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Chapter II

Gender and the Information Technology Workforce:
Issues of Theory and Practice[1]

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Abstract

Despite increases of women in the labor force, females are largely under-represented in the American IT workforce. Among the challenges that managers face in addressing the under representation of women in the IT workforce is the identification of an appropriate theory as a basis for understanding data about gender and IT in order to reverse the gender imbalance. Hence, the purpose of this chapter is to demonstrate the managerial implications of theory choice when addressing the under representation of women in the IT workforce. We provide an overview of the three main theoretical perspectives, the essentialist theory, the social construction theory, *and* the individual differences theory of gender and IT, *which are used to understand and investigate the IT gender gap. We then make the argument that the essentialist and social construction theories do*

not provide the analytical robustness required to pay attention to more nuanced managerial recommendations. Finally, we demonstrate how the individual differences theory of gender and IT can significantly contribute to the reconfiguration of analytical knowledge of the IT gender gap and spur innovative management policies.

Introduction

The explosion of the Internet has transformed and revolutionized the information technology (IT) workforce. The IT workforce has also become a large component of the world's economy and researching the composition and predicting the direction of the industry is an important matter for discussion. In addition, organizations and managers strive to identify ways to foster a business climate that encourages successful participation in the information economy. Therefore, researching, measuring, and evaluating the IT workforce are of growing importance.

Unfortunately, women are largely under represented in the American IT workforce, a phenomenon typically termed the IT gender gap. This female under representation in technical careers has gained the attention of researchers who have concluded that women are alarmingly under represented in the IT workforce, despite the recent growth of female workers in the American labor force. Thus, those concerned with managing IT professionals are faced with the task of recruiting, motivating, and retaining the necessary personnel to meet the current and future demands of the information age while promoting greater diversity and equality within the field.

Among the challenges that managers face in addressing the under representation of women in the IT workforce is the identification of an appropriate theory as a basis for understanding data about gender and IT, so as to reverse the gender imbalance. Hence, the purpose of this chapter is to demonstrate the managerial implications of theory choice when addressing the under representation of women in the IT workforce. We begin with a brief background on the under representation of women in the IT workforce. Next, we provide an overview of three theories used to understand and explain the IT gender gap: (1) the essentialist theory; (2) the social construction theory; and (3) the individual differences theory of gender and IT. In this discussion, we demonstrate how these theoretical foundations serve as a lens for interpretation and recommendations to address the IT gender gap. We then make the argument that the essentialist and social construction theories do not provide the analytical robustness required to pay attention to more nuanced managerial recommenda-

tions. Next, we demonstrate how the individual differences theory of gender and IT can significantly contribute to the reconfiguration of analytical knowledge of the IT gender gap and spur innovative management policies. Evidence of these contributions are drawn from research projects conducted in Australia and New Zealand (Trauth, 2002; Trauth, Nielsen, & von Hellens, 2000; Trauth, Nielsen, & von Hellens, 2003), Ireland (Trauth, 1995, 2000, 2004) and the United States (Morgan, Quesenberry, & Trauth, 2004; Quesenberry & Trauth, 2005; Quesenberry, Morgan, & Trauth, 2004; Quesenberry, Trauth, & Morgan, 2006; Trauth & Quesenberry, 2005; Trauth, Huang, Morgan, & Quesenberry, 2006; Trauth, Quesenberry, & Morgan, 2004; Trauth, Quesenberry, & Yeo, 2005).

Background

The historical under representation of women in IT disciplines has been an area of study for many years and researchers have concluded that women are alarmingly under represented in the IT workforce (Arnold & Niederman, 2001; Crawford, 2001; Nielsen, von Hellens, Greenhill, & Pringle, 1997; Sumner & Werner, 2001; von Hellens & Nielsen, 2001). The Information Technology Association of America (ITAA) shows that over time there has also been a decline in the participation rates of women in the US IT workforce. For example, in 1996, women represented 41% of the American IT workforce, in 2002, they represented 34.9%, and in 2004, they represented only 32.4% (ITAA, 2003, 2005). Yet, during the same periods, the percentage of women in all U.S. occupations was approximately half of the labor force (Bureau of Labor Statistics, 2005). The amount of women in the IT workforce has also declined in Canada over the last decade from 28% in 2001 to 25% in 2003 (Downie, Dryburgh, McMullin, & Ranson, 2004). In Europe, the Workforce Aging in the New Economy project (2004) found that the IT downturn in the late 1990s led to more sustained job losses for women than men. For example, in the UK and Germany, men outnumber women five to one in IT professions; in the Netherlands it is seven to one. Furthermore, in 2001, only 22% of the Australia IT workforce was comprised of women (Trauth et al., 2006).

