

## Exploring the Impact of Analyst Knowledge of Socio-Technical Concepts on Requirements Questionnaires Quality

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Abstract:	<p>Software development is the process of building systems that solve users' need and satisfy stakeholders' objectives. Such needs are determined through a requirements elicitation process which is considered an intensive, complex, and difficult by its nature, and the multi-disciplinary nature of it adds to this complexity. Interviews is the major technique to collect requirements, which consists of many phases, including developing a set of questions. Without proper attention to these phases, the system analysts are likely to 'short-cut' the requirements elicitation process, which in turn affects the completeness and accuracy of the elicited requirements. Following the design science research methodology, we propose a ST process model that can be used to enhances analysts' understanding of the problem domain and help them conduct more effective users' interviews that can be used later on for eliciting more accurate and comprehensive requirements.</p>

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*Emergent Research Forum Papers*

## Introduction

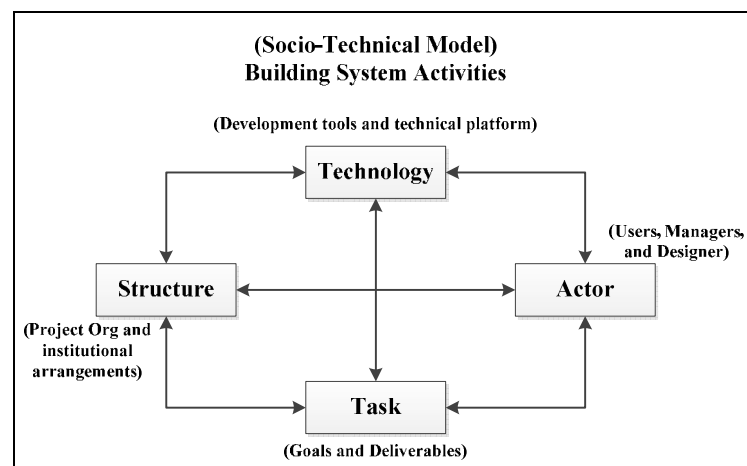
Software development is the process of building systems that solve users' need and satisfy stakeholders objectives (Hickey & Davis, 2004). Such needs are determined through a requirements elicitation process which is considered an intensive, complex, and difficult by its nature (Hickey & Davis, 2003), and the multi-disciplinary nature of it adds to this complexity (Zowghi & Coulin, 2005). In the context of requirements elicitation, interviews is the major technique to collect requirements (Agarwal & Tanniru, 1990; Vitharana, Jain, & Zahedi, 2012). The interview process consists of many phases, including developing the questions (Vasundran, 2012). Without proper attention to these phases, the system analysts are likely to 'short-cut' the requirements elicitation process, which in turn affects the completeness and accuracy of the elicited requirements (Pitts & Browne, 2007).

Following the design science research methodology, we propose a ST process model that can be used to enhances analysts' understanding of the problem domain and help them conduct more effective users' interviews that can be used later on for eliciting more accurate and comprehensive requirements.

## Literature Review

### *Socio-Technical Systems*

Baxter and Sommerville (2011) refer to sociotechnical systems design (STSD) methods as "an approach to design that considers human, social and organizational factors, as well as technical factors in the design of organizational systems". In the context of information systems, a socio-technical system can be modeled as a collection of four components and their connections as shown in Figure 1 (Leavitt, 1964; Lytinen & Newman, 2008).



**Figure 1. Components of a Socio-technical System (Lytinen & Newman, 2008)**

The major imbalances between socio-technical elements in the model are shown as gaps. Gaps are identified for the combinations of the components, namely task-actor, task-structure, task-technology, actor-structure, actor-technology, and structure-technology. The task-actor gaps exist when the identified actors in the model do not understand, do not accept, or cannot carry out any of the identified tasks, task-structure gaps arise when the identified structures are not aligned with any of the identified task or there is no adequate structure that is defined for a given task, task-technology gaps arise when the identified

technology is not adequate to support any of the identified task or it is unreliable or inadequate in its support, actor-technology gaps occur when any of the identified actors do not understand, cannot operate, or do not accept the technology, actor-structure gaps occur when any of the identified actors do not know the operating procedures, do not accept the structure, or are not aligned adequately with the identified structures, and finally, structure-technology gaps where the identified structure is not aligned with the identified technology and does not support technology operations and use (Lyytinen & Newman, 2008).

