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ABSTRACT

This study applies theory Channel Expansion Theory to assess factors that influence analyst perceptions of the richness of requirements elicitation techniques. These perceptions of richness are of interest as communication research has shown that richness perceptions are related to selection and effective use of communication channels. We find that an analyst's experience with a requirements elicitation technique is the strongest predictor of perceived richness from using that technique. Experience communicating with the informant was only marginally significant. Results from an initial analysis suggest further that analysts (in this organization) have a great deal of discretion in technique selection, and apply one particular technique more than others to gather and capture requirements. The results suggest that analysts need not only a broader repertoire of techniques, but also need to develop experiential bases in these techniques to enable them to articulate richer and more comprehensible requirements.

Keywords

Requirements elicitation, technique selection, channel expansion theory, field survey

INTRODUCTION

Requirements elicitation remains one of the most important and challenging steps in systems analysis and design. Difficulties in accurately identifying and capturing system requirements continue to be encountered and have been identified as a major factor in the failure of 90% of large software projects (The Standish Group, 1994; Hayes, 2005). In this paper we explore the factors which influence how analysts perceive and select a technique for requirements elicitation. We focus on this phase of the analysis and design process due to the frequency and persistence of concerns about the adequacy of the tools and techniques used and the important role requirements elicitation plays as a foundation for success in subsequent design phases (Marakas and Elam, 1998; Roberts, Cheney, Sweeney, and Hightower, 2005).

For requirements elicitation, a primary indicator of success is that requirements meet end user needs. However, this outcome has proven difficult to achieve as users frequently experience difficulty articulating their needs – they either cannot explain them in a manner that is readily intelligible by the analyst, or they have not been directly asked for in the analysts' questions (Moores, Change and Smith, 2004; Siau, 2004). Ineffective communication during requirements elicitation has persistently been blamed for information systems that disappoint end users, resulting in unused, poorly used, or misused systems.

Prior research has identified the need for effective collaboration between the analysis and design and user communities (Berry and Lawrence, 1998; Browne and Ramesh, 2002; Davis, 1982; Kim and Peterson, 2001). Communication between users and analysts is accomplished using a range of methodologies, tools and techniques. Over the past 30 years, research and development efforts have explored the potential of a range of techniques to facilitate user-analyst communication. A review of this work identifies three broad communication emphases, from providing methods to help the analyst ask questions to providing methods to help the user frame their responses to the analyst. Although these methods all strive for the common goal of optimizing the identification, description, and capture of user requirements, there are substantial variations in the manner of communication they facilitate.

A review of the requirements engineering literature highlights the introduction of elicitation techniques such as interviews, brainstorming sessions, scenario analysis, use case modeling, contextual inquiry, and even ethnography (Alter, 2003). These more qualitative, interpretive techniques are drawn from the social sciences. They contrast with the more traditional elicitation techniques' engineering origins and represent attempts to provide analysts with deeper insight into, and understanding of, the user's world (Somerville and Ransom, 2005). However, the inherent differences between these elicitation techniques as a means of communication between users and analysts have remained largely unexplored. This has

given rise to communication technique (or 'channel') compatibility issues: misinterpretations, misconceptions and mistakes in requirements elicitation have arisen from their injudicious use (Boehm and Huang, 2003).

Despite attempts to complement traditional engineering techniques (e.g., flow charting, note boards, etc.) with softer and more fluid elicitation techniques, analysts face a continuing dilemma. Analysts need robust and reliable elicitation techniques, but ones that do not constrain their ability to understand the end user's world or limit the opportunities for innovation and invention. Likewise, these techniques need to be as effective, efficient, and appropriate as possible given the business context and the understanding required.

Effective requirements elicitation thus remains a central and critical activity in the systems analysis and design process. The question this paper intends to answer is: what experiential factors drive analysts' perception of elicitation technique? By examining requirements elicitation techniques as communications media, we attempt to understand how analysts perceive and select these techniques so as to better understand the need for education and intervention to broaden the repertoire of elicitation techniques available to them, ultimately allowing for the collection of broader requirements. The paper begins with a review of relevant literature used to develop our theoretical model and hypotheses. We then provide an overview of the research site and methodology to test the hypotheses. The results of the research are then presented and their relevance to practice and future research discussed.

