

TECHNOLOGY IMPRINT: A SYSTEMATIC ANALYSIS ON THE IMPACT AND FILTERING EFFECTS OF TECHNOLOGY ON USER PERCEPTION

Mario G. Beruvides, Ph. D., P. E., Texas Tech University
Hisham Besheer, Texas Tech University

Abstract

This paper presents and discusses the concept of a technology imprint that affects user interaction with different forms of technology. A conceptual model was developed to explain (i) the components that make up a technology imprint, (ii) how the technology imprint is formed, and (iii) the way in which the imprint positively or negatively biases user decision-making. The paper also examines the possibility of existence of multiple imprints, each acting upon a certain element. A study is currently being conducted to examine the validity of this conceptual model. The critical issues concerning technology imprints, their effects on users, and implications on human resource and engineering management are explored.

Introduction

Over the last decade, the Internet has evolved from a largely unknown concept to what is arguably the greatest technological innovation of our history. Originally created with the intention of defending the United States against a catastrophic Soviet nuclear attack during the cold war era, it has become one of the most mainstream and widely used public tools. In a relative blink of time, the Internet has revolutionized the way we meet, interact, communicate, invest, work, study, play, shop, operate businesses, and conduct research. In one way or another, it has affected most aspects of our lives.

As with any other tool, the Internet has its positive and negative implications. It has allowed us to chat in real-time with family members or coworkers across the globe, but in the meantime has allowed viruses to propagate and infect millions of computers in a matter of seconds. Similarly, it is hypothesized that the Internet has produced mental imprints on its users. It will be shown later in the paper that imprints are near-irreversible attitudes of the highest strength affecting user judgment concerning certain technology-related target objects.

Imprints bias judgment either positively or negatively. They are a result of many factors including culture, social influence, and personal experience acting upon an individual. Technology imprints are not necessarily Internet-related, but can be associated with technologies of any type or form. Imprints are

believed to most commonly exist in the Internet field because of the widespread Internet use exhibited in the last decade and the speed at which whole populations were exposed to it.

The purpose of this paper is to identify and define technology imprint as well as propose a conceptual model explaining its dynamics and components.

Significance of study. In recent years, the computer and technologies that accompany it have become more and more an integral part of our daily lives. They are now used in education, training, work, recreation, and commerce among other areas. Computers also play a more subtle but equally as important part controlling our cars, homes, electronics, medical devices, and much more. Understanding the weaknesses of humans in dealing with computers can aid in overcoming many of today's obstacles set forth by the limitations of our human resources with regards to computer and technology usage.

This study analyzes and logically conceptualizes the conditions leading to technology imprints, the ways in which imprints affect users, and possible outcomes of such imprints. The resulting model draws on ideas from theories of different origins ranging from social psychology to industrial engineering to ethology. The model, however, is not merely a direct derivation from the above areas. It is believed to be a new construct that shares common components and exhibits similar effects as do other models and theories.

Literature review. Most of the studies reviewed concluded that there are a few main areas believed among researchers to be influencing factors on user e-shopping experiences and behavior. Among those factors are motivation (Volk 2002), purchase intent (Shim, Eastlick et al. 2001), and website design (Zhang, von Dran et al. 2001).

Each of these areas has been studied numerous times and various results, mostly in agreement, have been reported. Zhang, von Dran et al. (2001) claim that not enough effort has been put in trying to deduce scientific evidence of the relationship between the user and the influencing elements. They also expanded upon studies in which users were asked to determine whether a certain feature of a website was satisfying or

dissatisfying (Zhang, von Dran et al. 1999; Zhang and von Dran 2000; Zhang, von Dran et al. 2000). Their study went a step further and focused on ranking the importance of the different elements of a website based on user perception. In general, the study reported that the importance of features was not universal across websites. What was important in one domain could be insignificant in another.

The results of this study revealed important data that could be applied by website designers in order to achieve a more user-friendly website since it directly addresses the needs and desires of the user. The main limitation of this study, however, is that no consideration was given to the experience level or behavior of the user. It assumes that all Internet users are the same and that all websites are visited by users in the same common level.

