by exploiting entrepreneurial opportunities. The same importance is often attached to strategic repositioning, where entrepreneurial behaviors during the venture creation phases can place the venture in a new position within its pre-existing product-market domain(s) (Urban & Barreria, 2010).

Interlinking the empirical results of this paper with established literature allows for additional insights to emerge. For instance where individuals are thought to identify opportunities (the searching phase) because they possess uniquely different forms of knowledge or human capital (Venkataraman, 1997), ties in with higher levels of ESE typically required during the planning phase of the venture process. Moreover entrepreneurial opportunities encompass a social learning process whereby new knowledge continuously emerges to resolve uncertainty inherent to each stage of the venture creation process. In general, people discover opportunities that others do not identify since they are better able than others to recognize opportunities, given the same amount of information about it, because they have superior cognitive capabilities and self-efficacy beliefs (Krueger, 2000). This would suggest that a major factor influencing the process of opportunity recognition and development which leads to venture sustainability includes maintaining high levels of ESE. The success of any venture in terms of strategy is more probable when an individual has the ESE required to structure (accumulate and strategically divest), bundle (successfully combine), and leverage (mobilize and deploy) its resources (Sirmon, Hitt & Ireland, 2007).
In terms of each of the venture process phases, competent functioning requires both skills and self-beliefs of efficacy. Operative efficacy calls for continuously improving multiple sub-skills to manage ever-changing circumstances, as typified in entrepreneurial environments, most of which contain ambiguous, unpredictable and often stressful elements (Capelleras, Greene, Kantis & Rabetino, 2010; Chandler & Jansen, 1992). Not surprisingly the relationship between self-efficacy and performance has been found to be mediated by strategy use and vice versa (Forbes, 2005), which reflects the generative capability of self-efficacy where cognitive, social, and behavioral sub-skills are organized into integrated courses of action. Such effort requires perseverant effort and self-doubters are quick to abort this generative process if initial efforts are deficient (Bandura, 1997).

The introduction of innovative products, services, processes, or business models tailored to attractive niches is an additional opportunity for small and medium technology enterprises to stand out from competition (Porter, 1985; Preece, et al., 1998). In so doing, these technology enterprises can benefit from high brand loyalty of buyers and a reduced price sensitivity of demand as a consequence of customers valuing the uniqueness of the innovation. Serving attractive niches with innovative products is particularly advantageous for small and medium firms compared to large firms due to their limited size and greater nimbleness. By offering highly innovative products, small firms can avoid price competition. In addition, innovative products may create new demand and, thus, facilitate firm growth (Katila & Shane, 2005). If the innovating small enterprise manages to set high barriers preventing competitors from market entry, the company’s position in the industry is strengthened and the innovation can lead to persistent above-average returns.

By understanding the venture creation process, technology enterprises embarking on a product development process are encouraged to acknowledge that this process can lead to competitive advantage via enhancement, recombination or creation of resources and their deployment in value-creating strategies. The ability to reconfigure their resource base due to greater nimbleness and agility is a considerable advantage of small and medium enterprises compared to large corporations. As such, from a dynamic capabilities perspective, these enterprises can benefit greatly from innovation (Kickul, Belgio & Hanna, 2003). Additionally, navigating the venture creation process can not only lead to the direct effects on competitiveness, as indicated in the results, but learning during the innovation process generates absorptive capacity defined as the capability to identify, assimilate, and apply knowledge. The absorptive capacity developed by the technology enterprise, in consequence, implies competitive advantages. Further benefits of innovation include learning economies, economies of scale and scope, pre-emption of limited resources, advantages in further innovation, and the ability to set standards (Lee, Lee & Penning, 2001).

In a broader framework, research on entrepreneurship, in the African context as a whole, may be considered valuable as very few empirical studies have previously been conducted which focus on the venture creation process and competitiveness. Moreover, examining ESE in an emerging market context is pivotal to understanding entrepreneurship, since little evidence exists that self-efficacy is salient to entrepreneurs from non-Western cultures (Vecchio, 2003; Urban, 2010b). By contextualizing this study in the current South African socio-economic milieu, it becomes clear that in order to successfully navigate the venture creation process entrepreneurs need high ESE. Unless entrepreneurs perceive themselves as capable and willing to be entrepreneurial, their venture will remain uncompetitive and underperforming. Being motivated is not only considered an integral aspect of entrepreneurship but must be supplemented with education and training, since start-ups without possessing the requisite skills, knowledge and attitudes nullifies the formula for more entrepreneurship. Reflecting on the results of the present study the only non-significant result was for ESE implementing financial management phase of the new venture process. Consequently it is important to build capacity in this area as financial illiteracy has been ranked as the most important factor inhibiting entrepreneurial activity in South Africa (Orford, et al., 2003), and other emerging economies (Mueller & Goic, 2003).

The practical implications of this study are that entrepreneurs need to develop ESE throughout the venture creation process that begins with the recognition of an entrepreneurial opportunity and is followed by the development of an idea for how to pursue that opportunity, which leads to the evaluation of the feasibility of the opportunity, then to the development of the product or service that will be provided to
customers, and requires an assembly of human and financial resources (Reynolds, 2011; Shane et al., 2003). This means that ESE is integral during each of the venture creation phases, and may be linked from one stage of the entrepreneurial process to another in terms of overall competitiveness. In fact, it is quite plausible that ESE influences one part of the process which has effects at that stage in the process and possibly affects the later stages of the venture creation process, meaning that an ESE is required continuously to ensure the venture is competitively capable.

Further implications of this study can be advanced to the policy domain where it needs to be stressed that government initiatives will affect venture creation only if these policies are perceived in a way that influences self-efficacy (Krueger, et al., 2000). It has been suggested that the emergence of entrepreneurs in transitional economies depends on the entrepreneurial potential of the society which is, in turn, largely a function of systematic efforts of developing entrepreneurs with a high ESE. Instead of hoping for a massive capital infusion to improve business prospects, transitional economies may well be advised to implement formal self-efficacy programs to foster individual initiative for entrepreneurial development (Luthans, Stajkovic & Ibrayeva, 2000).

Limitations and Future Research
This study has typical survey design limitations in that data was obtained from a self-administered questionnaire, where self-serving bias may have influenced the responses. Secondly, since study was cross-sectional in design, results should be interpreted with caution and links between venture creation phases and competitiveness cannot be confirmed unambiguously. Future research could identify additional variables that influence and moderate this relationship. Moreover structural equation modeling, using path analysis to describe an entire set of linkages explaining the causal links between the variables is recommended. Longitudinal studies are required to explore the causal links between selected variables, specifically as the venture process is investigated.

ENDNOTE
1. Businesses in South Africa can be classified as micro, very small, small, or medium (SMME) according to a pre-determined set of thresholds. These thresholds are low by development-country norms. Many businesses regarded as SMME’s in Europe and the United States (those with fewer than 500 employees) would be defined as large enterprises in South Africa. SMME’s in South Africa can only employ up to 200 people (South Africa Survey, 2006/2007).

REFERENCES


Using Intranets to Reduce Information Overload

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Missouri State University

Today we are being overcome with enormous amounts of information coming at internet speed. There is plenty of content but little help in making good decisions. Imagine being able to monitor your critical concerns using only a single desktop computer screen. Your typical worker, who uses technology and information within the context of his or her job, spends more than 40 percent of their day processing work-related information. Today’s intranets and supporting software has the capability to delete irrelevant content and add important context information.

INTRODUCTION

Melcrum Publishing (www.melcrum.com) carried out an excellent survey of large companies in the UK, North America, and Europe. The top six benefits of an intranet were seen to be better internal communication (90%), improved processes (80%), sharing best practice (72%), improved efficiency (65%), and reduction in paperwork (65%). The main issues that needed to be addressed were content management (74%), lack of resources (52%), content overload (46%). Likewise, Agency.Com (www.agency.com) surveyed users of intranets, rather than intranet managers in the US. One of the interesting results of the survey was that the respondents were claiming to save about 7% of their time by using an intranet or portal. One interesting fact of the research was the fact that respondents shared knowledge because it substantially benefits them rather than because of a company-dictated policy or incentive program (White, 2002). In today’s world it is clear we need help managing all this glut of information we have created. Who would have thought the corporate intranet would hold the promise of a solution.

Today we are being overcome with enormous amounts of information coming at internet speed. There is plenty of content but little help in making good decisions. But there are approaches to managing information and technology to help you gain control and focus on what is really critical. Imagine being able to monitor your critical concerns using only a single desktop computer screen. Systems could be set up so everyone within your organization could monitor and display only those things relevant to just them or their group. All of this can happen using the same corporate intranet that mostly today serves as a corporate library.

Peter Drucker has noted that there is an information revolution under way. The revolution questions the meaning of information, and its purpose. He states that until now, the information revolution has centered on the collection, storage, transmission, analysis, and representation of information (Drucker
Drucker believed that past computer and information technology (IT) has had barely any impact on strategic decisions. He has observed that current use of information does not affect management decisions. He believed that current use of information technology has little to do with the CEO deciding whether to build a new office building, school, hospital, and so forth. IT is focused on collection, storage, transmission, analysis, and representation of information. Simply adding more information does not necessarily make it any easier to make a decision. As a result, the current approach to information technology has had no noticeable impact on the decision of a manager to enter a particular market or decide issues involving mergers. Drucker notes that the information technology revolution so far has been a producer of data rather than a producer of information.

Drucker emphasizes that information technology has had a near-zero impact on management decision-making. True, IT has helped preserve assets and control cost and this can be important since a serious cost disadvantage can destroy a business. But the strategic value and thus the usefulness of IT have been extremely limited. Controlling cost helps you survive, but executives understand that success will depend on carving out a successful strategy and sticking to it. Managing strategy is essential to finding innovative ways to add value, wealth, and even meaning to the lives of the employees.

LOTS OF SMOKE, NOT MUCH FIRE

Your typical worker, who uses technology and information within the context of his or her job, spends more than 40 percent of their day processing work-related information. This includes emails, instant messages, phone and conference calls, according to the Work Productivity Institute, an independent council of companies studying productivity (Barkow, 2004).