CONCEPTUAL BACKGROUND AND MODEL DEVELOPMENT

Requirements Elicitation as Communication

Communication has been defined as "a process in which participants create and share information with one another in order to reach a mutual understanding" (Rogers 1986, p 199). Communication channels facilitate or enable individuals to communicate with others to develop mutual understandings (Rice et al., 1990). These channels include many of the media that are used to communicate today, such as telephone systems and voice mail, as well as other computer-supported media such as videoconferencing, bulletin boards, instant messaging, and email. However, in a more general sense, a communication channel could be any device or technique that facilitates, guides, or otherwise enables individuals to communicate with one another. While much of the recent research into communication has focused on newer media such as email and video conferencing, other more commonplace communication methods, such as reports, documents, models (e.g. use case descriptions, use case diagrams etc), interview scripts, and agendas are also communication channels that in some way impact the nature of how individuals communicate.

Considering the interaction between user and analyst, the methods, tools and techniques employed by the analyst serve as channels that simultaneously guide, constrain, and facilitate communication as the analyst attempts to understand the requirements of the business situation at hand. In common with other communication channels, the techniques employed by the analyst may be more or less effective dependent on the context and manner in which they are used (Daft and Lengel 1986; Dennis, Fuller and Valacich, in press; Dennis et al., 2001).

A significant amount of research has examined how individuals select a communication channel. In general, this stream of research has focused on the prediction of a channel selection for certain types of communication-oriented tasks. The findings from this research, while often ambiguous, do acknowledge that characteristics of the communication task, certain salient characteristics of the channel, and characteristics of the individuals communicating can influence the selection and use of a particular medium for a task (Dennis and Kinney, 1998; Markus 1994; Rice and Shook 1990). Furthermore, to the degree that individuals have greater or lesser levels of familiarity with the communication task or topic, the individuals involved in the communication, and the channel that supports or guides the communication, differential results in communication performance can arise (Carlson and Zmud, 1999; Dennis, et al., in press).

Channel Expansion Theory

To understand how the use of communication channels can support the development of understanding between individuals we use the theoretical lens of Channel Expansion Theory – CET – (Carlson and Zmud, 1999). CET identifies certain experiences as important in shaping how an individual may perceive a certain communication channel as being rich enough to facilitate the communications necessary for efficient development of shared understanding. In this case, richness is defined as the ability of the communication channel to enable a change in understanding over some time interval (Daft and Lengel 1986). Specifically, CET proposes that an individual's experiences with the communications channel (e.g., communications method or technique), message topic, organization context, and communication partner can influence the perception of richness of the communication channel. CET proposes that as an individual develops additional experience across these four knowledge bases, they would perceive a medium to be more rich, and should be able to more efficiently

send (ask) and receive (interpret) messages than would be expected of a leaner communication channel. Conversely, it would suggest that if an individual has less experience with the message topic, the organizational context, the medium or the communication partner, they would perceive the medium as less rich, and likewise should require a richer communication channel to enable effective and efficient communications.

In this research, we apply Channel Expansion Theory in a systems development context to suggest that individuals (analysts) with varying degrees of experience across *three* of the knowledge bases central to requirements elicitation -- message topic (application development area), channel (elicitation technique), and communication partner (primary informant) -- would likewise vary in their perception that an elicitation technique being rich enough to efficiently send and receive messages to develop understanding.[1] In the context of requirements elicitation, this accords with previous research findings that suggest that the quality of the requirements elicitation process varies according to the analysts' level of experience with the specific domain (the message topic) that the information systems is attempting to address, the purpose (or topic) in which the information system will be implemented, the communication partner with whom they are interacting, and the tool used to elicit and capture requirements. CET leads us to propose that, based on these levels of experience, elicitation techniques will vary in their effective support of user-analyst dialogue. Therefore we hypothesize that:

> *H1: An analyst's experience with the primary informant will be positively related to their perception of richness of the elicitation technique used.*

> *H2: An analyst's experience with the application area (topic) will be positively related to their perception of richness of the elicitation technique used.*

> *H3: An analyst's experience with the elicitation technique will be positively related to their perception of richness of the elicitation technique used.*

Social influence has also been suggested to have an impact on the perceptions of and use of a communications medium (Carlson and Zmud 1999; Fulk, Schmitz, and Steinfield 1990). Social influence theory suggests that an individual's perception of a medium's richness is socially constructed, based on, among other things, statements from co-workers and workplace norms for media use. As a result, it would be expected that in an organization setting, social influence from relevant peers and supervisors would play a role in the perceptions of the richness of a particular elicitation technique. Therefore we hypothesize that:

> *H4: The perceived social influence to use the elicitation technique experienced by an analyst will be positively related to their perception of richness of the elicitation technique.*

Figure 1 provides our research model, based on the three constructs from Channel Expansion Theory, and social influence.
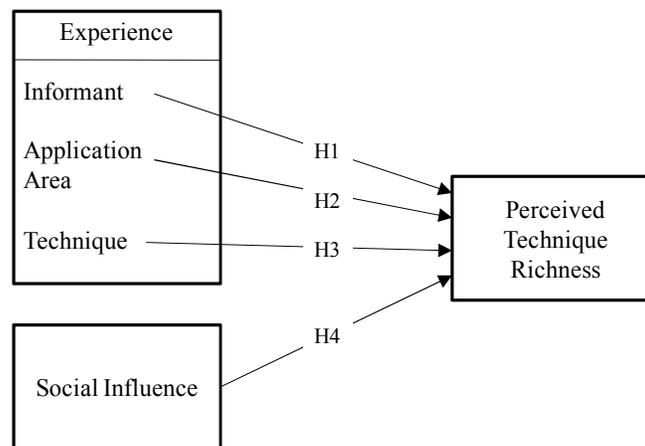
Figure 1. Research Model

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[1] Unlike the original application of CET, we do not include the organizational context in this study as we found that typically the organizational context of interest is – at this level of analysis – synonymous and commensurate with the communication topic as analysts strive to understand and articulate an organizational development need.

RESEARCH METHOD

Study Sample

The respondents for this study were individuals employed at a large financial institution in the southeast United States. The respondents had varying degrees of interaction in the development process, but all participated in requirements elicitation in some form for the application development projects in which they were involved. Out of 150 potential and solicited individuals, 112 responded providing an effective response rate of approximately 75%. 52.9% of respondents were male. Given the anonymous nature of the data collection, non-response bias was unable to be determined. However, based on varied demographics of those who did respond, non-response bias is likely minimal along demographic characteristics. Additional respondent characteristics are provided in Table 1.

DEMOGRAPHIC	MEAN	ST.DEV.	MIN	MAX
Age	41.11	11.914	19	63
Years in company	6.03	5.489	0	24
Years in position	3.33	3.636	0	22
Years of work experience	16.35	9.931	0	44
# projects elicited	46.94	58.977	1	200

Table 1. Respondent Demographics

Instrument Development

All variables were measured using multi-items scales derived from the literature (see Table 2). The measures for topic experience, organizational experience, co-communicant experience, elicitation technique experience, social influence, and perceived technique richness were adapted from Carlson and Zmud's (1999) measures for these same constructs.