The situation described above is inaccurate as some Internet users are experts and have been designing and programming websites for a decade or more while others have only recently started using the Internet. In addition, this paper will attempt to explain a technology imprint; a psychological construct that biases and sometimes dictates user behavior during interactions with the Internet. There is no reason to believe that there will ever be a time when all Internet users levels are saturated and all users become experts and all imprints are eliminated. There will always be Internet users (and more generally, technology users) with different experience levels and different types of imprints.

Historical background. The idea of imprinting in general is by no means an original idea nor is it a new one. The term *tabula rasa* has been used for centuries to refer to the theory that the mind is initially a blank slate, gradually imprinted with whatever thoughts and experiences it is exposed to that will influence it throughout its journey of life. It is not clearly understood where or when the term was first used. It is a fact, however, that the term has been used repeatedly in many periods and eras to describe what is more or less the same ideology and school of thought.

The term *tabula rasa* comes from the two Medieval Latin words *tabula*, meaning tablet, and *rasa*, meaning erased, with the two combined to mean clean slate. In ancient Rome, before paper was used, wax tablets were used for writing. The ability to wipe the wax smooth gave them the characteristic of being reusable (Altman 2001). A tablet on which the writings had been erased (*tabula rasa*) was therefore a tablet that was devoid of any writing, leaving it ready to be imprinted with letters and words that would last for a long period of time. Many thinkers, philosophers, and psychologists liken this blank slate to a human mind before it is gradually filled with information and experiences.

This theory is the foundation for the school of philosophy commonly known as empiricism in which the idea of the *a priori* is dismissed as being analytic.

The first documented use of the *tabula rasa* theory can be found in Aristotle's *De Anima* (*On the Soul*) (1963) written around the year 350 B.C. In his writing, Aristotle specifically mentions an analogy between the mind and a writing tablet. According to his statement, the mind is "nothing until it has thought," which is a rejection of the concept of innate ideas. The tablet starts off clean and empty and is filled in time with characters that represent the human experiences and interactions leaving their imprint on the mind.

Aristotle was not the only thinker to make this argument. In fact, the whole British empiricist movement that started in the 17th century believed in this theory. John Locke (1632-1704), generally recognized as the father of empiricism, was known for his writings on government, politics, tolerance, and human behavior. In 1689, in his *Essay concerning Human Understanding*, John Locke reintroduced the *tabula rasa* theory.

Many scientists, thinkers, and philosophers other than the ones listed above of many eras and of different backgrounds, cultures, and beliefs agree in theory with the *tabula rasa* concept. It would therefore be inaccurate to assume that imprinting is a new idea. The brief historical overview is not intended to spark the debate over rationalism versus empiricism. That is not of any interest or value to this research. It is not meant in any way for this research to support the argument of empiricism. The discussion above is merely intended to reveal that the idea of an imprint (related to technology or otherwise) has been under investigation for millennia.

Concept Analysis

Analyzing technology imprint required researching concepts and theories in many fields. In order to understand and define technology imprints, it was essential to review theories in psychology, ethology, technology, and others.

Theories in psychology revealed similarities between imprints and attitudes, while values, moods, traits, schemas, and other concepts were closely related. In ethology, imprints were shown to have been defined as early as the 1930s (Evans 1975).

In ethological terms, however, imprinting was mainly concerned with animals exhibiting a tendency to treat another animal, or even a human, as their parent. This was only achieved under certain conditions and also produced certain other outcomes such as a desire of the imprinted animal to mate with a member of the species with which it is imprinted.

The analysis and definition of technology imprint in an industrial engineering sense is obviously closely

tied to other disciplines. The discussion below highlights the similarities and differences among the different areas in more detail.

Attitudes, values, and moods. When defining the term imprint, it is essential to highlight the similarities, and more importantly the differences, between imprints, attitudes, moods, and values. The latter three are commonly used in psychology to explain different aspects of behavior. They are often used to describe each other and occasionally used interchangeably. This research will make a clear distinction between imprint and the other terms, including attitude. Although it will be shown that imprint and attitude are closely related, they will not refer to the same psychological construct.