### **Requirements Elicitation: Interviews**

The most widely used elicitation process is interviews, which use structured, semi-structured, or unstructured questions to gather requirements. Interviews have been rated as being the most effective technique used by analysts for gathering the necessary requirements (Chua, Bernardo, & Verner, 2010). Interviews are exploratory in nature and tend to be less guided, and characterized by a set of questions, where the depth and breadth of each of these questions is largely dependent on the analysts skills and experience (Hubbard, Schroeder, & Mead, 2000). According to literature, there is a limited guidance about the interviews' contents or questions (Browne & Rogich, 2001), and the kind of questions or inquiry that is most effective (Pitts & Browne, 2007). In some cases, interviews may consists of unnecessary questions that can lead to eliciting the wrong requirements (Kato et al., 2001). Also, analyst experience does not appear to be a relevant factor when using interviews as an elicitation technique (Davis, Dieste, Hickey, Juristo, & Moreno, 2006). Empirical studies showed that careful preparation of interviews has a much more marked effect than analyst experience (Davis et al., 2006). In some cases, novice analysts are capable of eliciting the necessary requirements exactly the same way as experienced analysts. In preparing for the requirements analysis phase using interviews, analysts experience does not appear to be a relevant factor (Davis et al., 2006). In fact, careful preparation of interviews has a much more marked effect than analyst experience.

*“Being familiar with the domain, an analyst can more easily prepare focused questions for an interview”* (Hadar, Soffer, & Kenzi, 2014). Analyst *“from traditional software engineering backgrounds may sometimes focus on the solution not the problem, and reply on only those techniques they are familiar with for all situations”* (Zowghi & Coulin, 2005). In some cases, it is necessary to investigate and examine the application domain in which the system will reside. Such investigation should not be limited to technical aspects of the problem domain but should also include the political, organizational, and social aspects related to the system (Aurum & Wohlin, 2005; Zowghi & Coulin, 2005).

Accordingly, we formulated the following research questions

1. Is there a difference in analysts' understanding between those who used the ST process model to enhance domain knowledge and those who have not?
2. Is there a difference in the quality of the user interview questionnaire developed by analysts who used the ST process model and those who have not?

### **Research Approach**

The research presented here follows the principles of design science by Peffers, Tuunanen, Rothenberger, and Chatterjee (2007).

The lack of important knowledge about problem domain can affect the quality of the interview's questions to be asked in order to collect the necessary requirements. In addition, the analysts should account for the intrinsic and interrelated characteristics of the social and technical aspects of the systems. Such account, also require analysts to be familiar with the problem domain. In order to come over these problems, the ST model components can help enhance analysts' domain knowledge and understanding by exploring the relationships between these components. The so called ST system theory as well as an extensive literature review will serve as a theoretical foundation for developing a new process model for enhancing analysts' domain knowledge.

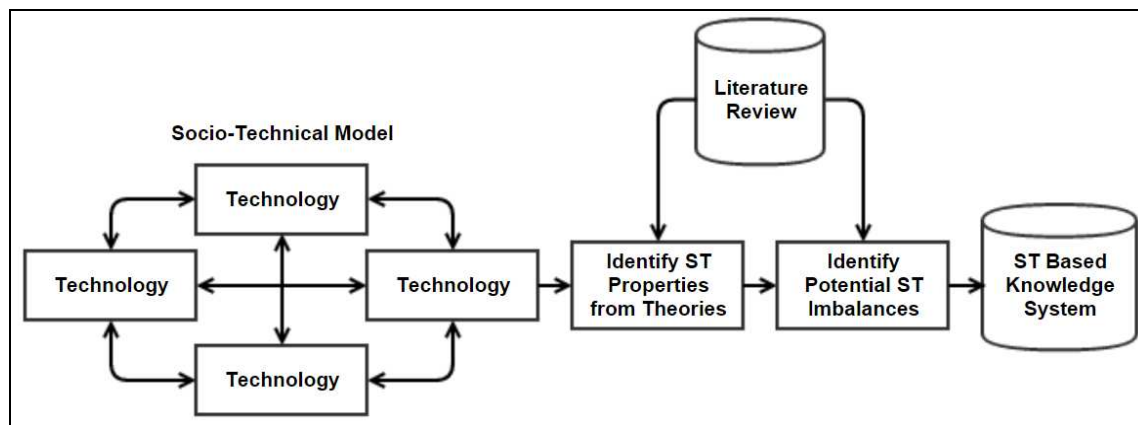
Once the proposed ST process model is developed, the resultant artifact will be tested for its feasibility in the self-care domain, where the objective is show how such process model can help improve the analysts' skills and understanding of that problem domain. An empirical investigation, to assess the extent to which the constructed ST process model helps the analysts preparing for the interview, is carried

out. Such experimental investigation consists of hypothesis development, variable measurement, experimental design and data collection, and data analysis.

## Building the ST System: A STS Based Process Model

In this section we discuss the proposed socio-technical process model as well as explain the different steps that are necessary to apply the new process model for improving analysts' domain knowledge, readiness, and preparations for the requirements analysis phase. Demonstration of the proposed socio-technical process model is carried out in the domain of self-care as a running example.

