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# THE IT WORKFORCE CHALLENGE: ADOPTION OF IT CAREERS BY MINORITY GROUPS—ISSUES AND RECOMMENDATIONS

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## Abstract

*America faces an internal challenge to its position as a global leader in information technology. This challenge is real, and it impacts the core of this country's historical greatness – the preparedness of the national workforce. Simultaneously, the 21<sup>st</sup> century worker is facing a dynamic environment where technology and workforce diversity are key drivers for organizational change. The skilled workforce of the future must identify and evaluate opportunities and risks, leverage knowledge competencies, and effectively integrate information in a manner that creates value for their organizations. We suggest that re-designing courses in non-core technology disciplines, such as business, can be an effective factor in addressing the needs and expectations for a technologically prepared workforce. Using five undergraduate courses, we identified relevant “front page” business cases/issues that garnered significant student interest, whereby student teams examined critical technological implications associated with managerial decision-making. The tutorial provides an in-depth discussion of the technology workforce challenge, and uses cognitive theories to examine how changes in awareness and attitudes, with regard to career options, can impact the minority presence – women, African Americans, Hispanic Americans, and Native Americans – in the 21<sup>st</sup> century workforce.*

**Keywords:** IT workforce, TAM, minorities, curricula

## Introduction

America faces an internal challenge to its position as a global leader in information technology. This challenge is real, and it impacts the core of this country's historical greatness – the preparedness of the national workforce. The 21<sup>st</sup> century worker is facing a dynamic environment, where knowledge, speed, and performance will determine positioning as a “have” or a “have not.”

The workforce issue is crystallized by the projected demands for highly skilled information technology (IT) workers. Analyses of Bureau of Labor Statistics suggest that the United States will require 1.3 million new IT workers in the core technology disciplines by the year 2006 (Meares & Sargent, 1999; U.S. Department of Commerce, 1999). These projections are important not only in terms of employment opportunities, but these high demand fields also offer high wage opportunities. By 2006, the statistics also indicate that 520,000 new systems analysts will be added to the workforce. In terms of occupational demand, the need for systems analysts is exceeded only by the need for cashiers (Meares & Sargent, 1999). The wage differential in these two high-demand occupations is indicative of the importance of preparing workers to meet the demands of the market. Failure to address this issue will result in profound economic and social costs, including a widening of the income gap, curtailment of growth in essential industries, increased competition for low-skilled jobs, and even greater demands by U.S. companies for offshore hiring and increases in the H-1B visa cap (Meares & Sargent, 1999).

Meeting the IT skill challenge is critical and will require a multifaceted approach. The research described in this document broadens the definition of IT workers and examines how changes in the belief structure of university faculty influences IT acceptance within an underrepresented student population. Specifically, the study, which focuses on the underrepresentation of African Americans, posits that significant minority representation in the IT workforce will be achieved when individuals experience a fundamental change in their *awareness and attitudes* with regard to IT-focused career options. An opportune environment to impact such a shift in “mindset” is present in the higher education environment, but this systemic change must

emanate from the introduction of innovative and simultaneous changes in curriculum, teacher and student roles, assessment, and professional development.

This study uses an extended definition of IT workers that includes, but is not limited to individuals with core technology degrees. While an informed IT workforce is essential, it is imperative for programs of study in business to emphasize the increasing technological implications associated with managerial decision-making.

## **Background**

This project requires the integration of critical IT knowledge and resources into the pedagogy of a select number of required business courses, across functions and student classifications. Other researchers found that the reconfiguration of the development, delivery, and evaluation of foundational courses can be disruptive to the traditional expectations of students, faculty, and administrators; therefore, it is important to evaluate the educational value of such an endeavor. Alavi, Yoo, and Vogel (1997) strongly expressed the difficulties associated with integrating information technology into management education, and they stressed that simply “providing computer access and training faculty and students” (p. 1312) is not of itself superior to alternative forms of learning and instruction. They support the notion for a more integrative technology-mediated learning environment that uses technology to leverage knowledge opportunities in and outside of the classroom (Alavi, et al., 1997). They conclude that such an environment facilitates information exchanges among course participants, and extends campus-based resources through the inclusion of external sources of business expertise.

The reorganization of the courses engages students in an IT-focused learning style. The expectations of the change include an enhancement of student motivation and performance and teaching effectiveness. Such changes in the instructional process can reduce the disparity between minorities and other ethnic groups in the IT workforce. Thus, the goal of this research was to investigate whether changes in the instructional delivery of traditional courses would lead to a greater student willingness to embrace technology and seek employment opportunities in IT related business environments. Further, the longer-term objective is to instruct a body of students in a manner that fosters continuous study and life-long learning.