The reason for the under representation of women in the IT workforce is a complex and challenging area of study because no single factor can be identified as the root cause. In addition, Adam, Howcroft, and Richardson (2002) explain that the topic of gender and IT is just beginning to surface and it is thus important to understand the gender dimensions being considered in current research. Therefore, selecting a robust theoretical perspective is critical in order to understand and formulate recommendations that address the IT gender gap.

Main Thrust of This Chapter

Currently, the gender and IT workforce literature is dominated by three main theories and includes: the *essentialist* theory, the *social construction* theory, and the *individual differences theory of gender and IT*. The remainder of this section provides an overview of each theory and demonstrates how each perspective influences managerial recommendations.

The Essentialist Theory

The essentialist theory is based on the assertion of fixed, unified, and opposed female and male natures (Trauth, 2002; Trauth et al., 2004; Wajcman, 1991). The explicit biological difference between the sexes has led to a typical assumption that other observed differences between men and women are also due to biological determinates (Marini, 1990). Thus, biological influences precede cultural influences and set predetermined limits to the effect of culture (De Cecco & Elia, 1993). With regard to IT gender gap research, the essentialist theory uses biological differences between men and women to explain differences in their relationship to technology. Any difference in male or female behavior is believed to be inherent, fixed, group-level and based upon bio-psychological characteristics.[2] These studies conclude that men, as a group, make decisions about technology based upon different criteria than women do as a group (Trauth, 2002; Trauth et al., 2004).

Gender and IT research with an essentialist theoretical foundation views gender as a fixed variable that is typically manipulated within a positivist epistemology[3] (e.g., Dennis, Kiney, & Hung, 1999; Gefen & Straub, 1997; Venkatesh & Morris, 2000). In this research, people are divided into the two separate groups of male and female who have different or opposing inherent psychological characteristics. Furthermore, these psychological characteristics affect their relationship to or their adoption of technology. Adam, Howcroft, and Richardson (2001) argue that the essentialist theory places too much focus on psychology at the cost of examining individual gender characteristics. Thus, this perspective does not account for the influence of context because it adopts a determinist stance of gender traits and preferences (Trauth, 2002; Trauth et al., 2004).

The essentialist theory also influences subsequent managerial recommendations by suggesting that men and women should be treated differently with regard to IT. An extrapolation of this notion to IT workforce considerations is that there should to be two different workforces: a female IT workforce and a male IT workforce. Thus, as Trauth has said elsewhere "policies for addressing the gender imbalance would focus on assumed inherent differences between women

and men and the equality issue would focus on 'separate but equal'" (Trauth, 2002, p. 101). The following briefly describes three examples of such research:

- Gefen and Straub (1997) argue that men and women inherently differ in their perceptions of email usage. In doing so, the authors extend the technology acceptance model (TAM) to account for differences in technology acceptance and usage by gender. The authors recommend that new communications environments should be created that account for gender differences by employing different media and training for men and women.

- Venkatesh and Morris (2000) utilize TAM to demonstrate how gender can be used as a moderator of technology. Their research examines mean differences between women and men in terms of abilities, traits, and psychological constructs. Venkatesh, Morris, and Ackerman conclude that women and men process information and make decisions about technology usage in very different ways. Therefore, managers implementing new technologies must consider acceptance and usage needs as applicable by gender.

- Venkatesh, Morris, and Ackerman (2000) investigate how gender differences influence technology adoption and sustainability and recommend that marketing and training should account for these differences. Specifically, productivity-enhancement factors (i.e., usage) should be emphasized for men and balanced factors (i.e., support and claims by peers) for women.