The socio-technical model and imbalances can help the analysts in the requirements analysis phase. Figure 2, shows the proposed ST process model. The proposed approach starts with the socio-technical model described by (Lyytinen & Newman, 2008). For each component of the socio-technical model, a list of relevant attributes is identified from literature. Once identified, imbalances between the socio-technical components are identified at the attribute level. The literature is then used to confirm that the list of imbalances exists in relevant systems. Finally, using the identified imbalances and the screened imbalances from the literature, we enriched the target domain with ST knowledge. Detailed description about the overall process, example imbalances, as well as evidence that support these imbalances can be found in (Reference Removed for Blind Review Purposes).



**Figure 2. Socio-technical System Process Model for Building the ST Based System**

## Evaluation, Data Collection, and Analysis method

Evaluation of the effectiveness of the ST based system is done by empirical investigation. We argue that the ST based system model enhances the analysts' domain knowledge and helps them to better prepare for users' interviews. Also, we argue that the ST based system model will directly enhance the quality of the developed user interview questionnaire.

The subjects in the user study are divided into two different groups, a treatment and control group. The treatment groups will have access to the ST based requirement elicitation support system where the control group will be provided by sample software requirement specification (SRS) for same domain and use their own experience in developing the requirement elicitation questionnaire.

The subjects' performance is modelled from two perspectives. The first perspective is to determine how the analysts feel about their understanding of the domain knowledge and how well they are prepared for the requirements analysis interviews (self-assessment perspective). Analysts will evaluate and compare their own knowledge and ability after using the proposed ST based requirement elicitation support system. We argue that access to the ST based system will increase the analyst's domain knowledge more than those who have not, which also will make the analyst feel better prepared for proceeding with users' interviews.

**H1:** There is a difference exists between *self-reported domain knowledge* of analysts who have access to the ST based systems and those who have not.

**H<sub>2</sub>:** There is a difference exists between *self-reported user interview readiness* of analysts who have accesses the ST based systems and those who have not.

The second perspective is the analysts' relative performance. In this perspective, the analyst performance when developing the interview questionnaire was compared for the treatment group and the control group. In order to assess analysts' performance, we recruit a third party judge (expert in the domain of system analysis and design) in order to assess the quality of the interviews questions. In this context, we argue that access to ST based system will improve the overall questionnaire quality.

**H<sub>3</sub>:** There is a difference exists between user interview *questionnaire quality* of analysts who have accesses the ST based systems and those who have not.

The instrument developed by (Vitharana et al., 2012) will be used to measure analyst's domain knowledge and self-reported interview readiness. We will test the hypothesis empirically using a controlled experiment. A two treatments pretest-posttest design is used to test the effectiveness of the proposed system. The purpose of the pretest is to make sure that all members of both controls and treatment groups have the same level of knowledge with respect to the main tasks of the experiment, and avoid the selection bias problem, or what is called selection threat (Trochim & Donnelly, 2001). To do so, we use random sampling and random assignment to select and assign subjects to different groups (Montgomery, 2008).

The main task is to develop an interview questionnaire for a diabetes mobile application. The subjects are graduate students at a Mid-Western University with systems analysis and design knowledge. The Multivariate analysis of variance (MANOVA) is used to test the hypotheses. According to some experiments that has been done with G\*Power (Faul, 2013), Power analysis for a MANOVA with two levels and two dependent variables, using an alpha of 0.05, a power of 0.80, and a large effect size ( $f = 0.40$ ) requires a sample size of 28.

To assess the rating process of the resulting interviews, judges are asked to rate each questionnaire based on the interrogatories technique, which involves asking "who," "what," "when," "where," "how," and "why"; questions (Browne & Rogich, 2001; Pitts & Browne, 2007). The Judges will evaluate each questionnaire along these six dimensions using the breadth and depth measures adapted from (Browne & Rogich, 2001; Pitts & Browne, 2007), where breadth refers to the number of different questions categories along each dimension, and depth refers to the number of questions obtained within each category. We posit that users with access to the ST based system will develop questionnaires with greater breadth and depth as compared to the control group, eventually leading to a more comprehensive analysis of the problem domain from a Socio-Technical perspective.

## Conclusion

The contribution of this work can be described along three dimensions: empirical, theoretical, and practical. A major empirical contribution of this work is to show how such process model can affect analysts' understanding and learning. The theoretical contribution is a new way to improve analysts' domain knowledge and preparation for developing interview questionnaire. To do so, a new ST process model based on the notion of ST model of information systems is developed. Finally, the practical contribution is an attempt to show that such theoretical ideas can be usefully applied to show that such ST process model can results in a change in analysts' domain knowledge and understanding of problem domain.

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