CONSTRUCT	ITEMS (measured on 1-5 likert, Strongly disagree to strongly agree)
Experience with Informant (INFORM)	ExpInf1 - I trust the primary contact ExpInf2 - I feel comfortable discussing non-work issues with the primary contact ExpInf3 - I feel I can approach the primary contact with questions I have ExpInf4 - I feel comfortable using informal communication (slang or abbreviations) with the primary contact ExpInf5 - I feel that I am not familiar with the primary contact ExpInf6 - I feel comfortable communicating with the primary contact ExpInf7 - I feel welcome to communicate with the primary contact ExpInf8 - Overall, I feel that I know the primary contact well
Experience with Topic (TOPIC)	ExpTop1 - I feel that I am experienced with the application area ExpTop2 - I feel that I am well-versed in the concepts associated with the application area ExpTop3 - I do not feel knowledgeable about the application area (R)
Experience with Technique (RET)	ExpRet1 - I am very experienced using {technique} ExpRet2 - I feel that {technique} is easy to use ExpRet3 - I feel competent using {technique} ExpRet4 - I understand how to use all the capabilities of {technique} ExpRet5 - I feel comfortable using {technique}

	ExpRet6 - I feel that I am a novice using {technique} (R)
Social Influence (SOC INFL)	SocInf1 - My co-workers frequently use {technique} to gather requirements
	SocInf2 - My co-workers have told me how useful {technique} is
	SocInf3 - My supervisor has told me how useful {technique} is
	SocInf4 - My supervisor frequently uses {technique} to gather requirements
Perceived Richness (RICH)	PerRich1 - {technique} allows the primary contact and me to give and receive timely feedback
	PerRich2 - {technique} allows the primary contact and me to adapt our communications to suit our agenda
	PerRich3 - {technique} allows the primary contact and me to communicate using a variety of different cues (emotional tone, attitude, formality) in our communications
	PerRich4 - {technique} allows the primary contact and me to use varied language in our communications

Table 2. Research Constructs and Measurement Scale

RESULTS

Scale Assessment

The scales were first assessed for their psychometric properties by examining item reliability and discriminant validity. Cronbach's alpha was calculated for the measurement scales. All of the scales exhibited acceptable reliability above the 0.70 threshhold (Nunnally 1978). Descriptive statistics and reliabilities for the constructs are provided in Table 3.

CONSTRUCT	# ITEMS	MEAN	ST.DEV.	ALPHA
Experience with Informant (Inform)	8	3.923	0.956	0.895
Experience with Topic (Topic)	3	3.850	0.933	0.920
Experience with Technique (RET)	6	3.626	0.998	0.906
Social Influence (Soc Infl)	4	2.869	0.962	0.809
Perceived Richness (Rich)	4	3.801	0.775	0.882

Table 3. Measure Statistics and Reliability

Discriminant validity was assessed using confirmatory factor analysis. We examined each item's factor loading to ensure that each idem loaded higher on its own construct than on any other construct. As noted in Table 4, and consistent with prior research, all items loaded on their own constructs appropriately with minimal cross-loading, indicating acceptable discriminant validity.

	CONSTRUCT				
ITEM	**INFORM**	**RET**	**RICH**	**SOC INFL**	**TOPIC**
exp_inf7	**.863**	-.064	.033	.088	.033
exp_inf3	**.827**	-.072	.139	-.203	-.018
exp_inf8	**.822**	.068	-.061	-.107	.199
exp_inf5	**.797**	-.013	.056	-.156	.095
exp_inf1	**.796**	-.050	-.026	-.113	-.222
exp_inf4	**.721**	-.027	.185	-.041	.177
exp_inf2	**.670**	.006	-.029	.098	.024
exp_inf6	**.602**	.067	.104	-.285	.083
exp_ret1	-.057	**.875**	.156	.027	.204

exp_ret5	-.026	**.866**	.224	.194	.119
exp_ret4	-.009	**.862**	.104	.116	.116
exp_ret3	.019	**.861**	.168	.184	.067
exp_ret2	.134	**.687**	.177	.296	-.148
exp_ret6	-.141	**.677**	.174	-.136	.209
ret_rich3	.041	.193	**.877**	-.082	.025
ret_rich2	.156	.221	**.817**	.158	-.054
ret_rich4	.059	.148	**.813**	-.123	-.013
ret_rich1	.104	.327	**.771**	.230	.084
soc_infl3	-.158	.110	-.096	**.866**	.051
soc_infl2	.016	.216	-.066	**.846**	.030
soc_infl4	-.196	.019	.053	**.715**	.161
soc_infl1	-.139	.169	.271	**.595**	.033
exp_top3	.144	.163	.025	.076	**.900**
exp_top2	.025	.171	-.013	.100	**.900**
exp_top1	.135	.107	.007	.074	**.898**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Table 4. Scale Factor Loadings