Agarwal’s (2000) research finds that the antecedents to individual acceptance of IT are direct interpersonal interventions (e.g., faculty interventions), social influences, and situational influences. We expect our research to provide significant insights into the use of these antecedents as influencers of behavior within a population dominated by African-American students, but that the findings of the research can be extended to other minority populations that are underrepresented in the IT workforce as well (e.g., women, Hispanics, Native Americans, and the disabled). Although our pilot study only examined student acceptances of IT, we also expect that faculty interventions would be bi-directional; as teachers change their beliefs to influence the beliefs of students, the learning opportunities will reciprocate and increase technological competencies within the faculty. Based on these expectations, the following general questions are relevant:

1. What change can we observe in the attitudes and beliefs of Business students who are intensively exposed to IT knowledge and resources in nontraditional IT courses?
2. Is there an observable change in the attitudes and beliefs of students who are not exposed to such IT intensive courses?
3. Is there an observable change in students’ integration of IT knowledge and resources in courses that traditionally do not involve IT?
4. How does training and exposure to IT change the attitudes and beliefs of participating faculty?
5. How do the attitudes and beliefs of non-participating faculty change with respect to IT?
6. Do employers observe a difference in IT readiness and proficiency of students exposed to IT intensive courses and students who have not had such exposure?

## **Literature Review**

Information systems research has investigated individual responses to computer technology from a variety of theoretical perspectives. Works examine the relationship using Diffusion of Innovations (Rogers, 1995; Compeau and Meister, 1997; Moore and Benbasat, 1991), the Technology Acceptance Model (Agarwal & Prasad, 1999; Davis, Bagozzi, and Warshaw, 1989;

Venkatesh & Davis, 1996), the Theory of Planned Behavior (Mathieson, 1991; Taylor & Todd, 1995) and Social Cognitive Theory (Compeau & Higgins, 1995a, 1995b). Each of the theories views the responses of individuals to the use of technology as the result of a set of beliefs about the technology. While each theory reflects a cognitive basis for behavior, the Technology Acceptance Model (TAM) and Social Cognitive Theory (SCT) are salient to this study. TAM is particularly important to this research because of its premise that social influences and belief structures affect acceptance and diffusion of innovations in communities (Rogers, 1995). SCT is useful in explaining the integral relationships between cognitive factors and individual behavior, and the prominence the theory gives to the concept of self-efficacy (Bandura, 1986).

### ***Technology Acceptance Model***

As researchers examine practical approaches for developing a more diverse IT workforce, one challenge that is recurrent in the literature involves the role of individual differences in the adaptation of new technologies. Kwon & Zmud (1987) reviewed varying research models pertaining to the implementation of information systems, and concluded that user motivation and capabilities are important determinants of success. Agarwal & Prasad (1999) observe, however, that while many studies find that specific individual difference variables are “germane influences on the implementation of a new IT” (p. 364), few studies examine the processes by which individual differences influence IT success.

Agarwal & Prasad (1999) describe the technology acceptance model as a parsimonious and theoretically grounded conceptualization that is useful in explaining and predicting individual behaviors toward information systems. According to this model, beliefs or perceptions act as mediating variables in the relationship between individual differences and IT acceptance. The researchers state that one implication that can be inferred from the model is that rather than focusing on individual differences, managers can “proactively [act to] influence beliefs directly through...broad-based information dissemination” (p. 363), which is the essence of this study.

Agarwal & Prasad’s (1999) empirical study of 230 information technology users from a Midwestern *Fortune* 100 corporation confirms the mediating role of beliefs (i.e., perceptions regarding technology usefulness and ease of use) as a predictor of technology usage. Further, a broader implication that emerges from the study relates to the tangential finding as to the importance of an environment that supports organizational learning. The authors note that “learning is critical to technology acceptance” (p. 385) and suggest the need for a work climate that encourages and rewards self-learning. While other authors discussed the relationship between technology acceptance and learning *theoretically* (Zmud, 1982; Rogers, 1995), Agarwal & Prasad’s (1999) *empirical* findings advance our awareness of the issue and support the need for extended study of this relationship.

### ***Social Cognitive Theory***

Social Cognitive Theory (SCT) is a widely accepted and empirically validated model of individual behavior (Bandura 1977, 1986). The theory’s premise is that environmental influences (e.g., social pressures), cognitive and personal factors (e.g., personality and demographic characteristics), and behavior are reciprocally determined (Compeau & Higgins, 1995). The reciprocal relationship suggests that individuals make choices (e.g., about their environment), and they are also influenced by these choices. In describing SCT, Bandura (1986) advances two notions, *outcome expectations and self-efficacy*, as the major cognitive forces guiding individual behavior.