Executives have not made use of the new technology because it has not provided the critical information they need to make strategic decisions. There are reams of detailed data, but little that helps them keep strategic decisions clearly in focus. Internets, faxes, emails, and intranet technologies provide more data, but little direction. Business success is based on creating value and wealth. Executives do not need more data, technology, or speed. What is needed is a managerial process and information technology that helps make sense of endless data so it can be turned into useful knowledge and work. Data needs to be refined so it can help them keep focused on their critical issues. Refining data can ultimately help us make the correct choices and act in a unified way.

Today’s intranets and supporting software has the capability to delete irrelevant content and add important context information. There are systems to help us better track, analyze, integrate and display essential information so decision-making is easier. Intranets can be used to integrate disconnected data and show executives a more realistic picture of what is really going on within the organization. In real-time, and at the click of a mouse, executives can see what is going on with their critical concerns like profitability or service concerns. Intranets are able to do this by integrating information through a series of computer screens that help anyone visually understand what’s going on, where they are headed, and how they are doing. Information technology can add context and help busy executives keep a “big picture” mentality about what is going on rather than having a piecemeal mentality.

In particular, the intranet’s capability to collect and rapidly display key information means managers can deal with reality. It cannot only give executives a clearer picture of what is going on but also can be used to cross-reference and display competitive benchmarks so you can compare these numbers to strategic objectives.

People who are using intranet tools don't care about the languages or other technologies that are used to create, store, and transfer the information. "They don't want to know how SAS works,” as David Butler, vice president of product strategy and marketing for software maker Spotfire, told me recently. "They want to access the information." Workers concentrate on the data and information they are manipulating rather than on how they are manipulating the data and information (Zipperer, 2001).

As Drucker notes, what is desperately needed today is not more data but rather technology that helps make sense out of the endless data that pile higher and higher. What's needed is a technology that helps us make the right choices and behave in ways that are consistent with our purpose and objectives. Today,
intranets can become a contextual tool for reshaping organizations and help add meaning and purpose to work. It can help isolate information that is strategic in nature and not simply more data. The ultimate result will be better decisions with less data.

INFORMATION OVERDRIVE

Everyone is on Internet time. “The compressed time for decision-making is putting more demands than ever on our time,” says Wayne Cascio, a professor of management at the University of Colorado in Denver (Krill 2000). “The Web provides huge amounts of data which many feel they will miss some important detail if they do not review all available data before making a decision,” Cascio said. But everyone needs to recognize that they do not need to examine every detail of data. Information Technology, without some strategic driver, is a primary cause of information overload. Sharing of data without some strategy only makes things worse.

Information overload is created by information technologies where the tie between information and human purpose has been severed. Postman (1993) has noted information appears indiscriminately directed at no one in particular, in enormous volume and at high speeds, and disconnected from theory, meaning, and purpose.

James Bodil (1997) observes, from a report commissioned by Reuters, that people are in a frenzy to acquire ever-increasing amounts of information. They remain firm in their belief that the more information you possess, the more powerful you become. Lewis said, “The exact opposite is proving to be the case.” Research shows, when faced with vast amounts of information and forced to make decisions quickly, humans can be overcome by stress.

Job stress due to overload and overwork is too often treated with medication or counseling when the real cure is to design work so you can keep focused on your critical few concerns and issues and ignore the trivial many. If it isn't clear what work is critical, all work can become critical. It is a matter of figuring out what is most necessary and what isn't. Jennifer Laabs (1999) observes that San Francisco-based Air Touch Communications, Inc.’s HR team says they have been trying to reduce rumbling about overtime. To nip the problem in the bud, the senior management team has a goal of trying to get better at prioritizing work throughout the company by letting employees know which company goals are most important. She says that even if they had all the money in the world, they still wouldn't have enough people and would have to let something fall by the wayside. There are a limited number of resources to maintain customer service and to create new products, so you have to focus on what is most important and create a balance.

Laabs also believes large numbers of managers are feeling a bit off balance by all this information and can be victims of "Information Fatigue Syndrome." Consider these facts—49 percent of surveyed managers said they were unable to handle the vast amounts of information received, 62 percent admitted their business relations suffer, 43 percent of managers think that important decisions are delayed and their ability to make decisions is affected as a result of having too much information. Alice LaPlante found that a study commissioned by Reuters News Service found that 40 percent of 1,300 business people surveyed in the U.S., U.K., Australia, Hong Kong, and Singapore believe their ability to make important decisions is hindered by an overabundance of information. Information Fatigue Syndrome is likely to increase since more information has been produced in the last 30 years than in the previous 5,000. The total quantity of all printed material is doubling every five years. The World Wide Web also plays an important part in the information glut with an estimated 320 million pages of information.

Justin Martin (1998) noted that so much information can make it harder to find the right solutions or make good decisions. Fortune magazine reports that the average executive receives 90 communications a day, including 30 emails, 20 voice messages, four pager beeps and three express mailings, along with the usual phone calls, faxes, and letters.

It isn’t only individuals that are affected by this information overload. Organizations, departments, and work groups, too, can become crippled by too much data. The burden can be so heavy that some experts are even predicting the demise of strategic thinking. Nobody has the time or inclination to think
long-term anymore (McCune 1998). That is probably an overstatement, but there are indications of faulty decision-making occurring due to information overload. For instance, few offices monitor how relevant information is coming in and out of their business. They have no precise way to keep focused on this mission or the critical few things essential to their purpose. But there is a fallacy underlying all this collecting and sharing of information.

It is a serious mistake to assume information should be shared. In large part, information overload and fatigue are due to our tendency to assume information should be plentiful or shared. Any information is worthless unless it has some purpose to a group or individual. Information sharing that makes data readily available is more of a curse than a cure. The first step in making better decisions and gaining control of information overload is to keep focused on your key organizational objectives is essential to any retrieve process. Ask yourself, “What do you want to do?” and “Is this data useful to that purpose?”

PARETO PRINCIPLE

The 19th Century Italian-Swiss economist and sociologist, Vilfredo Pareto (1848-1923), provided us with a deep insight for the way the universe operates. His knowledge can also help deal with the information overload affecting so many people. The Pareto (pah-ray-toe) principle is often called the 80/20 rule and was originally applied to economic thinking. Pareto’s studies showed that most (80%) wealth went to a small (20%) percentage of the people. The influential work of Vilfredo Pareto led to ramifications far beyond economics and the distribution of incomes. A so-called Pareto Distribution shows a universal relationship between variables. The most often cited example is that 20 percent of salespeople within a company or industry generally sell 80 percent of the products (Basile 1996).

The 80/20 rule has been applied to inventory management where a few inventory items are the critical few ones. Likewise, in writing, it has often been noted that about 80 percent of the material that goes into research and articles will probably come from about 20 percent of your sources (Fryxell 1997). Those who suffer from information overload will also find that about 80 percent of the information received is the “trivial many.” Only 20 percent will be of critical importance to your job, process, client, or decision-making process.

FILTERS VERSUS PRIORITIES

Information overload has also been one of the drivers involving discussions about “information filters” which, in theory, can be used to help cope with the volumes of data coming into the typical office. Paul Krill has observed that email filters are already being used to screen out less-than-critical messages. IBM has been experimenting with a technology known as Web intermediaries, which can make it easier to focus on specific information. Technological solutions like these, though, can just exacerbate the information overload problem. They do not restrict how much information you receive; they only make it easier to focus on specific information.

New information technologies that help filter and redirect email and telephone calls can also certainly help, but ultimately good decision-making is all about setting priorities. It is the good managers who tend to want to identify and track the “essential few” information needed to make good strategic decisions. The single thought every manager should keep in mind is, “What activities am I personally responsible for managing?” Bad managers are often simply overcome with the information. The explosion of information and accessibility of it preys on the human weaknesses of many, which is a belief in total accessibility and a yearning for total awareness and absolute control. Attitudes like this ensure that technology cannot be a salvation.

Focus your thinking on the context of information. Luckily, today we have both the technology and conceptual processes to help prioritize your work life and dramatically reduce the blight of excessive content.

There are some early technological solutions, like groupware, which support communication and collaboration through information exchange, shared repositories, discussion forums, and messaging.
Likewise, intelligent agents and other filtering agents, but most do not trust them, and rightly so, because they are too primitive. Alice LaPlante writes that Marc Demarest, chief knowledge officer at Sequent Computer Systems, Inc. in Beaverton, Ohio, has said, "These filters tend to be brain-dead because they don't have a good way of determining context. The biggest problem is that they cannot look at what is getting pushed to them and immediately know whether it has value or not. Many companies find electronic agents useful for digging through published material, such as newspapers, magazines, and white papers. Electronic agents help filter the news sources and deliver only relevant articles. A pilot program at National Semiconductor lets employees specify subjects and keywords. The software sorts through Dow Jones and live news feeds, but over-reliance on agents can be dangerous. A good rule is to not substitute filters for your own reading.

John Veiga and Kathleen Dechant (1997) note in their research that one manager has said, "I work in the cash management department of an insurance company. There is a strict time deadline every morning to notify bond traders of the company's net investment position. All workers have phones with voice mail and caller ID. As the deadline approached, analysts were in the habit of screening calls—only answering those calls from people known to supply cash flows. Apparently, someone called with information of a $10 million outgoing transaction from a different phone than he normally used. The call was ignored. Bank accounts were overdrawn."

Tom Davenport, past professor and director of the information management program at the University of Texas in Austin, said that information overload must be addressed on two fronts—individual and organizational. Workers should put serious thought into constructing a personal information environment that serves their needs. It means careful analyzing how you spend your time, how you best communicate with others, and the most effective ways to do it. In other words, we need to get our priorities straight.