Hypothesis Testing

Given acceptable reliability and discriminant validity of the measures, the items were summed and used for subsequent tests of the hypotheses. To test the hypotheses, the summated scales were analyzed using regressing to determine the relative strength of each predictor construct on the dependent variable, perceived richness. Results from hypothesis testing are shown in Table 5.

CONSTRUCT	β	p-VALUE
Experience with Informant (Inform)	0.188	0.097
Experience with Topic (Topic)	-0.093	0.402
Experience with Technique (RET)	0.435	0.001
Social Influence (Soc Infl)	0.033	0.768
Adjusted R^2 (F, p)	0.18 (5.261, 0.001)	

Table 5. Hypothesis Test Results

H1: Experience with informant. Prior experience with the informant was found to be only a weak predictor of perceived richness of the requirements elicitation technique. It is possible that our sample size was not large enough to capture the significance of this factor, however, it was only significant at the 0.10 level. Therefore, Hypothesis 1 received only marginal support.

H2: Experience with topic. Experience with the topic was not a significant predictor of richness perception. While we predicted a significant relationship, this result is not dissimilar from prior research (Carlson and Zmud 1999). As a result, Hypothesis 2 was not supported.

H3: Experience with technique. The analyst's experience with the elicitation technique was found to be a significant predictor of perceived richness (p=0.001). Therefore, Hypothesis 3 was supported.

H4: Social influence. The perception of social influence was not found to be a significant predictor of perceived richness of the requirements elicitation technique: Hypothesis 4 was not supported.

DISCUSSION

The results of this research provide support for some of the tenets of channel expansion theory as applied in a systems development context, considering elicitation technique as the channel. Specifically, we find that the analyst's experience with the requirements elicitation technique is the strongest predictor of their perceived richness of the technique when gathering requirements. Only marginal support was found for the experience with the informant. Surprisingly, no support was found for social influence or experience with the topic (or application area) as a predictor of richness. These findings are interesting and contribute to the literature and our understanding of how analysts choose requirements elicitation technique, and the dangers of overreliance on a single or limited set of techniques.

Overreliance on Experience for Elicitation Technique Selection

Elicitation techniques are selected in order to help the analyst gather and capture requirements. As such, they can be seen as an important communication channel that can simultaneously facilitate and constrain communication between the user and analyst. As noted above, analysts perceive elicitation techniques as being richer when they have a greater experiential base developed with that technique. This is not surprising in that they would have greater experience with the technique, and would therefore perceive it as more rich. However, this result must be taken in the context of the number and frequency of elicitation projects they perform, and the various techniques they can choose to employ in those projects. Respondents in this study were also asked if techniques were encouraged for use. As would be expected, given the weakness of social influence as a predictor of perceived richness, respondents indicated that typically no technique was encouraged (see Table 6).

TECHNIQUE ENCOURAGED	# RESPONSES
None Encouraged	34
Structured Interview	9
Requirements Workshop	6
Focus Group	4
Questionnaire/Survey	2
Screen/Interface Analysis	2
Other	1

Table 6. Encouraged Techniques Reported by Respondents[2]

Interestingly, given this level of discretion to the analyst, the majority of techniques used were of the same type, Structured Interview. Table 7 provides a comparative list of the techniques used and the number of projects used in (as considered in this survey).

TECHNIQUE USED	# RESPONSES
Structured Interview	28
Other	6
Requirements Workshop	5
Focus Group	3
Observation/Shadowing	2
Prototyping	2
Screen/Interface Analysis	2
Actor/Goal Identification	1
Cognitive Mapping	1
Document Analysis	1

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[2] In the interest of space, not all responses are shown (no response, and other responses – not categorized – are omitted in the tables.)