The concept of outcome expectations posits that individuals will be more likely to engage in behaviors if they believe the outcome will be valued. What the individual is seeking through valued outcomes is some level of personal control regarding the benefits associated with changing a behavior (e.g., Will the action favorably affect my career or academic progress?). Self-efficacy, or the personal judgments one makes about their ability to perform a specific task (Bandura 1986), influences an individual’s choice about which behaviors they will undertake. The linkage between outcomes and self-efficacy recognizes that if one doubts his or her ability to accomplish an action, even positive expectations as to the value of the outcome will not motivate active participation in the endeavor.

Applying SCT to technology usage, Compeau, Higgins, & Huff (1999) state that an individual’s self-efficacy and personal perceptions regarding the value of the outcome are critical to their decisions about whether, and to what extent, to use technology. Noting the tight linkage between outcomes and self-efficacy, the researchers comment that even when one believes the outcome is worthy, they still will not undertake the necessary learning required to change a behavior if they perceive that they lack the ability to perform the task. Compeau, et al. (1999) asserts that it is insufficient to anticipate a changed behavior in the adoption and use of technologies by simply offering individuals a well-reasoned argument regarding its merits. *Changed behavior must*

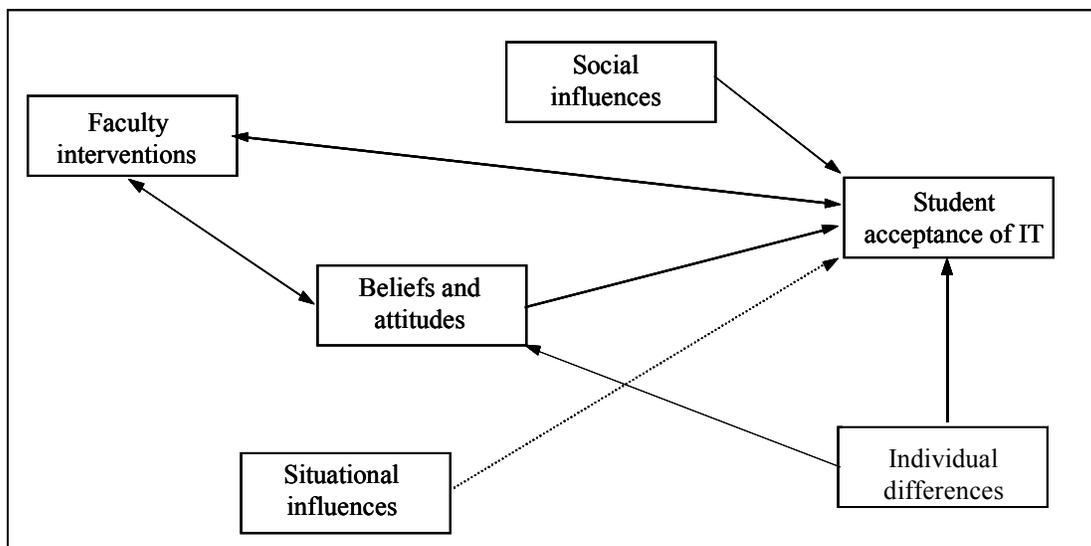
also be motivated through “coaching, teaching, and encouraging individuals to ensure that they have the requisite skills and confidence in their skills to be successful in their use” (p. 146).

Compeau, et al. (1999) tested the influence of computer self-efficacy, outcome expectations, affect, and anxiety on computer usage. The study used longitudinal data gathered from 394 end-users over a one-year interval. Findings from the study indicate a significant and predictive relationship between self-efficacy and computer usage, and the relationship was supported over a two-year period. With respect to outcome expectations predicting computer usage, the authors found a high correlation between expectations and usage. However, over the two-year period, the direct relationship between these two variables was slightly negative. Consistent with other expectation research (Ginzberg, 1981; Marcolin, 1994), Compeau, et al. (1999) found that when the expectations of participants about the benefits of technology were unrealistic (i.e., expected promotion, salary increase) users tended to be less satisfied and used the technology less than individuals with more realistic expectations. Using the longitudinal data, the authors found that persons who had expectations regarding financial rewards and increases in status in year one, had by year two, become disillusioned with those expectations, and that added information led to negative opinions about the use of technology. Otherwise, the model was supported, and persons with high beliefs about the personal benefit of technology indeed were more likely to use the technology.