The term attitude is widely used in many areas (scientific or otherwise), often with varying implications. A conceptual definition that has become very popular in recent years, however, is that attitude is “a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (Eagly and Chaiken 1993). According to Eagly and Chaiken, this definition implies three distinct characteristics for attitudes. First, the authors describe attitudes as tendencies, which they say means that attitudes are internal states and must in fact exist, if even for a short period. They are not merely psychological theories used to explain a phenomenon. Eagly and Chaiken also argue that the definition gives attitudes an evaluative property, meaning attitudes affect the stimulus such that the response is influenced by the attitude. In a way, attitude is like a filter through which one evaluates an attitude object, which is the third property of attitudes the definition implies. An attitude object is the object being subjected to the evaluation of the attitude. It could be abstract or concrete, tangible or intangible, and can range from concepts such as freedom to objects such as cars.

Attitudes can be positive, negative, or neutral, the latter being referred to by some researchers as non-attitudes (Converse 1964). Attitude is frequently considered a causal factor and predictor of behavior (Kelman 1961; Sherman and Fazio 1983).

Attitudes have numerous attributes according to researchers. Unlike traits, they must be associated with an object (Sherman and Fazio 1983). Since attitudes are always directed at an object, they are therefore also evaluative of that object (Sherman and Fazio 1983) and determine whether the feeling toward the object is positive, negative, or neither. Research has shown that attitudes can be changed (Kelman 1961; Petty and Krosnick 1995; Olson and Fazio 2001).

According to Eagly and Chaiken (1993), values are merely a form of attitude with which one evaluates “abstract goals or end states of human existence (e.g.,

equality, freedom, salvation).” In other words, the set of personal evaluative attitudes about abstract issues of right and wrong comprise one’s set of values.

Attitudes have another very distinct property, namely strength. The same attitude can occur in different levels of strength and its strength can change in time based on the experiences of the individual (Petty and Krosnick 1995). Research suggests that because of this attribute, it is easy to manipulate and change attitudes (Petty and Krosnick 1995; Converse 1964; Eagly and Chaiken 1993; Petty and Cacioppo 1981). Imprints, on the other hand, are almost irreversible, unlike ethological imprints, which are believed to be absolutely irreversible.

Imprints in ethology. Konrad Lorenz is a renowned scientist, pioneer, and Nobel laureate in the field of modern ethological science, a field in which animal behavior is studied. Imprinting is one of the most intriguing concepts introduced and studied extensively by Lorenz.

In 1975, Richard Evans interviewed Lorenz. In the interview, Evans asked Lorenz “what exactly do you mean by imprinting?” Lorenz responded with the following.

“[T]he fixation of an innate behavior pattern is one characteristic of imprinting. The second is its irreversibility. And the third is that it is effected [sic] during a comparatively short phase in the individual life of the animal...The term ‘imprinting’ was coined mainly with sexual behavior in mind” (Evans 1975).

Later in the interview, Evans asks if there are “any implications of this concept for human behavior?” He acknowledges that “that’s a very, very big leap, of course, I realize that.” Lorenz agrees that it is a big leap and proceeds to explain that “if you read the work of a very old and almost forgotten psychiatrist, Krafft-Ebing (1950), on fetishisms, you get the impression that some of his patients’ behaviors were analogous to imprinting” (Evans 1975). He asserts, however, that the imprinting effect on humans is “unverifiable” and has not been validated (Evans 1975).

In summary, according to Lorenz, the conditions and properties of imprints are as follows (Evans, 1975):

1. Only animals can be imprinted.
2. The behavior to be imprinted is innate.
3. The behavior is fixated in the mind.
4. It is irreversible.
5. The imprint can only be created during a certain period in the life of the animal, generally a relatively short one.