It can be argued that one of the most important outcomes that have arisen from the essentialist stream of gender and IT research is the attention the topic has received in the information system (IS) discourse. For instance, *MIS Quarterly*, a top IS journal, typically did not publish research on gender issues of IT prior to the late 1990s. Yet, two major articles appeared in the journal: Gefen and Straub (1997) and Venkatesh and Morris (2000). Although, these studies dichotomize people by gender, they begin to demonstrate the need for robust investigations of human characteristics in order to provide more nuanced findings and recommendations for interventions and/or policy changes.

The Social Construction Theory

Marini (1990) explains that the existence of historical and cross-cultural variation in gender role differentiation and stratification provides strong evidence that biological differences do not fully account for differences between the sexes. For instance, employment segregation, or division of labor by sex, differs by

culture and society and changes over time. Marini highlights the labor force differences between communist and democratic societies and the changes in the gender segregation in U.S. labor force during World War II. These changes in cultural and temporal views about women working demonstrate that their absence or presence in male-dominated careers is due to social constraints rather than biological forces. Hence, as an alternative to the essentialist perspective, the social construction theory argues that human outcomes cannot be fully understood by biological factors. Rather, these outcomes must be explained from a socio-cultural formation perspective (Berger & Luckmann, 1966). According to this theory, societal factors, instead of biological forces, are the primary constructs that shape individuals and their relationship to IT (Marini, 1990). Hence, IT has been socially shaped as "men's work" something that, places IT careers outside the female domain (Trauth, 2002; Trauth et al., 2004).

In gender and IT literature, the social construction theory tends to reflect an interpretive epistemology as a lens to investigate the IT gender gap phenomenon. In this sense, gender is broadly viewed as two separate groups of men and women who are affected by different sets of sociological influences. Hence, men and women are viewed as having different or opposing socio-cultural characteristics, which subsequently affect their relationship to and adoption of technology. As Trauth (2002) has argued, the social construction theory can be problematic because "the message is that women in the IT profession, as a group, are different from men, as a group, in the profession, albeit for sociological rather than biological or psychological reasons" (p. 102). In this sense, the social construction theory is a robust perspective as it accounts for a range of social influences and messages women receive in a given context. Yet, the focus on monolithic societal messages makes it challenging to investigate the diversity of people. Men and women as groups do not receive or respond to societal messages in the same way.

The majority of gender and technology research (e.g., Cockburn, 1983, 1985, 1988; Cockburn & Ormrod, 1993; Wajcman, 1991) and gender and IT research (e.g., Adam, Emms, Green, & Owen, 1994; Balka & Smith, 2000; Eriksson, Kitchenham, & Tijdens, 1991; Lovegrove & Segal, 1991; Slyke, Comunale, & Belanger, 2002; Spender, 1995; Star, 1995; Webster, 1996) utilize the social construction theory, rather than a biological or psychological theory (Trauth, 2002; Trauth et al., 2004). These studies typically result in two types of managerial recommendations for addressing the IT gender gap. One recommendation is to assimilate women into IT education and professions by helping them to fit into a male domain (e.g., Nielsen, von Hellens, Greenhill, & Pringle, 1997; Nielsen, von Hellens, Greenhill, & Pringle, 1998; Nielsen, von Hellens, Pringle, & Greenhill, 1999; Nielsen, von Hellens, & Wong, 2000; Pringle, Nielsen, von Hellens, Greenhill, & Parfitt, 2000; von Hellens & Nielsen, 2001; von Hellens, Pringle, Nielsen, & Greenhill, 2000; von Hellens, Nielsen, & Trauth 2001). The

second recommendation focuses on the call to reconstruct the world of computing to become more of a "female domain" (e.g., Spender, 1995; Webster, 1996). The following briefly describes three examples of such research:

- Joshi, Schmidt, and Kuhn (2003) found that negative stereotypes of the IT workforce permeate images and conceptions held by both men and women. Specifically, the authors found that the IT workforce is plagued with stereotypical images of IT employees who only sit in front of a computer all day, workers who are nerds or geeks, and other stereotypes including that all IT employees wear glasses. Unfortunately, the stereotypic images of the IT field do not fade away once students are informed about IT careers. These influences can be subtle, but create a difference in how women see IT and imagine their roles within it. As a result, the authors recommend that actions be taken to remove or reduce the pervasiveness of negative stereotypes of the IT workforce.