TECHNOLOGY AND STRATEGY

As work becomes more knowledge intensive, new ways of communicating this essential information becomes paramount to our ability to make decisions, build cooperation among group members, and coordinate unified actions. Finding easier ways to formulate and implement managerial strategies within a group, department, or organization will be critical. Intranet-supporting software makes it easier to implement strategy. Such software, when combined with good objective setting, data collection, and the intranet's ability to provide real-time feedback, makes it far easier to manage individual or organizational work. Employees, using their own personal desktop, can be greeted every day with critical information relevant. Such feedback makes it far easier to implement strategies critical to the organization. It can be used to better focus effort around critical strategic issues, and can be used to help you adjust resources to meet strategic objectives.

Saroja Gireshankar (1999) reports that an intranet at 20th Century Fox was constructed to track the millions of records associated with box-office receipts. It provides a good example of the capabilities of the intranet waiting to be unleashed. An essential component is that it highlights critical information that might require action. The intranet payoff for Fox’s managers is collection of real-time information they get that lets the studio spot regional and competitive trends and act quickly enough to exploit them. They are able to implement changes on the fly. Justin Yaros, CIO and senior vice president at Fox, notes, "This application allows us to manage our business more intelligently by giving us actual information on what's happening in the theaters, whereas before, we relied on intuition and gut feeling."

Before their intranet it would have been impossible to make strategic changes because they did not have the real-time information to make informed decisions. "Our executives and branch managers would call me or another person in IT, and we had to query box-office returns at different theaters one at a time. Now they are able to put the information at their manager’s fingertips so they can understand what is going on and make changes as needed. Such information is long overdue. This kind of aggregation of internal and external information to make executive decisions affecting the business is a good idea and, if anything, it moves the movie industry out of 1900s technology," said analyst Joe Butt of Forrester.
Research. Fox's intranet application also sets the stage for the future so they can match supply and demand on a daily basis.

Using this type of information means films could be selectively extended in markets or individual theaters where they are doing well. Strategies can be formulated in real time and films could also be pulled from theaters where they are slumping to cut losses. Fox officials also have the capability of instantly measuring the impact of promotional dollars spent on new films and adjust their campaigns accordingly. Such accessibility and aggregation of information also makes it possible to make better decisions. Changes in promotional dollars or campaigns can be immediately assessed to see how expectations compare to actual results.

Rick Whiting reports that Federal Express Corp. also is using a business-intelligence extranet that lets shipping companies using FedEx service in countries outside the United States gain access to reports about revenue, shipping volumes, transit-time analysis, and other performance data. Queries like, "How many packages arrived in Vietnam after 5 p.m.?" will be possible to answer.

Federal Express uses its internal intranet to improve the big picture view within their organization. Their system collects focused information in real time to help company executives make up-to-the-minute decisions about where it should locate the service centers and drop boxes that customers use every day. Gaining a big picture of what is going on, FedEx officials say, will be better customer service and lower operating costs. "We want to be located where our customers are, and now we think we have a better way of doing that," says Ron Houston, manager of systems and support with FedEx's retail division.

"The old system took too long, and it didn't allow analysts to ask follow-up questions," Houston says. "It just didn't support quick decision-making." So FedEx decided to give analysts direct access to information. It allows 120 analysts to tap directly into up-to-the-minute drop site usage data from any PC equipped with Netscape Communications Corp.'s Navigator browser.

Jeff Moad also reported on the benefits of intranet for FedEx. "Using the intranet, analysts can now get specific information on their screens in a matter of seconds rather than having to wait weeks," Houston says. "With that information, we will be able to begin more actively managing the location of our service centers and drop points as populations shift and customer habits change." In addition to more accurately tracking drop point usage, FedEx analysts will be able to get relevant information on the profitability of each service center and drop box. It will be easier for the company to get a more complete picture of population shifts and other customer trends (Moad, 1998).

**ROUTING CRITICAL INFORMATION**

Rick Whiting says that Michael Hammer, author and consultant who helped create the reengineering movement of the 1990s, doesn't worry about creating more great managers. He'd be happy just having a lot fewer bad ones. He emphasizes, "I'd like to turn the bad managers into adequate managers." Companies have used quality programs and data-intensive process management to improve such areas as procurement and order fulfillment. Now Hammer says it's time to turn that attention to the management process, relying on metrics and data in decision-making through what he calls "analytic performance management." Hammer believes information systems in the past have been too passive, built by technologists who focused on providing access to information in customer-management or financial systems. "There's a presumption that a businessperson knows what they want to ask. That's a fiction," he says. Managers need information pushed to them and decision-making guidance (Whiting, 2002).

Information sharing has been the primary use for intranets, even to the point of creating information overload, but things are beginning to change. Spreadsheets and electronic forms allow managers the option of storing performance reviews. Online evolutions and the so-called 360-degree feedback provide a way to create "upward feedback."

Samuel Greengard (1999) reports that at MindSpring Enterprises Inc., an Atlanta-based Internet service provider, the 1,900-employee company used to conduct surveys manually by tabulating responses and importing them into a spreadsheet. It was a costly and time-consuming process, says Cindy Buell, director of leadership and organization development. The HR department began using software to gain
feedback about core values. After drafting the questions, the software converted the survey into HTML, and it was placed on the firm's intranet. "The software has renovated the entire survey process. It has allowed us to do the job faster, cheaper, and better," Buell explains.

This whole process of converting manual surveys to intranet ones has also helped the company to conduct 360-degree assessments and design more effective packages and more quickly understand what their workers want. They have also found that by tracking answers to survey questions over time they are able to measure organizational change.

Interactive intranet technology can be a good vehicle not only to test employee comprehension of policies and procedures but also of critical objectives and expectations. It can help group members grasp a truer picture in real time of what is really going on both inside and outside their group. It has potential to greatly enhance group collaboration, reduce information overload, track change, and improve performance by continually providing visual feedback on what is going on within critical areas.

Shardin Gaudin (1998) reported that Middlesex Health System Inc. needed a way to share real-time patient information, improve care, and stay competitive. So Middlesex, which was a stand-alone hospital four years ago, built an intranet-based repository that houses 4.3 million clinical results, including real-time lab work and radiology test results, as well as care summaries and medication listings for 200,000 patients. Cardiologist Dr. Arthur McDowell said, "It's revolutionized the way we take care of patients. Everyone I take care of has another doctor, like a primary care physician. Before, we used to spend hours finding patient records. Now when I walk in to see a new patient, I head straight to my computer and see what doctors they've been seeing, what tests have been done, what the results are, and what medications they're on." Dr. Michael Saxe, chairman of the emergency department, said the system helps him treat patients faster. He said, "I don't have time to wait for someone to run up to records at 2 a.m. and find someone's history. On an average day, I go into the system every five to fifteen minutes. If I have to wait even six seconds, that's too much time for me."

PERSONALIZED INFORMATION

Intranets can help group members grasp where they really are in terms of performance in a rapid enough manner that they can change directions. It can also be used to track, display, and provide continuous feedback on information critical to your objectives. Web technology can be used to display information so all can more easily grasp where they are at and see what is needed.

Karen Schwartz’s (2000) notes that what Procter & Gamble wanted was to personalize critical information for each employee and then provide very rapid feedback about changes in that information. Dan Gerbus is the project manager for the personalized portal project in the Cincinnati company's IT division. He says, “A business manager always needs to track some key pieces of information; we'll build a dashboard for that.” Procter & Gamble employees use their dashboard to deliver a preset view into various information sources, and find all the up-to-date information they need to make decisions about new products, or other initiatives.

Using such a system, any group, department, or the entire organization can have quick and easy updates on critical changes. Intranets can improve collaboration and teamwork by building unity within a group or department. Future intranets will pave the way to not only greater cooperation but also to a more focused organization.

Combining the intranet’s ability to deliver real-time feedback with software that organizes that information so it is easy to digest makes it easier to monitor and manage organizations. Executive dashboards can be used to monitor essential information that relates to a specific manager or employee. You can monitor this critical information using a series of status lights on your executive dashboard. These lights can change shape and color reflecting different changing conditions within the organization. When unusual changes occur you can then drill down through a series of other graphics to see what has happened. For example, a series of status lights can be set up to monitor morale or attitudes using surveys and more objective data on a variety of topics. The status lights on the dashboard would then alert you whenever a certain statistical trigger had been crossed. If you wanted to know when a customer or
employee survey score reached a critical numerical value or your standard deviation or variation in scores had exceeded normal conditions, then the dashboard could be used to communicate those changes to you.

Status lights on an executive dashboard can indicate everything is operating normally or it can show when a measure is below some competitive or historical benchmarks. Such lights could also indicate exceptionally good performance. A series of raw data and historical graphics can be accessed from this screen to help team members see why certain status lights have changed shape and color.

Such a dashboard, which runs on the company’s intranet and is displayed on individual desktop screens, can continually and instantly show the status of changes occurring within the organization. Dashboards like those employed by Procter & Gamble can be customized and personalized so everyone can keep updated about changes they specifically want to monitor. It lets every individual within the change process monitor changes within their personal responsibility.

Collecting data and measuring results will be a waste of time if the information is never acted upon. Good management is a communication and feedback issue. Look at your own work and ask, "How do you regularly communicate key concerns to all areas?" Work systems, like our groups and organizations, face the continual challenge of keeping on track and not getting distracted by all these details and all that information. Having a strategy or vision is not enough. Atrophy within an organization or group will occur unless there is continual communication and feedback about where we are at and how we are doing. Getting feedback on what happened that is three months or even a year old really should not be thought of as feedback.

The intranet, when combined with the proper groundwork, makes it easy for group members to see the results of their work and compare that to where they want to go. Rapid feedback, which the intranet can deliver, encourages a flexible control that is the ideal for self-directed and empowered work. The intranet is a new tool that can provide continual updates and feedback so it is important to make sure you provide the right kind of feedback.

