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Using Cross Tabulation and Kendall’s Tau-c in an Effort to Understand Gender Issues of Socio-Technical Systems Development of a Healthcare Informatics Application

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HCI Issues in Healthcare IT

Abstract

The National Institutes of Standard and Technology (NIST) estimates nearly $64 billion dollars is lost annually to failed systems development projects. Failed systems development projects are attributed to lack of implementation, poor planning, and lack of management support, scope creep, and function creep are several identified factors. Various systems development approaches exist. While NIST does not endorse any particular approach, NIST acknowledges that reasons for failed system development projects may be due to lack of user involvement in the development process. One approach that may thwart failed system implementation is sociotechnical systems development. An additional consideration that may affect successful system implementation is gender differences. Research has shown gender is an attribute of system acceptance.
Successful systems development is deemed important in the healthcare community as the Health Insurance Portability and Accountability Act (HIPAA) requires healthcare providers to adopt information technology for better patient care tracking.

In this paper, a sociotechnical systems development approach is discussed. The discussion is grounded in research at a Veterans Affairs facility located in the District of Columbia. In the discussion, review of socio-technical systems development is presented as well as particulars of the featured information system. Cross tabulation using Kendall’s tau-c statistic demonstrates partial outcome of socio-technical development evaluating gender perspective.

Keywords: sociotechnical systems development, medical informatics, healthcare informatics, gender differences
Introduction

The National Institutes of Standard and Technology (NIST) estimates nearly $64 billion dollars is lost annually to failed systems development projects. Failed systems development projects are attributed to lack of implementation, poor planning, and lack of management support, scope creep, and function creep are several identified factors.

Within the next three years, the Health Insurance Portability and Accountability Act of 1996 necessitate medical service providers to adopt a computer system for tracking patient care. Attempts to adopt computer systems to patient care have received tepid reception. Various systems development approaches exist. While NIST does not endorse any particular approach, some of the reasons for failed system development projects may be due to lack of user involvement in the development process, in particular, adherence to gender differences.

In spring 2005, Cedars Sinai Hospital in Los Angeles witnessed physician’s complete denial to use the computer systems. Physicians cited ineffectiveness in providing medical care due to time spent typing information (Ceci, 2005). Numerous other reports citing low productivity when using computer systems in conjunction with patient care are reported in the New York Times, Wall Street Journal, USA Today, the San Francisco Chronicler to name several.

However, at one institution with 116 hospitals, implementation of a comprehensive medical informatics system is operational and has been operational since 1996. Continuous improvements to the system regularly occur. All persons involved in patient care are required to use the system. System adoption and diffusion occurred due to the strong culture and climate of the institution and as a result of user involvement in system development. The system, Computerized Patient Record System (CPRS) is the creation of the Veterans Affairs (VA). Development began in the 1970s with select hospitals involved in the development and subsequently migrated to the entire institution.

The success of this development activity is attributed to sociotechnical systems development. This paper reviews the origin of sociotechnical systems development, provides brief background of the development opportunity at VA, and uses Kendall’s tau-c in cross tabulation to determine whether gender adoption issues are an affect. This will manifest itself in job satisfaction as explained through efficiency and effectiveness research.

Socio-Technical Systems Development

Originally proposed by E. Trist from a behaviorists view of organizational development, socio-technical system development expands on the ideas investigated by Trist and other researchers (Trist and Bamforth, 1951; Emery and Trist, 1960; Emery and Trist, 1965; Trist, 1981). The socio-technical systems development approach applies increased user involvement in the requirements analysis phase of development. This increased user involvement requires an organization with strong culture and climate.
Organizational culture and climate influences how well technology is adopted by employees. In brief, organizational culture and climate impinge on employee’s perception of efficiency and effectiveness depending on whether employees are eased into or forced to adopt technology. Schein wrote that organizational culture is “a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptations and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems” (Schein, 1992). Further research has confirmed that organizational culture impact individual behavior in the organization. Organizational culture distinguishes shared values of individuals within the organization. These values “embody certain assumptions about work, working together, and how things should be done, given a specific context” (Mallak, Lyth, Olson, Ulshafer, and Sardone, 2003). Additionally, culture includes the “traditions, customs, language, and norms that must be learned from the social community” and are specific to the work unit (Mallak, et. al., 2003; Bussey-Jones and Genao, 2003). A strong culture is particularly acute in a hospital setting where healthcare providers are “expected to assume responsibility for member wellness, and they often work as members of collaborative patient-care teams” (Safran and Perreault, 2001) where decisions “must be made expediently to best serve the patient's needs” (Mallak, et. al., 2003). In essence, the culture of an organization motivates and drives the work ethic of the employees. Therefore, culture is broad, deep, and stable and will have several levels that include “artifacts, espoused values, and basic underlying assumptions” (Schein, 1999).