Definitions of imprint and technology imprint. The main difference between an attitude and an imprint is that neutral attitudes (or non-attitudes) are also considered a form of attitude. In other words, attitudes

consist of positive and negative attitudes as well as non-attitudes. However, there is no such thing as a non-imprint. A non-attitude is a neutral attitude toward a certain issue. There can be no neutral imprint. One is either imprinted positively or negatively or they are not imprinted at all.

One of the definitions of the word imprint in the Merriam-Webster Dictionary (2003) is “to fix indelibly or permanently (as on the memory).” While the early thinkers stressed that a mind is like a blank slate ready to accept ideas caused by experiences, they usually also claimed that this is the case for a child’s mind at birth. None of the early works gave reference to such a phenomenon in an adult’s mind.

The authors of this study strongly believe that imprinting is the process of indelibly fixing ideas, beliefs, and attitudes in a person’s mind regardless of age (child or adult). Therefore, it will be used loosely within the text of this study and will more closely resemble the Merriam-Webster definition than John Locke’s definition. No commitment is being made to emphasize or prove an empiricist definition of imprinting. In addition, imprinting in this study does not refer to the type of ethological sexual/mate imprinting stressed by scientists such as Konrad Lorenz (Evans, 1975) as discussed previously.

With the help of the literature review conducted, several properties of the technology imprint have been developed and are here proposed. It is important to emphasize that while technology imprints and attitudes are two separate concepts, there are still some common properties shared among them:

1. A technology imprint has a biasing evaluative nature; once it is created, it will from then on bias the person either for or against certain technology-related entities.
2. It has varying levels of strength that can be represented on a scale. However, in order for it to be a true imprint, it has to be on an extreme end of the strength scale, whether positive or negative.
3. Imprint objects exist in technology imprints much like attitude objects exist in attitudes. An imprint object is the entity upon which the imprint acts to bias the person and must be technology-related. It should be noted that it is not the intention of this study to suggest that imprints can only be technologically-based. In fact, it is assumed that imprints of all kinds exist. This work, however, will only deal with technology imprints and as such, imprint objects must be technology-related.
4. It is affected by experience and social influence as well as personal traits and values.
5. It is not just a theory used to explain a phenomenon; rather it is a structural reality that can be defined in scientific terms and measured using the appropriate tools.

Based on the previous considerations and for the purpose of this study, imprint will be defined as *a predisposition stronger than any attitude, harder to change than any attitude, and always acting to positively or negatively bias assessments of target objects regardless of age of the individual under the influence of the imprint.*

Further, technology imprint will be defined as *an acquired predisposition stronger than any attitude, harder to change than any attitude, and positively or negatively biasing assessments of technology-related target objects, resulting from one’s own experiences, values, and traits and the surrounding culture, society, and influences.*

Technology imprint model. The technology imprint is based in part on existing psychological theories and constructs. It is, however, an independent model explaining a phenomenon not previously explored.

It is important to break the technology imprint down and identify its components. It is equally as important to understand how the imprint functions as an entity. First, the imprint must be created. This depends on several factors. It is believed by the authors that the factors contributing to the formation of a technology imprint can be grouped into three categories.

The first category of factors is *personal experience*, which refers to the background and history of the person upon whom the imprint will be created. This category includes experiences in education, relationships, family, and travel among other things. Experiences with technological tools, products, and innovations also play a big role in this category.

Culture is the second category contributing to the creation of an imprint. Culture is defined by Westrum and Adamski (1999) as “an ensemble of patterns of thought, feeling, and behavior that guide the action of the organization’s members.” There are many types of cultures, some of which are religious, academic, organizational, political, and national. At any given time, each person is immersed in several cultures simultaneously. This results in cultural and social influences, which bias the person in one way or another (Kelman 1961).

The third and last group contributing to the formation of an imprint is that of *cognitive factors*. In the technology imprint model, this refers to one’s thoughts and perceptions as well as attitudes, values, beliefs, and traits. In a way, these elements are related to culture. Some attitudes, for example, are acquired as a result of social influence. However, once the attitudes are established, they act alone.