Mark Baven (1997) documents a case at Compumotor Division of Parker Hannifin in Rohnert Park, California where the intranet was used to get information quickly into the hands of decision makers. The company is a manufacturer of circuit boards using robotic motion-control systems. The company used their intranet to show the condition of critical issues. David Krauthamer, the information systems manager at Parker Hannifin's, is primarily responsible for deploying the company's intranet. He says it has had the most immediate effect on real-time manufacturing processes. “Our SQL server has a front-end mechanism that captures and reports on manufacturing defects in process. This provides feedback to the floor, where they can respond to the problem immediately. It also helps us notice patterns and make remedial changes – real-time corrections. Such information makes it easy to understand what you're supposed to be doing and where you're supposed to be headed.

DATA VISUALIZATION

Profiling your group can become an internal mechanism for team self-management. It can show group members where they are at in terms of customer service (or other concerns) and how it is being affected by the group's efforts, attitudes, and choices.

Creating an “executive dashboard,” which runs on the company’s intranet and is displayed on individual desktop screens, shows the status of your critical concerns.

The system administrator for the software chooses appropriate statistical values that will set off the lights and the software automatically calculates, evaluates, and graphs the results. Whenever a critical stage has been reached, the lights change to match appropriate conditions. The system administrator also is the one who decides who will input data into the system, how often, in what format, how results will be graphed, and who will see those results. It is possible for every individual within an organization to have their own unique desktop screen that is tracking these measures that are most relevant to the organizational strategic concerns.

As numerical data are entered and automatically analyzed and graphed by the software, the intranet makes these results known to whoever needs to see them. If a performance measure is worth
investigating, you simply click on the text box near the status light and you can see the *actual results* graphed out. Such software is designed to alert you to changes in current results that exceed pre-defined statistical conditions. Text messages also appear, highlighting some of the important changes occurring in your data. Graphs can be used to compare and contrast any organization's critical concerns to each other and graphically display their interaction.

Data Visualization software, combined with good objective setting, data collection, and the intranet's ability to provide real-time feedback, makes it far easier to implement strategy (or teamwork, manage change, employ employees). Employees, using their own desktop, can be greeted every day with visual feedback about what information is important, where they are headed, and how they are doing. It makes it far easier to implement strategy if feedback is continually provided on an organization's critical concerns. It better focuses group effort around critical concerns and issues, and it can give employees a direct connection between what they do and overall corporate strategy. Today, it is possible to integrate the concern for customer satisfaction with other issues involving productivity or the need for greater employee involvement. There is no limit to the critical concerns the intranet and supporting software can integrate and display.

**OVERVIEW**

The intranet can be used to provide continual updates and highly visual and understandable feedback by keeping employees focused on what is really critical; it can be used to dramatically reduce information overload. It can do this by combining intranet's feedback with data visualization technology so you can quickly summarize where you stand so all can see what is going on. Spreadsheets cannot do that, but visual displays and graphs used in conjunction with the intranet can be used to help the organization's efforts and, in the process, reduces and refines data so it can be better used.

Drucker notes that past information technology has barely impacted strategic decisions. By this statement, he implies such technology has mostly produced data rather than knowledge. What is desperately needed is not more data but rather application of Web technology that helps make sense out of the endless data that pile higher and higher. What's needed is a technology that helps us make the *right* choices and behave in ways that are consistent with the purpose and objective of the organization. Today, intranets can become tomorrow's tool for reshaping organizations, helping to add meaning and purpose to work, and greatly simplifying the management of information.

**REFERENCES**


Schwartz, K. (July 3, 2000). Companies spin personalized portals to their advantage—technology improvements provide portals for every taste and job requirement. *InformationWeek*, 74.


**ADDITIONAL INFORMATION**

Major Data Visualization Vendors as reported by PC Magazine

- Visual Insights (a Lucent spin-off)
- Silicon Graphics Inc.
- Cognos Inc.
- DataView Inc.
- Epiphany Inc.
- Quadstone Ltd.
- MapInfo Corp.
- Environmental Systems Research Institute Inc.
- MathSoft Inc.
- Spotfire Inc. (Deck, 1999)

Lucent Technologies Inc. unit, Cognos Corp. and Spotfire Inc. have features ranging from business mapping to more esoteric graphics such as data constellations and histograms, which chart data values by density.
Advizor software from Visual Insights, a Lucent division in Naperville, Ill., provides users with a way to query and explore the vast amounts of customer, product and market data generated by electronic commerce and customer relationship management, officials said. (Hammond, 1999).

Spotfire's software combines data visualization and querying flexibility. It is known as DecisionSite and installations starts at $100,000. Spotfire's software lets users do what-if comparisons of data from different sources by moving sliders on a computer screen with a mouse. The results appear as brightly colored bar graphs, pie charts, scatter plots, and even maps. (Brown, 2001).
Creating a Mindset for Innovation

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To stay ahead of the development of new technology, we believe engineers need to understand what it means to be innovative. This research focuses on the developed methods and efforts being implemented to advance the culture of innovation within our college of engineering. The primary method we have developed to help our students better understand the process of innovation is what we call Innovation Boot Camp.

The Innovation boot camp is an intensive, hands-on, collaborative, experiential learning workshop focused on educating students on the principles of innovation by providing them real-world situations that require them to apply these principles. The structure of the initial Innovation Boot Camp is a two-day experience, blending students and faculty from different programs and departments (i.e., Technology Engineering Education, Manufacturing Engineering, Industrial Design, and Information Technology,) from the School of Technology in the college of Engineering at Brigham Young University.

The primary instructional techniques and curriculum were based on a hybrid model culled from several sources, including IDSA National Conference presentations, site visits to the Stanford d.school and IDEO, publications from the Rotman School of Management, and other sources on creative problem solving. We defined the innovation experience as being; Human Centered, Environmentally Safe, Multidisciplinary, Makes Ideas Concrete, and is Guided by the Process, those being: (1) problem finding by discovery through the activities of Observation, Experience, and Inquiry; (2) problem shaping by Organizing, Simplifying, and Clarifying; (3) broad divergent ideation through activities of Point of View, Association, and Connection; (4) problem refining by Visualizing, Validating, and Iterating; and (5) sharing insight using the activities of Show, Demonstrate and Describe.

The purpose of this paper is to further describe the purpose, curriculum development, organization and logistics, activities developed and engaged in, and methods of instruction of the Innovation Boot Camp. Additionally, the paper will outline the learning outcomes and the relative impact the Boot Camp is having on student understanding of and skills associated to innovation, and how the experience is impacting our college’s initiative to create a culture of innovation.
Kleppe (2001) notes that, dating from the late 1700s to the modern day, “a major source of technological advancement has been the result of individual inventors [and] innovations” (p. 16). Surprisingly, most technology and engineering programs in the United States do not explicitly teach innovation (Smoot, 2006). With the increasingly complex and competitive global market, and with new interest and concern over environmental issues, biotechnologies, and so forth, many companies (American and foreign) are reforming how and where they do business. Additionally, many academic institutions are calling for a “radical restructuring of the theoretical knowledge taught in academic education programs…in order to create competencies of professional value in today’s business situations” (McAloone, 2007, p. 770). In order to address the many challenges involved with the new global industrial arena, many technology educators believe the theoretical restructuring that needs to take place must involve and center on innovation. Kleppe (2001)

Despite the need to include innovation as a key component of technology and engineering curriculum, and although some universities have made restructuring efforts to include aspects of innovation, a study done by the Southern Technology Council found that there are very few universities supportive of educational initiatives that teach innovation. The lack of support and inclusion of innovation in technology and engineering-related programs seems to stem from archaic mathematics and science curriculum standards, as well as immature technology and engineering curriculum standards. Although engineering programs have existed and been taught for well over sixty years at the university level, most of the courses and degrees have focused on traditional engineering concepts (i.e., hard math and sciences) and have not bridged into the areas of creativity and innovation. It has only been in the last five years that universities have started to recognize creativity as a key component of engineering (Courter, 2006). In light of the need to ensure that our students are ready for the challenges of our global economy, we, as technology and engineering educators, need to ensure that we are continuing to evolve our practices and curriculum, which, at the present time, demand the need to include innovation as a key component of technology and engineering curriculum.

The purpose of this study is to understand the impact of the Innovation Boot Camp on students’ innovative abilities and attitudes. Holistically, we feel the adoption and commitment to explicitly teach and provide students with innovation training is necessary. However, the plausibility of a college-wide buy-in and adoption is questionable due to the college’s deeply traditional academic approach to teaching engineering and technology. The effort required to change this culture requires school administrators and professors to spend a significant amount of time, separate from our normal teaching and research load, as well as provide additional funding for the experience. Consequently, this research study not only adds significantly to the theoretical underpinnings of innovation and creativity pedagogy, it also provides insight as to the needs and benefits of such an endeavor. To understand the influence of the Innovation Boot Camp experience on our students and college we gathered data throughout the entire boot camp experience (i.e., during curriculum development and instructional time, as well as at the end of the boot camp). The summative evaluation efforts have included an online survey, a focus group interview session, and one-on-one follow-up interviews.

Statement of Problem

With the economic need and acceptance for outsourcing, as well as competition in areas such as global product development, many American engineering and technology institutions are rethinking and restructuring the content and instruction of engineering and technology curriculum (McAloone, 2007).

In an effort to address this issue, our college has established several school-wide technology and engineering initiatives that focus on the issues of leadership, global awareness, and innovation. College administrators established a committee to investigate ideas on how to promote innovation. The committee, known as the Innovation Design Team, travelled to several institutions recognized internationally for their exemplary models of innovation (e.g., Stanford d.school, IDEO, etc.), and performed a literature review on the subject of innovation and its various related topics.
One of the ideas the Innovation Design Team developed and hoped would make a positive impact on student innovation ability was to institute an Innovation Boot Camp. In short, the boot camp was developed as an intensive, innovation-focused workshop that would immerse students in an experiential collaborative learning environment that would require them to work in teams with students from various programs housed within the college (i.e., Industrial Design, Mechanical Engineering, Manufacturing, Technology Engineering Education, IT, and Construction and Facilities Management) in order to identify and solve problems using processes of innovation.