- Nielsen et al. (2000) conducted an interpretive investigation of learning organizations and found that the learning environment influences subsequent skills development. The authors recommend that masculine values of learning organization be expanded, so that female students can negotiate the environment.

- Balcita, Carver, and Soffa (2002) found that the under representation of women in the IT workforce creates a lack of female mentors and role models. As women look for support through mentoring, role models or social support they are typically disappointed. Without the much needed encouragement and guidance of co-workers of their own gender, women are left in search of support. As a result, the authors recommend efforts be taken to produce additional female mentors and role models.

A number of important findings have come from social construction research primarily by understanding and recommending ways to achieve greater social inclusion. A number of findings have recommended ways in which women can more easily fit into the IT workforce. For instance, research has suggested that support structures, such as mentors (e.g., Townsend, 2002), support groups (e.g., Ahuja, Robinson, Herring, & Ogan, 2004) and role models (e.g., Cohoon, 2001, 2002), are of extreme importance. In addition, positive societal message about women working and women working in technical careers are important in closing the IT gender gap (e.g., Joshi et al., 2003; von Hellens et al., 2001, 2000). A number of other findings have suggested that the domain of IT work should be adapted to more easily accommodate diverse employees including women. In this sense, Webster (1996) and Wajcman (2000) focus on the social shaping of

female gender identity and the implication for women's relationship to workplace technologies. Furthermore, Spender (1995) offers another perspective based on the analysis of women as a social group in cyberspace and predicts that an influx of female values into the cyberspace virtual world will accompany an increased female presence (Trauth et al., 2004).

The Individual Differences Theory of Gender and IT

The notion that individual differences causes differences in human behavior is not new to IT research (Couger, Zawicki, & Oppermann, 1979; Jago & Scammel, 1982; Jiang, Klein, & Pick, 1996; Zmud, 1979), however researchers have only recently begun to examine individual differences with respect to gender and IT. At the forefront of this research are Trauth's studies of the individual difference theory of gender and IT (Trauth, 2002; Trauth et al., 2004) which rejects essentialism and offers refinement of various under-explored areas of the social construction theory. This refinement is accomplished by focusing on an individual level of analysis while understanding that the skills needed to enter or to be successful in IT workforce span the gender continuum. More specifically, the theory examines the individual variations across genders as a result of both personal characteristics and environmental influences in order to understand the participation of women in the IT profession. Hence, the focus is on differences *within* rather than *between* genders. The theory also examines women as individuals who possess different technical talents and inclinations and respond to social shaping in unique and particular ways.

According to this theory, the individual differences believed most relevant to gender and IT are grouped into three classes: personal data, shaping and influencing factors and environmental context (Trauth et al., 2004) (see Table 1). Personal data includes: demographic data (such as age, race and ethnicity), lifestyle data (such as socio-economic class and parenting status), and work-place data (such as job title and technical level). Shaping and influencing factors include personal characteristics (such as educational background, personality traits, and abilities) and personal influences (such as mentors, role models, experiences with computing, and other significant life experiences). Environmental context includes cultural attitudes and values (such as attitudes about IT and/or women), geographic data (about the location of work) and economic and policy data (about the region in which a woman works). Collectively these constructs contribute to the differences among women in the ways they experience and respond to characteristics of IT work, the IT workplace, and societal messages about women and IT.

To date, the individual differences theory of gender and IT has reflected an interpretive epistemology as a lens to investigate the IT gender gap phenomena.

Table 1. Constructs of the individual differences theory of gender and IT (Trauth et al., 2004)

High Level Construct	Sub Category Construct
Personal data	Demographics Lifestyle Workplace
Shaping and influencing factors	Personal characteristics Personal influences
Environmental context	Cultural attitudes and values Geographic data Economic data Policy data

Individual characteristics cross genders and combine with sociological influences to affect an individual's particular relationship to IT. As Trauth (Trauth, 2002; Trauth et al., 2004) explains, gender-based characteristics are not assigned to a group level; rather they are applied or challenged at an individual level when appropriate. Thus, not all women react in similar ways to technology. According to this theory, women, as individuals, experience a range of different socio-cultural influences, which shape their inclinations to participate in the IT profession in a variety of ways.