The three categories described are not independent of each other. They are constantly interacting and feeding back and forth into each other. The imprint,

however, is created by all three categories acting simultaneously. Once the imprint is forged, it is difficult to reverse, although it is believed that in some cases it may be weakened or reinforced. The relationships between the three categories and technology imprints are shown in the exhibits below. Exhibit 1 demonstrates the creation of the imprint.

Exhibit 1. Formation of a technology imprint.

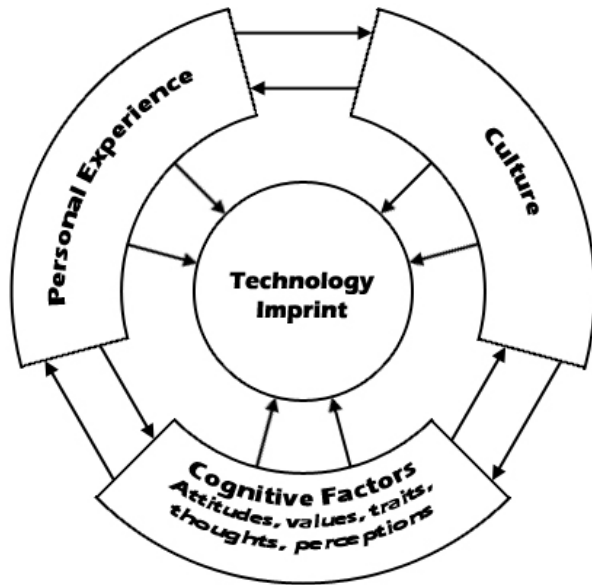
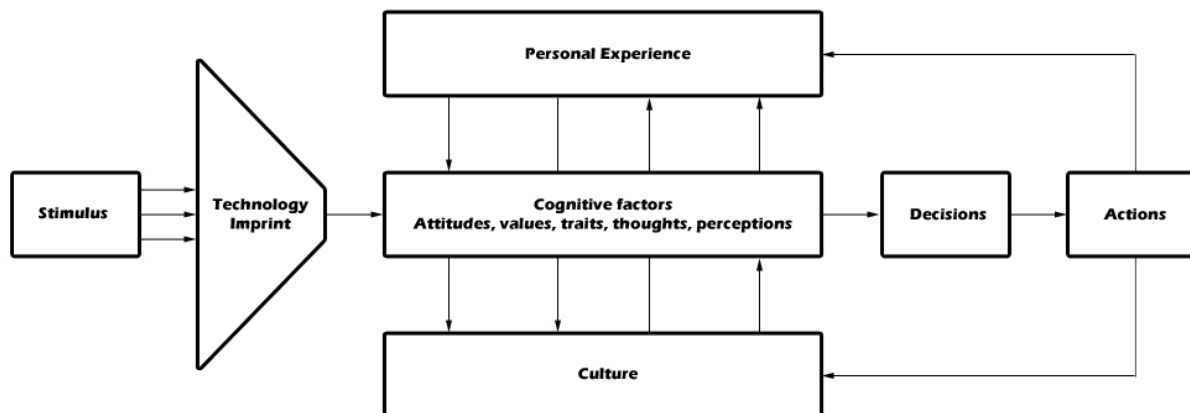


Exhibit 2 shows the way in which a technology imprint functions. The imprint acts a filter that narrows down the number of possible responses to any given stimulus. The resulting limited group of responses is then matched with one's personal experience, cognitive factors, and cultural influences to produce the final biased response. The response provides feedback to the culture and personal experience, which are constantly interacting with one another and with the cognitive factors.

Exhibit 2. How the technology imprint functions.



Technology imprints are not expected to be one single entity existing in every person's behavior pattern. Instead, it is believed that multiple imprints can and do exist, each relating to a specific issue. While Internet use is believed to be a good example of a situation where imprints are created, it is also believed that separate technology imprints are created in other areas, and maybe even detailed enough so as to vary among different components of the same group. For example, an imprint may exist that biases a user toward a specific software package while no general software imprint exists. A user may be imprinted negatively against software package A while having negative, neutral, or positive attitudes about packages B, C, and D, all of which perform the same function as package A. So the user is not imprinted against all software packages that perform the same function, rather he or she is only imprinted against one of the alternatives and merely has attitudes toward the others.