**Approach**

There are three phases to this research project: (1) developing and implementing the Innovation Boot Camp, (2) evaluating the Innovation Boot Camp experience, and (3) assessing and restructuring the Innovation Boot Camp.

**Development**

The Innovation Design Team used the data they collected from their observations during their visits to the various well-known innovation institutions, and the literature they read (i.e., *Handbook of Creativity*, *Creativity in Context*, *Lateral Thinking*, *Creative Toolbox*, various journal articles, and so forth) to formulate several ideas for creating a culture of innovation in our college of engineering and technology. Various ideas were hypothesized, though it was ultimately decided that an intensive experiential workshop highlighting the key principles of innovation would be first tried. This workshop came to be known as the Innovation Boot Camp.

**Format**

We are currently on our 16th iteration of the Boot Camp experience, and its structure is currently organized in the following way: it is a two-day experience, wherein students from the various programs of the college collaborate to engage in problem finding, shaping, and exploring, and communicate a proposed solution to the problems they discover. There were typically two to three students and one faculty member from each of the four programs, averaging 18–24 participants in all.

**Boot Camp Process**

The students were split into 4–6 multidisciplinary groups of 4–6 students each, while the faculty members were put in their own group. We wanted to give the students a chance to work independent of the faculty, without the influence of any authority figures. We also wanted to have a sense of competition between groups.

On day one, we introduced the students to the need and idea of innovation, leading the students to establish a working definition of the term. We then provided the students with the five key principles of innovation and had them engage in one experiential activity per principle—an approach that served as a tactical opportunity to semantically encode the principles. Each activity built upon the previous, thereby helping the students transfer and scaffold their learning from principle to principle. By the end of the day, the students had developed an innovative product or system as a result of working collaboratively through each innovation principle activity. To conclude the first day, each group of students presented the problem they identified and the innovative proposal they developed as a result of employing each principle of innovation.

At the conclusion of their presentations, they were introduced to a capstone activity that would require them to go through the steps of innovation one additional time. The students were expected to work Friday evening and early Saturday morning to ready themselves for the capstone presentation and evaluation. The purpose of the capstone experience was to evaluate whether or not the students understood the innovation principles well enough to combine them in pursuit of developing tools they could use to identify problems and develop innovative solutions.

Day two of the Innovation Boot Camp consisted of each group showing how they came up with their respective problems, accompanied by a proposal of their capstone projects based on the five key
principles of innovation. A panel of judges from local design and engineering companies were brought in to evaluate the students’ projects, and awards were provided to the top three teams.

Before the boot camp was completed, there was a final summary discussion session wherein students were asked to share their reflections of the experience. They were encouraged to determine whether or not their camp experience helped them to develop and learn skills; they were also asked to defend their opinions. Exit surveys were emailed to each student at the conclusion of the boot camp in anticipation that the students would complete the survey within the first few days following the experience. Additionally, several students were randomly selected to participate in a focus-group exit interview.

RESULTS

As stated above, formative and summative methods were used to evaluate the impact of the boot camp experience on students and faculty. A video documentary of the boot camp was filmed and later used to critique and analyze the attentiveness and participation of each student. The instructors of the boot camp were also invited to watch the video to help evaluate their instructional methods and the associated activities and content. Two outside observers from the college were also in attendance at the documentary screening and asked to take notes on what was done, how they perceived the instruction was being received, how the activities were helping the students understand the principles and concept of innovation, how the students seemed to enjoy or not enjoy the experience, and so forth. The students were also asked to provide summative feedback at the end of the boot camp experience in both a survey and exit interview. A few of the key themes from the evaluations will be shared in this document.

Participant and Observer Feedback

Overall survey results and interviews (n = 54) stated that 100% of the students reported their belief that the Innovation Boot Camp should be continued, and 71% of the students (n = 54) identified their time spent at the boot camp as Effective on a scale that included Ineffective, Not Very Effective, Moderately Effective, Effective, and Very Effective. When the students were asked to rate on a 1–5 scale (5 being high) how the Innovation Boot Camp influenced their understanding of innovation, the mean was 4.0, the variance was 1, and the standard deviation was 1. When the students were similarly asked to rate how they believed their propensity for innovation to have been influenced by the camp, 43% responded that it made a significant amount of difference. Then, when the students were asked to rate how they believed their skills related to innovation were influenced by the boot camp experience, 86% reported that they believed their skills to have been significantly influenced by the experience. Also, 85% of the students said that they thought their time at the Innovation Boot Camp was spent either effectively or very effectively. The outside observers reported similar findings, and, while they proposed various suggestions, the majority of their thoughts centered on curriculum design issues and content.

DISCUSSION

We recognize that we are still in the beta stages of our development of the Innovation Boot Camp. However, we believe that the findings from the surveys, interviews, and qualitative observations have provided helpful insight as to how we might restructure and continually develop the Boot Camp experience.

The primary areas of restructuring we have thus far addressed center on curriculum issues. We have found that there are two primary sets of principles common among innovation-related literature, and though the principles innately suggest similar concepts, we feel it is important to solidify the language (i.e., vocabulary) being used in our own curriculum. For example, in the first few boot camps, we used the idea of “Design Thinking” and its associated principles, “Think, Look, and DO” (Welsh, 1993; Osborn, 1965; Sternberg, 1999; Kelly, 2005), while in the later boot Camps we used the principles of observing, questioning, idea networking, associated thinking, and experimenting (Dyer et al., 2001). We believe that there is a need to continue evaluating the boot camp experience. We anticipate a continued restructuring
of the workshop, though we also feel the results thus far have provided great insight as to how the seeds of a culture of innovation might be initially planted.

CONCLUSION

Although our data set remains somewhat limited for now as a result of the Innovation Boot Camp’s newness, we believe that we are commencing on an important journey toward better preparing our students for the globally competitive technology and engineering market. In such a market, innovation is an essential and defining skill. We anticipate that the boot camp experience will continue to evolve, and we hope the experience will help us develop a culture of innovation, wherein our students will benefit from working on multidisciplinary teams to solve important problems while learning and becoming increasingly innovative. In this way, they will be better prepared for the rapidly evolving and competitive world in which we live.

REFERENCES


An Estimation of the Elasticity Demand for Tap Water

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This paper examines the elasticity of the demand for water as well as the household characteristics that influence their demand for water. Two empirical models are estimated employing a panel dataset from South Milwaukee, Wisconsin. The initial model employs a probit model to determine the characteristics that might classify a home as a “high user”. The second model estimates a simple OLS model for estimating elasticity. The findings are twofold, first consumer elasticity demand is dependent on where along the demand curve that consumer is. Second, household characteristics are an important determinant in their demand for water.

INTRODUCTION

Water is arguably the most important natural resource and has been shown to lead to prosperity and wealth (Arbues et al. 2003). Despite its global abundance, it is also a highly local resource that is not distributed evenly and in many locations water resources are depleting and/or degrading. As a result, sustainable use of water resources has become increasingly important in the last decade with much attention having been turned towards conservation of water. Many businesses that are intensive water users are beginning to see value in reducing their water footprint. However, the average consumer has not significantly changed their demand schedule, and is still using almost the same amount of water as what they were using yesterday. The reason for this can be explained on how people are billed for their water usage.

Water prices are often set quite low, such that price provides little incentive to reduce water usage. One such case is the city of South Milwaukee, WI, where people are charged on a decreasing block rate (set to recoup fixed capital costs), so their marginal cost for each additional unit (a unit representing 1,000 gallons) decreases. The marginal price itself may not even matter as the average consumer does not typically act on the marginal cost of water, but rather focuses solely on the entire water bill, and thus calculates average cost and consumption because it is easier to do (Carter and Milon, 2005). Would a
price increase reduce water usage without being too ruinous to the household budget? If not, what other forces shape water demand? This paper is an effort to provide answers to these questions so that policy makers might gain more insight into shaping policy to make water demand more sustainable. The first question seeks the price elasticity of demand for water, the second other non-price determinants. To answer these questions data from the city of South Milwaukee consisting of trimester water consumption and bills for the time period 2000-2010 is associated with housing characteristics obtained from assessor records, providing 59,472 observations at the household level.

There are countless components that might influence the quantity of water demanded. This paper tries to assess the main determinants that have a bearing on demand through hedonic analysis. One such determinant is obviously the price of water (Arbues et al. 2003). In addition to the price of water, the physical characteristics of a consumer’s home and property may be equally or more important in affecting household water demand (HWD). Physical property characteristics are such things as the architectural type, size of house, number of bathrooms, the number of people living in a house, etc (Fox et al. 2008). The results suggest that the demand for water is relatively price-inelastic, and that the characteristics of a house are an important determinant to water consumption.

LITERATURE REVIEW

Using hedonic analysis techniques, it is possible to deduce that the physical properties of a home, the price of the home (which will be a proxy for income), and the price of water itself do in fact affect the demand for water. Many of these attributes are bundled; often times a more expensive home will naturally come with more bedrooms, bathrooms, a bigger lawn size, etc., and so the demand for water reflects the bundle of items listed above. However, because of heterogeneity between houses and the demand for water, we can examine the differences in each of the attributes listed above and differentiate among the components. Econometrically, the demand for water is estimated by a multivariate regression model with water demand as the dependent variable and the above components as the independent variables.

Based on literature available in this field, others have shown that the above components are significant when determining the demand for water. Clarke et al. (1997) contributes to this review in his study of demand for water by showing how property size affects the demand for water. Clarke breaks property size into two components, the number of rooms in the home, and the number of individuals living in the home. Clarke uses these two components as proxies to determine household size and income. Clarke demonstrates that a larger home, with more rooms and individuals living there, the greater the overall demand for water. Similarly, Agthe and Billings (2002) used the number of bedrooms in a home as a proxy for the number of individuals living in a home. In their research they found that the more bedrooms/people in a home, the greater the water demand as each additional person requires a marginal amount to the total demand of the household. Liu et al. (2003) found that while overall demand for water increases as the number of people living in a house increases, the per capita water demand actually decreases holding income constant.