As previously mentioned, to date the individual difference theory of gender and IT is being developed through qualitative studies conducted in Australia/New Zealand, Ireland, and the United States. Data collection methods employed in these research projects include: in-depth, face-to-face interviews with female practitioners and academics, behavioral observations of the participants, and document analysis of the regions in which they live and work. The interview length ranges from 60 and 120 minutes, although the majority of interviews are approximately 90 minutes in length. Interviews are held in private meeting spaces with the interviewer and the interviewee. Generally, the interviews are held in the interviewee's place of employment, but upon request, the interviews are occasionally held in alternative locations such as interviewee's home or off-site meeting facilities.

In terms of managerial recommendations, the individual differences theory of gender and IT has been applied to a number of themes. The following briefly describes three examples of such research:

- Morgan et al. (2004) investigated how women in the IT profession are affected by and relate to predominately male informal social networks. These social networks are important for information sharing in a less formal setting, and to establish and build trust in personal relationships. The

research presented a conceptual framework to explain the reactions and strategies with respect to the network that women employ for continued participation in the IT profession. The framework illustrated the experiences of both "insiders" and "outsiders" to the network. The analysis demonstrated that women respond to exclusion from the network in a variety of ways, depending upon environments, personalities, and responsibilities. The findings recommend that organizational social networking barriers be examined and removed and programs be implemented to increase the number of female role models and mentors.

- Quesenberry et al. (2004, 2006) investigated the role of balancing work-family issues in the IT profession and the connection between these issues and the under representation of women in technical careers. This research presented a framework for analyzing work-family balance to show the range of ways in which work-family considerations influence women's IT career decisions. The findings illustrated an identifiable theme that crosses geographical regions and timeframes: societal messages are complex and difficult to digest, and are processed in different ways by different women. Yet, these messages contribute to the decisions women make about their professional and personal lives. Consequently, more innovative work-life programs should be introduced such as flexible work arrangements, part-time employment, and return to work training programs that take into account the variety of work-family issues that women confront.

- Trauth et al. (2005) analyzed the role of environmental context in the under representation of women in the IT workforce in order to strengthen the environmental construct of the individual differences theory of gender and IT. The results suggested that economic factors (e.g., size of the information economy, household income, and cost of living) and cultural factors (e.g., attitudes and values regarding women, women working and women working in IT) exert an influence on the experience of women in the IT profession. These findings bolster an argument in favor of looking beyond the data at hand, to the women *in context* and recommend considering regional influences in organizational decision making.

To date, these empirical studies have focused on an improved understanding of the under representation of women in the IT workforce by supporting the individual differences theory of gender and IT. A major contribution of this research is the recognition that not all women are the same and hence, experience different influences and react to the same influences differently. Thus, management practices toward women should not stereotype or generalize to a holistic group of women. Another contribution of the individual differences theory of gender and IT is that it offers an alternative viewpoint on gender and

IT by allowing for the examination of individual variation among women. In this sense, this research is investigating the IT gender gap from a fresh theoretical perspective.

Implications for Research

The essentialist and social construction theories have several shortcomings with regard to the robustness of the perspective. The essentialist theory has been roundly criticized and rejected in the burgeoning literature on gender and technology (Cockburn, 1983, 1985; Wajcman, 1991, 2000). Adam et al. (2002) argue that an essentialist perspective dichotomize males and females by relying on stereotypical characteristics. Whereas, the social construction theory has been criticized as it tends to depict individuals as empty organisms that are filled and shaped by society and consequently under emphasizes the role of conscious-ness or intention (De Cecco & Elia, 1993). In this sense, the shaping of people's beliefs about gender operates at a group level and as a result, influences the choices of all men or women in the same ways.

It can also be argued that the essentialist and social construction theories view gender and technology as fixed. Both theories assume that women in the IT profession, as a group, are different from men, as a group, either for biological, psychological, or sociological reasons. This suggests a gap in the theoretical options available for analyzing gender and IT (Trauth et al., 2004) with regard to postmodernist thoughts of Haraway and Butler and the argument that there is no "universal woman." Women do not constitute a tightly knit group with common interests, backgrounds, values, behaviors, and mannerisms, but rather have come from a range of classes, races, sexual orientations, geographic locations, and generations. As a result, women as a group have experienced a range of challenges in their history, needs, and aspirations. Therefore, more cross-cultural comparisons are needed that examine a range of diverse factors such as social, economic, institutional, cultural, and political aspects and their role in encouraging or discouraging women from participating in science (Schiebinger, 1999).