SCT transfers readily to the goals for this study and for the challenge of increasing minority participation in the IT workforce. We believe that the process will encourage greater student use of technology, and further, give these students the confidence to seek employment opportunities in IT related business environments.

**Theoretical Model**

The theoretical model (Figure 1) as adapted from Agarwal (2000) guides our research. We examined whether changes in pedagogical approach influenced students to improve use and familiarity with information technology, and whether this effort influences a subsequent likelihood of choosing an IT-related career. Incorporating variables associated with social cognitive theory, the model indicates that social influences, situational influences, and beliefs and attitudes directly motivate student acceptance of IT. Further, beliefs and attitudes are shown to be a function of faculty interventions within the target (i.e., student) population. Although TAM postulates that individual differences have an indirect effect on the acceptance of IT, a significant body of literature in diffusion of innovations (Rogers, 1995) supports a simultaneous direct effect. The model used in this study includes indirect and direct effects of individual differences on IT acceptance. The diversity of the population with respect to gender, socio-economic status, and to a lesser extent age and ethnicity, should extend our knowledge of individual differences and the direct and indirect effects of such differences on IT acceptance.



**Figure 1. Theoretical Model (adapted from Agarwal, 2000)**

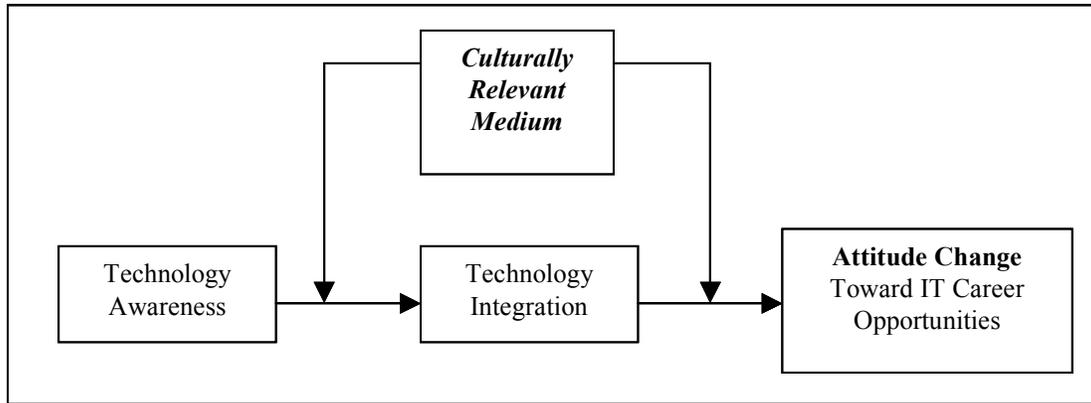


Figure 2. Research Model

### Research Model

Classic organizational change theory indicates that successful change is achieved through a three-step process of *unfreezing, moving, and refreezing* (Lewin, 1951). Non-emphasis of technological knowledge and resources in traditional business functional courses represents the status quo, or equilibrium state. Unfreezing this state of equilibrium requires that faculty and students embrace a different model of instruction and learning - one in which IT resources and knowledge is integral in course information delivery. The unfreezing stage of Lewin's (1951) model corresponds to the *technology awareness* variable. The moving stage, in which we introduce a culturally relevant project, corresponds to the *technology integration* variable. Finally, the refreezing stage corresponds to the students' *attitude change* regarding IT opportunities. As the research model proposes, technology awareness impacts technology use when moderated by the intervention of a culturally relevant medium. Continued use of this medium impacts IT career opportunities, as measured by changes in attitude. The research model is presented in Figure 2.

### Research Design

Hammond (1995) notes several programs that are designed to increase the number of African-American professors, including the Florida Education Fund (formerly the McKnight Foundation), the PhD Project, and other programs under the auspices of the Ford Foundation and the AICPA. These programs were effective at increasing the numbers of underrepresented minorities in graduate programs, and particularly in the sciences and computer technology fields. The work presented here extends the idea that similar curriculum interventions could also be effective at the undergraduate level. It is important to perform research on this possibility since these students will likely comprise a significant portion of the IT workforce. To this end, we examined several undergraduate courses in our study, which introduced a culturally relevant medium/project that changed the way the courses are traditionally taught. The projects focused on timely and significant events and needs in the IT industry.