In contradiction to Liu, Rushton et al. (1991) found that the average consumption for an individual living by themselves is actually less per capita than a two person household. This contradiction may be explained by holding income constant, since income was not held constant in Rushton’s study. Furthermore, there was no mention made if the same logic held true for increasing the number of individuals in a home from two to three, three to four, or if the per capita usage only applied to an increase from one to two individuals per household. In addition to the number of individuals living in a home, Rushton has studied how architectural type influences demand. Rushton showed in his study that detached homes demand more water when compared to bungalows, flats, and mixed homes. One of the main reasons for this is that a detached home is simply larger than any of the other above listed homes above on average. With a larger home, there are often more bathrooms, dishwashers, etc. that use more water. In addition to the physical properties of a home, Dandy et al (1997) was a study that focused on how water price shapes the demand for water, noting that the price of water is one of the major components in determining demand, and one of the best ways to control demand is to control prices. This
goes back to the law of demand: that as the supply price increases, the demand for a good will decrease which is pointed out by Liu et al (2003).

While increasing the price of water will undoubtedly decrease the demand for water, the question becomes by how much. In Nataraj’s (2007) study of the elasticity for the demand of water, she finds that water is a very inelastic good, especially in the short run. Her results indicated that a 100 percent increase in the price of water only resulted between a 15-25 percent decrease in the demand for water. Likewise, Hillenbrand and Schleich (2009) found that the price elasticity for water demand in Germany was -0.24 in the short run. Part of this can be explained by the fact that an individual’s water bill is a small portion of their total expenditures, so unless it is exorbitantly high, not much attention is paid to it. Furthermore, as was referenced in the introduction, most people do not realize the marginal price paid for water; hence they are not as likely to be affected by an increase in price. However, a study done by Hanemann and Nataraj (2008), showed that a 100 percent increase in water prices lead to a 12 percent decrease in demand in Santa Cruz, California from one year to the next. Likewise, Martinez (2002) found the price elasticity in Spain to be between -0.12 and -0.17. Martinez also found the price elasticity to increase during the summer months as people became more conscious of water usage. In a different study, Nataraj (2007) noted that an increase in the price of water does have a larger impact in the long run. She states that a 100 percent increase in the price of water could decrease demand by up to 50 percent. It is at this point where people will begin to purchase appliances that are more environmentally friendly which will inevitably reduce their water usage and the amount of water they demand. The age of the home also greatly affects water consumption since newer homes often come with the most efficient water appliances in the market. Thus, it is no surprise that older homes that have inefficient water appliances use more water than newer homes. This difference in water consumption is further aggrandized if the home develops leaks in piping as it ages (Agthe and Billings 2002).

In terms of installing water efficient appliances, Agthe and Billings (2002) stated that although homeowners will reduce their water usage mildly due to a price increase, most of the water that is saved is an outcome of installing water efficient appliances (such as small flush toilets). Installation of these water efficient appliances applies more to homeowners rather than renters, the reason for this being that installing water efficient appliances is a capital investment which means it is initially costly to do. As time progresses the water and money saved from the reduction in water usage eventually pays for the initial investment. Agthe and Billings argue that renters, because they rent for such a short time on average, see no financial incentive to install water efficient appliances given that they are unlikely to see the return on their investment. Unlike renters, homeowners are more apt to make the initial investment since they will see future savings from doing so. Similarly, the number of individuals living in the home also applies to the value of water efficient appliances and the likelihood of installing them. For example, a low flush toilet will have a shorter payback period if there are three or four people using the toilet rather than one or two people.

Setting aside cost savings from using less water, policy makers often times try to appeal to one’s sense of water conservation as the correct and moral thing to do. This would in fact be necessary if necessary price increases were to be judged undesirable for whatever reason. In fact, many businesses try and employ the same concept, although they often do so as a way to cut expenses. For example, as Ferraro and Price (2011) state, for those who have done any sort of traveling, and have stayed consecutive nights in a hotel room, there will frequently be a sign in the bathroom saying that the hotel is trying to help save the environment. They then proceed to say they would appreciate the visitor to do their part and reuse towels by hanging them up to dry, which will ultimately lead to less wash and less water used. Ferraro and Price refer to this form of appealing to one’s moral obligation as non-pecuniary motivations. In fact, in their study they found non-pecuniary motivations to reduce water consumption by 4.8 percent, which they say is equivalent to a 12 to 15 percent increase in water prices.

There are several things a model can account for in determining the demand for water, but there are also many things that a model cannot account for. Some of these unaccountable variables can be found in the socio-economic and socio-demographic categories. For example, Rushton et al. (1991) makes note of an occupant’s age on HWD, arguing that retired individuals spend more time at home and perform
different activities than those who hold full time jobs and are away from home all day. As a result, retired individuals consume more water on average. In fact, Rushton et al. found that the average retired householder uses 70% more water than an individual of working age. In addition, while a house may be identical in terms of the physical components, demand will be slightly different for all homes. Some people may prefer longer showers, or do more wash than others, or maybe they have a garden and water weekly, or even daily. Factors like these cannot be accounted for in a model unless every individual were asked myriads of questions and if the model contained hundreds of variables. All of these differences give uniqueness to each household when it comes to their demand for water.

This paper acknowledges that there are variables that simply cannot be accounted for with existing data, and indeed our results show that much explanatory power lies outside our models. However, what this paper hopes to accomplish is to provide an accurate estimate of HWD based on the physical components of a home. This study adds to the literature by classifying water users into either low or high water usage, and determining the price elasticity for each category. Moreover, this study attempts to show through hedonic analysis how much water an individual household will demand.

DATA & DESCRIPTIVE STATISTICS

This research uses a panel of water usage and price data from South Milwaukee matched to household characteristics. The water usage data is on a trimester-basis obtained from water billing records. These data points are matched to household characteristics derived from assessor records. The assessor records are only available for 2010. Thus, while water usage and price varies over the panel household characteristics do not. These observations are in turn used to estimate different consumers’ elasticity of demand of water. The panel runs from the first trimester in 2000 through the third in 2010, providing thirty periods of observations.

The panel is unbalanced for two reasons. First, not all homes appear across all years of the panel owing to various reasons for the property to not appear in the assessor records (e.g., torn down or built up during sample period or vacant for extended periods). Second, the disaggregation into high and low users of water results in some homes appear as a high or low user in different years. The disaggregation occurs because South Milwaukee uses a decreasing block-rate pricing system. Meaning, once a household consumes water past a set threshold (the initial block), further water usage occurs at a rate cheaper than in the previous tier. This creates a problem for price rationing, as it appears that higher users of water pay less per unit for that water. To correct for this, the data is disaggregated into South Milwaukee’s “low-users” and “high-users”. This allows for a more accurate estimation of how different levels of consumers respond to changes in water prices within their block. A probit analysis is also conducted regarding the likelihood of a household appearing in one block or the other. However, this is not integrated into the elasticity estimations.

Residents of South Milwaukee saw a small, regular increase in the price of water of 3% during 2004, 2008 and 2009 and a more dramatic 62.09% increase in 2010 (Table 1) due to significant capital investments made by the utility, mostly to control discharge into Lake Michigan. The price changes do not necessarily occur at regular intervals, and usually occur during the middle of the year. This creates some challenge regarding the accurate price that people viewed for the year. To correct for this, the variable employed is the average price that people paid during a period subject to a price increase.

Although the periodic water usage figures from households are used, the characteristics of those households are only available from the 2010 property assessments. This means that the housing characteristics repeat across years for individual addresses. This provides two disadvantages compared to having the housing characteristics of each year. First, it further unbalances our panel; houses which were destroyed between 2001 and 2009 are omitted because there is no description for the characteristics of that house. Second, any modifications made to the home will not be addressed.

This potential problem is of limited concern as a result of discussions with South Milwaukee’s Assessor. First, South Milwaukee is an older city, with little new construction due to a lack of empty lots. As a result, very little new housing came on line during this decade. Second, there was little “permitted”
remodeling that occurred and could be tracked. Minor internal remodeling may have occurred out of the
city inspector’s view. As a result, these limitations are unavoidable. However, this creates a challenge for
further and deeper investigation of household characteristics to future research.

Controlling for individual characteristics of the home may be an important determinant of water
usage, but the characteristics of the people in that house might be a more important determinant. In an
attempt to capture some of this variation, some estimation that control for the personal characteristics of
the neighborhood that the house is located in assigning a dummy variable to the Census tract containing
the property are run.

The descriptive statistics for the characteristics of the Census Tract for South Milwaukee reveal
several characteristics and are presented in Table 2. For South Milwaukee, Census Tract 1705 and 1706
are the poorest communities in the region with the lowest median household income, low occupancy rate,
and the highest percentage of people living below the poverty line. Contrary to this, the other five Census
Tracts in South Milwaukee appear to be relatively affluent with a higher median income and fewer people
living below the poverty line.

EMPIRICAL MODELS

Estimating how different household characteristics influence the elasticity of water demanded, this
paper attempt to model both household demand within a water usage block and also the likelihood of a
household being in the high-usage block. The latter is estimated using a probit model and model the latter
with OLS as well as a “fixed effects” specification with the effect being fixed on the unique Census Tract
that the city is located in. This differs from the traditional fixed effect model where the effect would be
fixed on the individual homes controlling for all time invariant characteristics of that individual home
(which in the case of households would be almost anything).

Probit Model

A probit model is estimated to try and determine the characteristics of individual households that
would allow them to be classified as a high user of water by their respective city. The following equation
is considered:

\[
P(Y_{it} = 1|Z_{it}) = G(\delta_i + \varphi Z_{it})
\]  

(1)

Where, \(Y_{it}\) is a stationary variable representing whether a house, \(i\), during a given year, \(t\), is classified as a
high user of water. This is estimated against a vector of control variables, \(Z_{it}\), which includes the number
of bathrooms, half bathrooms, age of the home (simply calculated as the given year minus the year the
home was built), value of the home in thousands of US dollars separated into value of the lot and the
value of improvements, square feet, square feet squared, square feet of the lot, square feet of the lot
squared, and the square feet of either an attached or a detached garage.