Flowchart/Flow Diagram	1
Questionnaire/Survey	1

Table 7. Techniques Used Reported by Respondents[2]

As a whole, these results indicate that the analyst (at least in this organization) has a great deal of latitude in choosing which elicitation technique to apply for any project. However, it seems that one elicitation technique is preferentially applied. This lack of diversity in requirements elicitation technique use, coupled with the finding of this research that experience with a technique drives the perception of richness from using the technique suggests a potential self-reinforcing circle of technique use. The concern about this is that use of a single technique will likely only capture a certain type of requirement; thereby not capturing other requirements, yet repeated use will reinforce its use and perception of being rich. While the argument has been made that analysts need a repertoire of elicitation techniques to capture a broader and more robust set of requirements, the findings from this research suggest that analysts depending on their own experience with elicitation techniques will select the same technique over and over and believe it is sufficiently rich to capture requirements.

Implications for Practice

These results have important implications for practice. First, organizations in general, and IT managers in particular, need to be aware of, and be more proactive in their recommendation of elicitation techniques. While the application of CASE tools to manage and organize requirements has increased, these tools and repositories do not generally suggest or identify the manner in which requirements were elicited. As a result, managers responsible for both software and organizational development need to be more vigilant and proactive in their encouragement of the use of a broader and richer set of elicitation techniques, to reduce overreliance on a single or narrow range of techniques, and to enable a richer set of requirements to be elicited and captured.

Second, development groups need to continue to expand their repertoires of techniques by exploring new and different elicitation techniques, to develop relevant experience in the selection and use of these techniques. While analysts will likely continue to perceive as richer those techniques they are more experienced in using, the development of these same experiential bases with other techniques can help to provide alternatives to the analyst.

Implications for Research

The results of this initial analysis also have important implications for research. Research on user-analyst interaction has previously considered this interaction in a communication context. But this study extends that research by recognizing that the techniques used to facilitate and support that research can be successfully examined as communication channels. This suggests that as a communication channel, these techniques could be examined from a communication perspective. While this research focuses on factors that affect analyst selection of the technique, future research could also consider technique selection and performance from the same communication perspective. Therefore, communication behaviors typically associated with communication media, such as communication content changes and channel switching behaviors, should also be examined in this context. For example, while this research was focused on selection of a particular elicitation technique, analysts can, and frequently do "channel switch" by the application of more than one elicitation technique. What triggers this switching behavior and the robustness of requirements elicited when switching is a relevant question for future research.

As with other studies that only examine a single research context, care should be applied when generalizing these results to other organizations. While our interest was not on the organizational context, but rather the techniques used by analysts, the results are certainly influenced by the overarching policies, practices, and expectations that exist in the one organization. Other organizations with different policies and practices could likely have very different results. However, this suggests that future research should examine the role that these organizational characteristics have on analyst perceptions and selection factors. Likewise, it must be noted that many factors influence technique use and selection, beyond perceptions of richness and experiential factors. However, we hope to highlight the influence that these experiential factors have on perceptions of these techniques, and how this could lead to preferences to a subset of these techniques. Further, although the financial services sector is frequently seen as the epitome of IT innovation (the organization we studied has an annual revenue of some $2.7 billion) the question of generalizability cannot be ignored. With 6000+ employees, they rely primarily on in-house development for much of their business systems. It is not clear if these results would apply in organizations in other economic sectors or those that primarily undertake development as contractors for other organizations.

CONCLUSION

The findings from this initial analysis of our study examine analyst selection of requirements elicitation techniques within the context of a large financial services company. The results of a survey applying measures from Channel Expansion Theory finds that analysts perceive as richer those elicitation techniques with which they have the most experience. The analyst's experience with the informant was only marginally significant as a predictor of perceived richness. This finding, along with the fact that analysts in this organization have much discretion over their selection of elicitation technique, and the primary application of a single technique for multiple projects, suggests that analysts may over rely on experience to assess richness of the technique and should expand their technique repertoire to gather more robust requirements.

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