The individual differences theory of gender and IT promises to contribute to the reconfiguration of analytical knowledge of the IT gender gap and spur innovative management policies for several reasons. First, researchers have stressed the need to think about issues of gender in conjunction with, and not in isolation from, issues of class, race, ethnicity, and sexual orientation, and have forcefully illustrated that differences among women must be understood and theorized in order to avoid essentialist generalizations about "women's problems" (Kvasny, 2003; Naryayan, 1998). The individual difference theory accounts for this

diverse perspective of people and does not generalize individuals by demographic group. Secondly, Adam and Richardson (2001) explain that gender research should emphasize the making of knowledge through the lived experiences of women's lives. This is particularly important because the power structures at play in organizational settings require more detailed analysis than is available in typical approaches. Furthermore, Adam et al. (2002) argue the theoretical need to recognize the role of women's agency (or the ability of women to exert power over themselves) in shaping their position and resisting stereotypical assumptions about their behavior. The individual difference theory of gender and IT is directed at the study of women as individuals including their personal agency and influences in order to gain an in-depth understanding of their experiences.

Implications for Practice

With regard to practice, the under representation of women in the IT workforce limits the diversity of IT products and services (Joshi & Kuhn, 2001; Trauth et al., 2006; Wardle, 2003). Elmuti (2001) argues that being sensitive to a variety of people and having a diverse workforce is beneficial in gaining a competitive edge in the marketplace. Hartenian and Gundmundson (2000) found evidence that diverse workgroups make higher quality decisions, are more creatively motivated and have higher productivity potentials than less diverse groups. In addition, Florida (2002) reports a strong correlation between the most successful high tech economies and diversity indices in a demographic study of the population characteristics of US high tech sectors. Thus, one aspect of developing the IT innovation capacity of an organization is developing the diversity of the local population (Trauth et al., 2006). Addressing the under representation of women in the IT workforce would contribute to a more diverse workforce and thus, more diverse goods and services.

The individual differences theory of gender and IT is centered on a deep understanding of personal and social shaping constructs that influence gender and IT, which subsequently allows for innovative and robust managerial recommendations. Hence, implications for practice include several awareness factors and intervention recommendations. In terms of awareness, it is important that organizations, managers and employees be aware of diversity issues facing the IT workforce. The individual difference theory of gender and IT has been used to explain diversity in the global IT workforce and recommends that managers expand their definition of diversity (Trauth et al., 2006). Furthermore, the individual difference theory of gender and IT demonstrates that there is a range of differences within women as a gender group. Personal factors such as race, age, geographical location, influences, and characteristics shape women at an individual level and thus, make gender generalizations insufficient.

Conclusion

The nature of the IT workforce is diverse due to its integration of concepts from a wide variety of disciplines, such as management information systems, computer science, and engineering. Yet, the actual demographic makeup of the IT workforce does not reflect a diversity of people. The reason for this lack of female diversity is a complex and challenging area of study because no single factor can be identified as the root cause. Therefore, selecting a robust theoretical perspective is critical to understand and formulate recommendations that address the IT gender gap. For these reasons, the goal of this chapter is twofold. First, is to demonstrate how theory choice impacts managerial recommendations that are given to address the IT gender gap. The second is to demonstrate how the individual differences theory of gender and IT, in particular, can significantly contribute to the reconfiguration of analytical knowledge of the IT gender gap and spur innovative management policies. Professionals and academics faced with the task of addressing the IT gender gap must understand the relationship between theoretical perspectives, epistemological assumptions and managerial recommendations, particularly in order to recognize how holistic perspectives, such as the individual differences theory of gender and IT, offers actionable and innovative managerial recommendations.

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Endnotes

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[2]   The essentialist perspective is reflected in the recent remarks of Dr. Lawrence Summers, former President of Harvard, at an academic conference, when he suggested the innate differences between men and women may be the reason why few women succeed in math and science careers (Anita Borg Institute, 2005).

[3]   Epistemology is a theory of knowledge, which specifically delineates how beliefs can be legitimatized as knowledge (Caws, 1967; Harding, 1997; Orlikowski and Baroudi, 1991).