The unique Census Tracts are included rather than the several individual variables measured within a
Census Tract. The Census Tract has a nearly infinite number of characteristics from that neighborhood
which would be impossible to include individually without omitting important variables, and the level of
variation within a tract is potentially quite large. Instead, use of a dummy variable does attempt to account
for all of these factors and is not remarkably inferior to average measures that could be employed for each
tract.

The primary variable of interest in this equation is the number of bedrooms, \(\beta_1 Rooms_{it}\), in house, \(i\),
in time, \(t\). This is the primary variable of interest because it can be viewed as a weak proxy variable for
the number of people in the house which we would a priori expect to be strongly related to household
water usage.
OLS

Similarly, an OLS model with and without the census tract dummies is estimated. The OLS model will take the following form:

\[ W_{it} = \delta X_{it} + \beta_1 Price_{it} + \epsilon_{it} \]  

(2)

Where the dependent variable is the natural log of annual water consumption, \( W_{it} \), in home \( i \), and time, \( t \). The same control variables that were included in the probit model are included, bolstered by the addition of one more variable, the natural log of price of water during that period. Also included is a variable for the price of water during that year, which is the primary variable of interest in estimating elasticity. This log-log specification has the advantage of providing an estimated coefficient that is own-price elasticity of water demand. Similarly, a stationary variable for Census Tract is not included. The OLS model acts primarily as a robustness check for the fixed effect model, which is our primary model of interest.

It is expected that water demand to be negatively related to price though inelastically given the typically low price for water and large quantities in which it tends to be used. As property value may bear some positive relation to income, with water serving as a normal good, water usage should increase with property value. House size may be similarly related to income, though total square footage sometimes interacts with the number of rooms in unexpected ways. The impact of house age is not immediately clear; older houses are perhaps less efficient users of water, but newer houses may have more water-using amenities and water-using equipment and appliance in older homes could have been updated at any point in their existence. While it is predicted that the number of rooms and bathrooms to correlate with the number of people in the home and thus usage, which has the stronger impact is open to investigation. When including lot square footage, the expectation is that it is positively related to usage as larger properties are unlikely to see less outdoor water use. Lastly, Billing Period 3, which includes the middle trimester of the year and thus late spring and early summer, should witness the highest usage due to more outdoor water use (pools, sprinklers, etc.).

RESULTS

Summary statistics of the variables are presented in Table 3.

Probit Model

The first model to consider is a probit model, where we estimate the unique housing characteristics that result in a consumer being considered a “high” user of water. In the city of South Milwaukee, a consumer is considered a “high” user when they have consumed more than 5,000 cubic feet of water (or 37,900 gallons).

The results from this model (Table 4) suggest that most household characteristics are positively related to the probability of being a high-using household. Of particular note, the number of rooms in the house is the strongest such influence in terms of the size of the coefficient. The number of bathrooms and half-baths are also positively related to high usage, but with coefficients a third of that on total number of rooms. House age is a significantly positive contributor, but with a rather small coefficient. House size in square feet and house value are both significantly as positively related with high usage, with diminishing impact of house footage. Perhaps surprisingly, the value of the lot itself is negatively related to high usage. Perhaps lot value is negatively correlated with lot size if higher value properties are in denser neighborhoods. Also surprising is that garage space is negatively related to high usage whether attached or unattached though the coefficient on attached garage space is larger than that on unattached garage space. The mid-year trimester billing period, Billing Period 3, is associated with high water usage. Lastly, there is one census tract weakly associated with higher water usage but otherwise the location of the house by tract does not seem to significantly matter.
OLS Elasticity Estimations

Table 5 presents results for the elasticity estimations. The sample was segregated into low and high usage households for each billing period. Estimations with and without the census tract dummies are provided as a sort of robustness check as to whether the variables of interest are significant as opposed to some sort of neighborhood effect.

The primary variable of interest here is price. Price is both statistically significant and to have a negative coefficient. However, the measured elasticity’s are quite low, -0.164 for low users and -0.035 for high users. These results are consistent across estimations for a given sub-sample. Water demand is inelastic for both groups consistent with a priori expectations, but much more inelastic for high users; indeed, for high users price seems to have very little impact on water usage. This has significant implications for price as a rationing tool which we will discuss further in our conclusions.

In regards to household characteristics, the number of rooms in a house is positively correlated with water usage, though more so for low users. The number of half-baths seems to have a positive correlation with usage for high users, but not low users. The number of bathrooms is significant only for one specification for one usage group. Household age is positively related with usage, but again only for high users. House value is significantly and positively related to usage, and more so for low users. It might be that this is indicating stronger income elasticity for low users which may be more income-constrained. The house value effect tends to weaken with tract dummies; this may be due to some cross-correlation between house values and census tracts. In addition, land value is negatively correlated with usage only for low users. The size variables suggest that lot size may be positively correlated to usage for low users and more so as the lots are bigger, but this result is not robust with respect to tract dummies and is small in magnitude regardless. Curiously, the size of an attached garage is negatively related to usage for both high and low users and the significance of a detached garage is inconsistent across specifications and usage groups. There is a significant seasonal effect for low users during the middle trimester of the year, but usage by high users seems to not have a significant seasonal variation. Lastly, it should be noted that these estimations are explaining a very small part of overall variation in water usage. Many of the variables explored here are statistically significant. However, this analysis does not capture the forces that shape household water demand very well.

CONCLUSIONS

This paper looked at how consumers changed their consumption function in response to changes in the price of water. Evidence that was found supports the hypothesis that consumers are relatively inelastic to changes in the price of water, particularly when they are classified as a high water user. The number of rooms in a household is a consistently significant non-price determinant of water demand, positively correlated both with usage within usage blocks and whether a household is in a high usage block or not. This variable may be reflecting income in general as house square footage and value also have similar significance, and economic theory would predict that as income goes up, the water bill becomes a declining portion of the total budget and thus would be associated with lower price elasticity of demand. While a significant seasonal impact exists, it does not necessarily seem related to lot size or value.

However, the estimations are also generally a low fit with the data. Clearly, there are non-price forces at work. Personal habits likely play a significant role as people consider other factors in their water usage, and we cannot claim to have captured that. The efficiency of water-using appliances likewise is probably important, yet that is not captured in this study. The results may also be idiosyncratic to decreasing-rate block pricing structures.

The implications of these results for policy approaches to water use suggest that price alone could contribute to water rationing efficiency, but would do so unequally and incompletely. Raising price will have most impact on low users. It is accurate that in the community of South Milwaukee, low users are responsible for more total water usage than high users by a ratio of nearly 3:1. As a result, rationing by the low user group would be essential to any water rationing objective. However, these users may also be the most wealth-constrained (using land and improvement value as a proxy) and such will experience the
most adverse budget shock and will likely object the most vociferously at any proposal to raise water prices. Given that so much water demand comes from non-price factors, any water conservation strategy must therefore also make use of non-price tools. It should also be noted that given inelastic demand, raising prices would raise revenues for utilities. Given the pressing need to replace and expand a lot of the aging and at times decrepit water infrastructure nation-wide, more revenues to pay for such should not be unwelcomed.

ENDNOTE

1. This description implies an exogeneity of price in determining quantity demanded. Water utilities often set price on a cost-recovery basis using only long-run estimates of usage and changes to the rate are subject to considerable frictions. Thus, it is not usual in water demand studies to treat price as exogenous.

REFERENCES


TABLE 1
WATER PRICE TREND

<table>
<thead>
<tr>
<th>Price at Year Ending</th>
<th>Low User*</th>
<th>High User**</th>
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</thead>
<tbody>
<tr>
<td>2000</td>
<td>$1.65</td>
<td>$1.38</td>
</tr>
<tr>
<td>2001</td>
<td>$1.65</td>
<td>$1.38</td>
</tr>
<tr>
<td>2002</td>
<td>$1.65</td>
<td>$1.38</td>
</tr>
<tr>
<td>2003</td>
<td>$1.65</td>
<td>$1.38</td>
</tr>
<tr>
<td>2004</td>
<td>$1.70</td>
<td>$1.42</td>
</tr>
<tr>
<td>2005</td>
<td>$1.70</td>
<td>$1.42</td>
</tr>
<tr>
<td>2006</td>
<td>$1.70</td>
<td>$1.42</td>
</tr>
<tr>
<td>2007</td>
<td>$1.70</td>
<td>$1.42</td>
</tr>
<tr>
<td>2008</td>
<td>$1.75</td>
<td>$1.46</td>
</tr>
<tr>
<td>2009</td>
<td>$1.82</td>
<td>$1.52</td>
</tr>
<tr>
<td>2010</td>
<td>$2.95</td>
<td>$2.60</td>
</tr>
</tbody>
</table>

* Price for the first 5,000 cubic feet (37,402.5 gallons)
** Price for all additional water usage
### TABLE 2
**SOUTH MILWAUKEE CENSUS TRACT DESCRIPTIVE STATISTICS**