Conclusions

The technology imprint model has many useful implications in engineering management. The following paragraphs shed light on some of these issues.

Significance of technology imprint to industrial engineering. The mental constructs presented thus far are both logically developed and presented, and are based on a plethora of previous studies. That is, the arguments presented can be confidently said to possess face validity. But questions beg to be asked. How does this concern engineers and engineering management? How does the existence of a technology imprint impact engineering management and practice? To answer these questions, the effect or impact of a technology imprint needs to be explored. If a technology imprint exists within an individual or group of individuals, or even a specific culture, what are the possible ramifications of its presence? The presence of an imprint, technology-based or not, implies that a bias (super-saturated attitude) is acting upon an individual or group of people.

The presence of a technology imprint, due to the strength of its influence (fixed indelibly or permanently on the memory), can be considered paradigmatic in nature. If technology imprints are paradigmatic, then the implications upon engineers and engineering managers are significant. Before exploring the possible impact of the paradigmatic nature of technology imprints, it is important to review the extent to which technology imprints are in fact paradigmatic.

In *The structure of scientific revolutions*, Thomas Kuhn (1980) defines scientific paradigms as “accepted examples of actual scientific practice, examples which include law, theory, applications, and instrumentation together (that) provide models from which spring particular coherent traditions of scientific research.” Kuhn goes further to explain that “men whose research is based on shared paradigms are committed to the same rules and standards for scientific practice.”

Willis Harmon (1970) in *An incomplete guide to the future* defines a paradigm as “the basic way of perceiving, thinking, valuing, and doing associated with a particular vision of reality.” Finally, Adam Smith (1975) states that a paradigm is “a shared set of assumptions.” Smith further describes the concept by writing “when we are in the middle of the paradigm, it is hard to imagine any other paradigm.” It is not hard, however, after reviewing what constitutes a paradigm, to state that technology imprints are paradigmatic. They are not paradigms per se, but are paradigmatic in nature. One can easily envision “a predisposition stronger than any attitude, harder to change than any attitude, and positively or negatively biasing assessments of technology-related target objects, resulting from one’s own experiences, values, and traits and the surrounding culture, society, and influences” as falling within the realm of “the basic way of perceiving, thinking, valuing, and doing associated with a particular vision of reality.”

The significance of paradigms to the engineering world is well documented, written about, debated, and understood. It is part of the business lexicon and practice. The paradigmatic nature of technology imprints should be similarly considered. Thus the impact of this concept should be felt in two distinct ways.

Internally, engineering managers need to evaluate whether their organizations are being unduly influenced by a technology imprint. Externally, are customers or vendors under the influence of such an imprint? How does this affect the organization? What impediments are caused by this imprint? What advantages are to be gained by the imprint?

Simply put, technology imprints are potentially critical elements in any engineering manager’s landscape. They need to be aware of their existence and how to handle such a phenomenon.

Future studies. The model presented here is the first of many steps needed to identify the technology imprint. Extensive research is currently being conducted at Texas Tech, as part of a doctoral thesis, to expand the understanding of the technology imprint. It is essential to be able to quantify and measure technology imprints. A distinction must be made between imprints and other similar constructs in terms of numbers and measurements. An experiment will be conducted to verify the factors believed to contribute to the forging of imprints. Threshold limits will also be determined in order to differentiate between attitudes and imprints.

In the future, it is important to examine whether imprints can be intentionally created, manipulated, or eliminated. If it is proven that such actions are possible, it would be an invaluable tool for business managers to help manage their work force more efficiently.