Several factors leading to increased pressure on healthcare providers are:

- the decreasing patient lengths of stay in hospitals in tandem with complexity of patient care after discharge;
- decreased walk-in patient visits resulting in clinicians facing incentives to care for more patients per day;
- new skills requirements of clinicians to provide more information to health executives and managers;
- provisioning of workflow and information systems to manage and inform of healthcare economics (Safran and Perreault, 2001).

Organizational climate is often overlooked as an organizational influence, or frequently bundled into discussion with organization culture. Nevertheless, organizational climate is distinct from organizational culture in that organizational climate affects and has an impact on the individual. “Organizational climate has generally been defined as an individual’s perception of his work environment” (Downey, Hellriegel, and Slocum, 1975) and organizational climate is “how it feels to work in a particular environment and for a particular boss” (Watkin and Hubbard, 2003). Hence, organizational climate will impact an individual’s job satisfaction on a personal and individual level. Downey et al found that “Job satisfaction indicated to be a function of the interaction between the personality characteristics of the individual and the perceived environment (organizational climate)” (Downey, et. al., 1975, p. 153).
Framework for Sociotechnical Development at DC VAMC

Research conducted at a health care setting found that “cultural norms and the nature of the job, were far more important in predicting use of technology than the potential user's perception of likely usefulness or ease of use” (Bangert and Doktor, p. 2, 2002). By removing variables that include usefulness and ease of use from the discussion, the research can directly focus on the impact of how supportive the technology is in allowing healthcare workers to tend to patient care. In this regard, the research sought to understand care providers perceptions of efficiency, effectiveness, and job satisfaction when caring for patients supplemented by use of the CPRS. Following are brief explanations of each of these factors – efficiency, effectiveness, and job satisfaction.

**Efficiency**

The term efficiency is paramount to success of healthcare informatics (Lincoln, 1987; Hammond, 1987; Landro, 2003; Moore, 1996; McGuire and Cooper, 1983). Efficiency refers to the capability of the technology to provide information to the medical personnel so that the medical personnel can better serve the medical needs of the patient. In order to better serve the needs of the patient, the medical personnel must perceive the technology as allowing sufficient time for attending to the patient.

**Effectiveness**

In addition to efficiency, effectiveness is seen as equally important to the “quality of medical care” and its impact on patients (Chen, Bursh, and Zarember, 1975; Hammond, 1987; Landro, 2003; Flagle, 1987; Watkin and Hubbard, 2003). In this research, effectiveness is the perception medical personnel have in their ability to practice better medicine on their patients with the assistance of health informatics.

**Job Satisfaction**

Organizational culture and climate impinge on job satisfaction depending on whether employees are eased or forced into technology adoption. Downey et al found that “Job satisfaction indicated to be a function of the interaction between the personality characteristics of the individual and the perceived environment (organizational climate)” (Downey, Hellriegel, Slocum, 1975:153). Therefore, an “employee's perception of those aspects of their environment that directly impact how well they can do their jobs” (Watkin and Hubbard, 2003:380) will have “specific measurement characteristics” (Watkin and Hubbard, 2003:380).

Earlier research conducted by Stamps and Cruz, they found that assessing physician satisfaction is conducted in one of two ways. One strategy is to direct attention at the physician’s role. Stamps and Cruz found that “to focus on the stress that is inherent in the role definition of physicians” (Stamps and Cruz, 1994:160) is key to understanding physician satisfaction. If a physician experiences high stress an associated low level of job satisfaction is present.
Another strategy for assessing physician job satisfaction, according to Stamps and Cruz is to direct attention at those areas in a physician’s practice that can cause the physician satisfaction or dissatisfaction (Stamps and Cruz, 1994). Several of these areas of potential satisfaction or dissatisfaction for physicians is a threat to physician authority Warren, Weitz, Kulis, 1998:358); work-related outcomes (Barry and Crant, 2000:649); relationship to patients (Warren Weitz, and Kulis, 1998:358); which includes the ability to define and prescribe the best treatment for patients.