<table>
<thead>
<tr>
<th>Census Tract Number:</th>
<th>1701</th>
<th>1702</th>
<th>1703</th>
<th>1704</th>
<th>1705</th>
<th>1706</th>
<th>1707</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupancy Rate</td>
<td>97.2%</td>
<td>92.2%</td>
<td>96.0%</td>
<td>98.4%</td>
<td>97.6%</td>
<td>92.6%</td>
<td>95.8%</td>
</tr>
<tr>
<td>Population in Occupied House</td>
<td>2,790</td>
<td>3,510</td>
<td>2,732</td>
<td>3,367</td>
<td>2,167</td>
<td>3,374</td>
<td>2,912</td>
</tr>
<tr>
<td>Median Number of Rooms</td>
<td>5.6</td>
<td>5.0</td>
<td>5.0</td>
<td>5.8</td>
<td>4.9</td>
<td>4.7</td>
<td>5.6</td>
</tr>
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<td>Median Rent</td>
<td>$620</td>
<td>$613</td>
<td>$539</td>
<td>$531</td>
<td>$516</td>
<td>$461</td>
<td>$652</td>
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<td><strong>Income:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Household Income</td>
<td>$51,724</td>
<td>$44,336</td>
<td>$41,315</td>
<td>$58,269</td>
<td>$37,703</td>
<td>$32,435</td>
<td>$51,947</td>
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<td>Household Income:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $25,000</td>
<td>20.1%</td>
<td>19.6%</td>
<td>20.8%</td>
<td>12.4%</td>
<td>28.0%</td>
<td>37.9%</td>
<td>17.8%</td>
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<td>$25,000 - $50,000</td>
<td>28.2%</td>
<td>38.2%</td>
<td>41.9%</td>
<td>26.3%</td>
<td>33.9%</td>
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<td>More than $50,000</td>
<td>51.9%</td>
<td>42.2%</td>
<td>37.3%</td>
<td>61.3%</td>
<td>37.9%</td>
<td>26.9%</td>
<td>53.8%</td>
</tr>
<tr>
<td>Percent Below Poverty Line</td>
<td>1.80%</td>
<td>1.10%</td>
<td>1.10%</td>
<td>0.90%</td>
<td>12.70%</td>
<td>9.60%</td>
<td>6.90%</td>
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<tr>
<td><strong>Employment:</strong></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Labor Force Participation Rate</td>
<td>68.1%</td>
<td>65.8%</td>
<td>69.2%</td>
<td>74.7%</td>
<td>55.0%</td>
<td>67.4%</td>
<td>73.8%</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>3.2%</td>
<td>1.7%</td>
<td>4.6%</td>
<td>4.2%</td>
<td>2.1%</td>
<td>8.1%</td>
<td>4.7%</td>
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</tbody>
</table>

Source: U.S. Census Bureau - American Fact Finder
## TABLE 3
### SOUTH MILWAUKEE DESCRIPTIVES

<table>
<thead>
<tr>
<th></th>
<th>Low User</th>
<th></th>
<th>High User</th>
<th></th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>Water Usage*</td>
<td>23.458</td>
<td>11.832</td>
<td>82.585</td>
<td>1127.323</td>
<td>86.357</td>
<td>587.949</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>1.452</td>
<td>2.580</td>
<td>1.579</td>
<td>1.444</td>
<td>1.463</td>
<td>2.499</td>
</tr>
<tr>
<td>Half Bathrooms</td>
<td>0.357</td>
<td>0.515</td>
<td>0.419</td>
<td>0.584</td>
<td>0.362</td>
<td>0.522</td>
</tr>
<tr>
<td>Rooms</td>
<td>6.399</td>
<td>1.692</td>
<td>7.597</td>
<td>2.340</td>
<td>6.506</td>
<td>1.793</td>
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<tr>
<td>Age</td>
<td>67.3</td>
<td>85.6</td>
<td>63.7</td>
<td>127.4</td>
<td>59.0</td>
<td>23.8</td>
</tr>
<tr>
<td>Land$</td>
<td>63.3</td>
<td>10.3</td>
<td>64.0</td>
<td>11.8</td>
<td>63.4</td>
<td>10.5</td>
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<tr>
<td>Improvement$</td>
<td>112.0</td>
<td>35.0</td>
<td>123.9</td>
<td>42.0</td>
<td>113.1</td>
<td>35.9</td>
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<tr>
<td>Square Feet</td>
<td>1441.7</td>
<td>770.7</td>
<td>1756.0</td>
<td>856.3</td>
<td>1469.8</td>
<td>783.9</td>
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<tr>
<td>Lot Square Feet</td>
<td>8661</td>
<td>37827</td>
<td>8626</td>
<td>12666</td>
<td>8658</td>
<td>36289</td>
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<tr>
<td>Attached Garage (sq.ft.)</td>
<td>37</td>
<td>126</td>
<td>36</td>
<td>129</td>
<td>37</td>
<td>127</td>
</tr>
<tr>
<td>Detached Garage (sq.ft.)</td>
<td>327</td>
<td>256</td>
<td>304</td>
<td>273</td>
<td>325</td>
<td>258</td>
</tr>
<tr>
<td>(N)</td>
<td>150,708</td>
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<td>14,873</td>
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### TABLE 4  
PROBIT ESTIMATION

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<tr>
<th>Coef.</th>
<th>S.E.</th>
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<tbody>
<tr>
<td>Bathrooms</td>
<td>0.0034***</td>
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<tr>
<td>Half Bathrooms</td>
<td>0.0445***</td>
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<tr>
<td>Rooms</td>
<td>0.1271***</td>
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<tr>
<td>Age</td>
<td>6.626E-4***</td>
</tr>
<tr>
<td>Land$</td>
<td>-0.0035***</td>
</tr>
<tr>
<td>Improvement$</td>
<td>0.0022***</td>
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<tr>
<td>Square Feet</td>
<td>2.289E-4***</td>
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<tr>
<td>Square Feet $^2$</td>
<td>-1.450E-8***</td>
</tr>
<tr>
<td>Square Feet Lot</td>
<td>-2.270E-7</td>
</tr>
<tr>
<td>Square Feet Lot $^2$</td>
<td>-7.800E-12***</td>
</tr>
<tr>
<td>Attached Garage</td>
<td>-2.001E-4***</td>
</tr>
<tr>
<td>Detached Garage</td>
<td>-1.183E-4***</td>
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<td>Billing Period 2</td>
<td>-0.1552</td>
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<tr>
<td>Billing Period 3</td>
<td>0.3299***</td>
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<tr>
<td>Tract 1702 (1600)</td>
<td>-0.0264</td>
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<tr>
<td>Tract 1703 (1800)</td>
<td>0.0309*</td>
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<tr>
<td>Tract 1704 (1900)</td>
<td>-7.511E-4</td>
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<tr>
<td>Tract 1705</td>
<td>0.0447**</td>
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<tr>
<td>Tract 1706</td>
<td>0.0150</td>
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<td>Tract 1707</td>
<td>-0.036</td>
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<tr>
<td>Constant</td>
<td>-2.6957***</td>
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*R-Squared* 0.0765
TABLE 5
SOUTH MILWAUKEE LOG-LOG ELASTICITY ESTIMATIONS

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<th></th>
<th>High User</th>
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<tbody>
<tr>
<td></td>
<td>Coef. S.E.</td>
<td>Coef. S.E.</td>
<td>Coef. S.E.</td>
<td>Coef. S.E.</td>
<td>Coef. S.E.</td>
<td>Coef. S.E.</td>
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<tr>
<td><strong>Log Price</strong></td>
<td>-0.1646*** 0.0095</td>
<td>-0.1638*** 0.0218</td>
<td>-0.0357*** 0.0072</td>
<td>-0.0352*** 0.0094</td>
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<tr>
<td><strong>Bathrooms</strong></td>
<td>-0.0014*** 4.332E-4</td>
<td>-0.0014 0.0010</td>
<td>-3.954E-4 0.0015</td>
<td>-4.853E-4 8.910E-4</td>
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<tr>
<td><strong>Halfbath</strong></td>
<td>0.0079* 0.0043</td>
<td>0.0076 0.0098</td>
<td>0.0161*** 0.0045</td>
<td>0.0154*** 0.0070</td>
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<tr>
<td><strong>Rooms</strong></td>
<td>0.0416*** 0.0014</td>
<td>0.0438*** 0.0024</td>
<td>0.0150*** 0.0013</td>
<td>0.0139*** 0.0026</td>
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<tr>
<td><strong>Age</strong></td>
<td>-9.170E-5** 3.690E-4</td>
<td>-7.370E-5 1.251E-4</td>
<td>1.622E-4*** 1.780E-5</td>
<td>1.519E-4*** 1.570E-5</td>
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<tr>
<td><strong>Land</strong></td>
<td>-0.0026*** 2.107E-4</td>
<td>-0.0028*** 6.304E-4</td>
<td>2.601E-4 2.801E-4</td>
<td>4.853E-4 5.028E-4</td>
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<tr>
<td><strong>Improvement</strong></td>
<td>0.0020*** 1.585E-4</td>
<td>0.0018* 6.538E-4</td>
<td>2.542E-4*** 8.340E-5</td>
<td>3.408E-4** 1.895E-4</td>
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<tr>
<td><strong>Square Feet</strong></td>
<td>4.290E-5*** 7.820E-6</td>
<td>4.800E-5 2.770E-5</td>
<td>-4.410E-7 6.970E-6</td>
<td>6.620E-8 1.590E-4</td>
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<tr>
<td><strong>Square Feet Lot</strong></td>
<td>6.550E-8*** 2.480E-8</td>
<td>5.790E-8 3.830E-8</td>
<td>-6.920E-9 1.100E-7</td>
<td>4.020E-8 5.650E-8</td>
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</tr>
<tr>
<td><strong>Square Feet Lot ²</strong></td>
<td>3.160E-12*** 3.860E-13</td>
<td>2.890E-12 8.630E-13</td>
<td>3.070E-12 9.890E-12</td>
<td>5.610E-12 1.540E-11</td>
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<tr>
<td><strong>Billing Period 2</strong></td>
<td>0.0037 0.0042</td>
<td>0.0038 0.0154</td>
<td>-0.0069 0.0064</td>
<td>-0.0074 0.0059</td>
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<tr>
<td><strong>Billing Period 3</strong></td>
<td>0.0848*** 0.0042</td>
<td>0.0849*** 0.0161</td>
<td>0.0047 0.0055</td>
<td>0.0041 0.0098</td>
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<tr>
<td><strong>Constant</strong></td>
<td>2.7121*** 0.0162</td>
<td>2.7205*** 0.0624</td>
<td>4.0987*** 0.0219</td>
<td>4.0813*** 0.0416</td>
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</tr>
<tr>
<td><strong>R-Squared</strong></td>
<td>0.0343</td>
<td>0.0341</td>
<td>0.0250</td>
<td>0.0245</td>
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</tr>
</tbody>
</table>