References

- "imprint". (2003). *Merriam-Webster Online Dictionary*. Retrieved 10-20-2003, from <http://www.m-w.com>
- Altman, R. (2001). *The writing world of the Dead Sea scrolls*. Retrieved 10-12-2003, From http://www.st-andrews.ac.uk/~www_sd/altman_dss.html
- Aristotle. (1963). *De anima (On the soul)* (J. A. Smith, Trans. Vol. 3). Oxford: Oxford University Press.
- Converse, P. E. (1964). The nature of belief systems in the mass public. In D. E. Apter (Ed.), *Ideology and discontent*. New York: Free Press.
- Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth, TX: Harcourt Brace Jovanovich.
- Evans, R. I. (1975). *Konrad Lorenz: The man and his ideas*. New York: Harcourt Brace Jovanovich.
- Harmon, W. (1970). *An incomplete guide to the future*. New York: W. W. Norton.
- Locke, J. (1979). *An essay concerning human understanding*, Peter H. Nidditch (Ed.). Oxford: Clarendon Press.
- Kelman, H. C. (1961). Processes of opinion change. *Public Opinion Quarterly*, 25(1), 57-78.
- Krafft-Ebing, R. V. (1950). *Psychopathica Sexualis*. New York: Pioneer Publications.
- Kuhn, T. S. (1970). *The structure of scientific revolutions*. Chicago: Chicago University Press.
- Olson, M. A., & Fazio, R. H. (2001). Implicit attitude formation through classical conditioning. *Psychological Science*, 12(5), 413-417.
- Petty, R. E., & Cacioppo, J. T. (1981). *Attitudes and persuasion: Classic and contemporary approaches*. Dubuque, IA: Wm. C. Brown.

- Petty, R. E., & Krosnick, J. A. (1995). Attitude strength: An overview. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Sherman, S. J., & Fazio, R. H. (1983). Parallels between attitudes and traits as predictors of behavior. *Journal of Personality*, 51(3), 308-345.
- Shim, S., Eastlick, M. A., Lotz, S. L., & Warrington, P. (2001). An online prepurchase intentions model: The role of intention to search. *Journal of Retailing*, 77, 397-416.
- Smith, A. (1975). *Power of the mind*. New York: Ballantine Books.
- Volk, F. A. (2002). Internet users' attitudes and e-commerce behaviors. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, 62(9-B), 4278.
- Westrum, R., & Adamski, A. J. (1999). Organizational factors associated with safety and mission success in aviation environments. In D. J. Garland, J. A. Wise & V. D. Hopkin (Eds.), *Handbook of aviation human factors*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Zhang, P., & von Dran, G. (2000). Satisfiers and Dissatisfiers: A two-factor model for website design and evaluation. *Journal of American Association for Information Science*, 51(14), 1253-1268.
- Zhang, P., von Dran, G., Small, R., & Barcellos, S. (1999, January 5-8). *Websites that satisfy users: A theoretic framework for Web user interface design and evaluation*. Paper presented at the Hawaii International Conference on Systems Science (HICSS 32), Hawaii.
- Zhang, P., von Dran, G., Small, R., & Barcellos, S. (2000, January 2-6). *A two-factor theory for website design*. Paper presented at the Hawaii International Conference on Systems Science (HICSS 33), Hawaii.
- Zhang, P., von Dran, G., Blake, P., & Pipithsuksunt, V. (2001). Important design features in different web site domains. *e-Service Journal*, 1(1), 77-91.

About the Authors

Mario Beruvides is an associate professor of industrial engineering at Texas Tech University. Dr. Beruvides is also the I.E. graduate advisor, director of the Center for Systems Solutions, and runs the Systems and Engineering Management M.S. program at Texas Tech. He received a Ph.D. in Industrial and Systems Engineering from Virginia Tech and an M.S.I.E and B.S. in mechanical engineering from the University of Miami. His research interests include human and organizational systems performance improvement as well as advanced economic performance issues.

Hisham Besheer is a Ph.D. student at Texas Tech University. He received an M.S. in ergonomics and human factors engineering from Texas Tech and a B.S. in mechanical engineering from the American University in Cairo. His current research involves investigating, measuring, and analyzing technology imprints.