The courses studied included students from sophomore to senior level and crossed all business functions. The courses were of three groups and included projects that focused on information systems and technology uses. Specifically, the courses involved were: (1) two sections of an introductory MIS course for business students, as well as other majors, that introduces students to MIS concepts and functions in organizations; (2) two team-based MIS courses that were co-developed simulating one function of an Enterprise System; and (3) a cross-functional effort involving two senior level courses for non-MIS majors.

#### 1. Introductory MIS Course

This course is required for all business majors; it is also one of the suggested electives for computer science majors. The course is an introduction to management information systems and its uses and impact on organizations. General MIS concepts are discussed, culminating in a project involving current technology trends. Since the late nineties, the course project followed the rise and fall of the dot-com industry and e-commerce issues in general, as well as traditional firms' integration of IT processes such as data mining, CRM, and outsourcing.

## 2. Enterprise Systems Simulation

### Advanced Programming for Business Systems

This course presents object-oriented and procedural software engineering methodologies for data definition and measurement, data construction, and data use in developing screen editors, reports and other information systems applications. The language used was Visual Basic. Students designed the front end for a payroll system as part of a human resources function of an Enterprise Systems (ES).

### Database Applications

This course covers information system design and implementation with a database management systems environment. Students designed business applications using Oracle. The course project for this class was the datamart, which was co-developed with the Advanced Programming course to simulate the back-end of the payroll system in the human resources function.

These two courses are required for MIS majors and are taught during the same semester. Approximately 90% of the students are registered for both courses.

## 3. Cross-functional Project

### Organizational Theory

This course examines the underlying managerial concepts of open systems, organizational contingencies, conflict, and technology. Emphasis is placed on organizational design, authority, structure and effectiveness. The course is required for management majors and may serve as a business elective for finance and marketing majors.

### Business Information Systems

This course is case-based and involves the discussion and evaluation of challenges of managing in an information age, information technology and strategy, and managing information assets. This course is required for business education majors and may serve as a business elective for other majors.

We recognized the overlap of business concepts covered in both courses and saw an opportunity to introduce a relevant medium/project that would increase students' understanding of business theories and issues and the integral role of IT in creating sustained competitive advantage for organizations. Students researched the Napster case - one that encompasses key business issues such as critical technology (peer-to-peer), management concepts, organizational strategy, and legal and ethical questions. This case proved a great fit between the courses, in which students were able to understand the cross functional aspects of business.

In our study, we examined the following research questions to determine if the introduction of projects that were relevant to MIS majors and non-majors would change their attitudes and enhance their knowledge of the career options in the IT arena. Our results were collected through open-ended questions and focus group discussions.

1. What change can we observe in the attitudes and beliefs of Business students who are intensively exposed to IT knowledge and resources in nontraditional and traditional IT courses?
2. Is there an observable change in students' integration of IT knowledge and resources in courses that traditionally do not involve IT?

## Results and Implications

Results of the study to date indicate that students appreciate the technological influence on business decisions and their knowledge of this subject was significantly enhanced. The relevance of the project subject matter made a difference at each academic level - sophomores were able to use the outcomes of these classes in other courses and more senior level students were able to envision direct career applications. The relevant projects changed students' attitudes toward the work of persons in the IT field, inasmuch as students now realize that there are many possibilities for business careers that involve direct IT applications. Students can now see the integration of IT in the more focused business functions and value technological issues such as the effect of outsourcing, CRM, data mining, and privacy and security on organizations.

Graduates seeking employment know the importance of having critical IT skills. Garcia & Giles (2000) recently reported that “graduates are facing the fact that being IT-enabled or computer literate has evolved from being a ‘plus’, to being a ‘requirement’, and will become an ‘assumption’” (p. 40). The authors note that computer science, computer engineering, and management information systems degrees are critical to meeting the IT demands of society, but they also state that as we seek to include all social groups and races in an IT dominated society, the effort must encompass a multi-disciplinary approach. Specifically, Garcia & Giles (2000) state that “current curricula will have to incorporate [IT] into all programs” (p.47).

The present study addresses the issue of integrating IT into the core curriculum and reducing the under-representation of minorities in the IT workforce. We have proposed the development of an instructional delivery process that examines how teachers, through the beliefs and attitudes they impart in the classroom, can influence underrepresented groups to pursue IT related careers. The introduction of IT intensive courses into the core business curriculum is expected to offer students the opportunity to engage in a process of learning that will be applicable to coursework in every major, and will prepare business students for IT-based careers and/or graduate study. As instructors express their enthusiasm for the subject matter and engage the students in the long-term relevance of course content (Stanford University, 1998; Lester & White, 2000), Schiefele (1991) suggests that students will strive for high levels of performance and exhibit an intrinsic motivation for the subject.

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