In research conducted by Barry, et al, and Kalleberg, these concepts of work related outcomes and relationship to patients were found to be instrumental measurements of job satisfaction (Barry and Crant, 1994; Kalleberg, 1977). Their research in various employment fields is consistent with research conducted by Edwin Locke from 1969 to 1976. Locke found that a worker's level of job satisfaction is a function of the range of specific satisfaction and dissatisfactions that he/she experiences with respect to the various dimensions of work (Locke, 1968; Locke, 1969; Locke, 1976). In this regard, workers will experience variation in job satisfaction and dissatisfaction. Kalleberg found that it is “possible for individuals to balance these specific satisfactions against the specific dissatisfactions and thus to arrive at a composite satisfaction with the job as a whole” (Kalleberg, 1977:126). For example, medical personnel may have effective outcome with regard to patient care but experience poor patient relationship. The effective outcome may be a result of having the medical informatics system available and easy-to-use. However, because so much of healthcare is conducted through support of the medical informatics, the medical personnel may experience poor patient relationship. This is just one example of a dyadic relationship that may exist and for which this research may expose.

Gender Discussion

Previous gender research is presented by Venkatesh and Morris (2000) where the authors examine gender differences in technology acceptance and usage. The outcome of this research is that women are influenced by perceptions of ease of use. Men, on the other hand, identified technology adoption with perceived usefulness.

Venkatesh, Morris, Davis and Davis (2003) revisited this research determining that genders technology acceptance influences stems from socialization rather than biological influences.

Powell and Johnson (1995) found that technology designers ignored gender differences. Nevertheless, Mackrell (2005) found that when all participants are competently trained, no difference exists between male and female users of technology.
Researchers Reddy, Pratt, Dourish, and Shabot (2003) identified three approaches to socio-technical development during the requirements analysis. These three approaches are:

- "Integrating social processes into the existing technical requirements methodology;"
- Involvement users more directly in the design process through methods such as participatory design; and
- Viewing technical requirements as embedded in the work practices of the user” (Reddy, Pratt, Dourish, and Shabot, 2003)."

In order to understand adoption and diffusion of technology in DC VAMC, a discussion of organizational culture and climate is important. As presented earlier, adoption and diffusion of technology by healthcare professionals is reflected by the “institutional attitudes towards information technology” (Moore, 1996).

At the Veterans Affairs District of Columbia Medical Center (DCVAMC), located in Washington, DC, hosts more than ten medical care facilities that include Emergency Room, Pharmaceutical, Mental Health, Medical Care, Surgical Care, and Dentistry, are just a few. Each of these care facilities can have a combination of medical care providers that consists of providers, defined as those persons responsible for overseeing the patient care with prescription authorization; nurses, those persons completing provider’s instructions; and clinician/administrators, those persons that include sociologists, psychologists, pharmacists, as well as clerical. In each care giver classification, several layers of personnel exist. For example, providers include medical doctors, interns, residents, and nurse practitioners. The nursing category includes registered nurses, licensed practical nurses, and nursing assistant. All personnel categories interacting with patients are identified as care providers.

Care providers at DCVAMC have access to patient records. Access is provided at several levels. Providers require access to enter notes, prescriptions, review patient vital signs, and conduct diagnostic related physicals. Nurses require access to review doctor’s notes and react, enter additional notes and information. Clinicians/administrators require access to specify specialty care or schedule appointments.

While access to general patient information is available, some patient information is accessed only by provider and nurse categories. Two such pieces of patient information are pop-up alerts and diagnostic related groups.

Pop-up alerts and diagnostic related groups make providers and nurses aware of specialty needs of patients. For example, if a patient was hospitalized for heart condition, an alert notifies attending provider and nurse to ask specific questions recommended for patients with heart conditions. Similarly, diagnostic related questions for hidden diseases such as diabetes are presented to providers and nurses. These specialty notifications are not necessary to patient care by administrators and some clinicians, and are therefore not presented during a computer session.
Product Development

Veterans Affairs provides a medical care delivery system comprising 172 medical centers, 551 ambulatory and community based clinics, 131 nursing homes, 40 domiciliary (Bubniak, 2000; Ivers, Timson, Blankensee, Whitfield, Keltz, and Pfeil, 1983) in 48 of the 50 United States and territories. Development of “effective use of computer technology to meet the challenges” (http://www1.va.gov/pubaff/histbrf.pdf) of medical care for veterans “has become one of the VA’s major priorities” (McGuire and Cooper, 1983). The VA adopted a technology solution to achieve its mandate to provide health care and benefits to America’s veterans. Part of the technology solution is development of VISN (Veterans Integrated Service Network).

CPRS began as an optional technology enhancement available on demand by the individual Veterans Affairs locations. If a Veterans Affairs location desired to install CPRS, the software and support was free. However, the location must provide the computer system. Over a twenty year period, the software migrated from optional to must-have. All Veterans Affairs centers, including hospitals, assisted living, and other tertiary care centers implemented CPRS. Adoption of CPRS spread to Department of Defense facilities as well.

The Study

Surveys were distributed to 120 participants in three care units at DCVAMC. Of the 120 distributed surveys, 88 were determined evaluable. Of the 88 evaluable completed surveys, 87 responded with gender identification. One respondent chose to not identify their gender. Of the 87 gender respondents, 24 were male and 63 were female.

Over 72% of respondents were female. Early research conducted by Lichenstein indicates most care provider positions responsible for completing patient notes were female. This is due to the high number of females in the nursing profession. Therefore, in understanding whether job satisfaction and perceptions of efficiency and effectiveness are achieved when implementing sociotechnical systems development is determined appropriate.

Two or more questions were asked in categories of job satisfaction, perception of efficiency and perception of effectiveness. A Likert scale of 1 to 6 representing very satisfied to very dissatisfied allowing for not applicable was used. Data collected was ordinal data.

Cross Tabulation and Kendall’s tau-c

Cross tabulation using Kendall’s tau-c statistic evaluated responses to the above category questions. Survey responses used an ordinal scale.
Kendall’s tau-c statistic is used to determine level of concordance and discordance between genders in using the medical informatics system. Kendall's tau-c is similar to gamma yet makes an adjustment for the number of rows and columns and uses the total number of cases rather than just the total number of concordant and discordant pairs as in gamma.
The Kendall’s tau-c statistic shows some discordance in three of the four questions relating gender to job satisfaction when using the medical informatics program. These responses are explored further in the following discussion section.

**Discussion**

With 72% of the respondent population represented by women, the researchers expected to find significance towards job satisfaction when using the system. The results are surprising in that outcomes indicate a level of dissatisfaction with the system.

Venkatesh and Morris (2000) examined gender differences in technology acceptance and usage and found differences exist. The authors learned that women are influenced by perceptions of ease of use while men identified technology adoption with perceived usefulness. Venkatesh, Morris, Davis and Davis (2003) revisited this research and determined that gender technology acceptance influences stems from socialization rather than biological influences. However, Powell and Johnson (1995) found that technology designers ignored gender differences. And finally, Mackrell (2005) learned that given competent technology training both genders are able to perform equally well.

The current research indicates that differences may exist between gender usage of the medical informatics system. Using Kendall’s tau-c statistics the outcome indicates that a number of opportunities exist for improving gender technology acceptance. The institution may engage in gender specific training by providing separate training opportunities for men separate from women. Recognizing Powell and Johnson’s observation that technology development ignores gender differences, the institution might explore the development and design of the product to determine whether gender issues are present.

As Homer R. Warner (1995), a lead researcher in health care/medical informatics stated, “medical informatics is 10% medicine, 10% compute science, and 80% sociology”. It is the sociology of technology acceptance by the work force for which the technology is designed to improve efficiency and effectiveness that may assist in improving and sustaining job satisfaction.

**Conclusion**

This research engaged in understanding whether gender differences exist manifesting itself in job satisfaction measurements when using the medical informatics system. Employees at the institution have used the system since 1996. Based upon previous research presenting gender differences are minimal to non-existent providing competent training is involved and nurturing environment is provided, this research sought through to explore gender issues using ordinal scale. Measurement used was Kendall’s tau-c. A 6-point Likert scale survey was used to collect participant opinions. The results indicate that the institution may be experiencing gender differences in the use of the technology. A proposal to address
gender training and technology development is submitted. Further research is recommended at the institution to determine whether training, technology development, or nurture may be the core of the issue.

References


