11-2007

Important characteristics of software development team members: An empirical investigation using Repertory Grid

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doi:10.1111/j.1365-2575.2007.00254.x

Important characteristics of software development team members: an empirical investigation using Repertory Grid

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Abstract. *An information system is typically developed by a team of information systems (IS) professionals. Research shows that teams staffed with the right people are more likely to be effective and efficient. There is a paucity of study that examines the important traits of IS professionals in team contexts. The objective of this research is to identify and understand the important characteristics of good team members in software development projects. We applied an established psychological technique (Repertory Grid) to guide our interviews with 21 experienced IS professionals, who have had extensive experience in software development teams. The comprehensive list of important characteristics was analysed qualitatively using open coding method of grounded theory. Fifty-nine unique characteristics were identified and classified into eight categories. Among them,* attitude/motivation, knowledge, interpersonal/communication skills, and working/cognitive ability *were perceived by research participants to be the most important categories. Our study provides a context-specific (i.e. software development team) evaluation of important characteristics of IS professionals. The results have significant implications for IS recruiting, IS training, IS staffing, and IS human resource management. Our study also supplements the research on management of IS development teams.*

Keywords: software development team, Repertory Grid, grounded theory, qualitative study

1. INTRODUCTION

Developing information systems (IS) has always been a challenging task. Reported statistics (e.g. Standish, 2001) have shown that the disappointing productivity and failures of systems development projects were enduring phenomena (Siau, 1999; Erickson *et al*., 2005). Work team is a primary mechanism for developing IS (Faraj & Sproull, 2000). It is therefore imperative to improve software development team productivity and effectiveness en route to successful IS development. Teams staffed with the right people are more likely to be effective and efficient in software projects (Klein *et al*., 2002; Gorla & Lam, 2004). One important question about team staffing is: 'what are the important characteristics of good software development team members?'

Some research efforts have been taken to identify the important traits of IS professionals in general. For instance, Lee *et al.* (1995) interviewed 52 IS managers and summarized four broad categories of critical knowledge/skills for IS professionals: (1) technical specialties knowledge/skills; (2) technology management knowledge/skills; (3) business functional knowledge/skills; and (4) interpersonal and management knowledge/skills. Hunter (1994) interviewed 70 research participants, including various stakeholders of system development projects, and identified several important themes about the characteristics of excellent systems analysts – communication, attitude, knowledge, investigation and experience. Using MBA students as research participants, Wynekoop & Walz (1999) conducted a Delphi study to generate a list of 19 characteristics of exceptional software developers. The studies of Wynekoop and colleagues (Walz & Wynekoop, 1997; Wynekoop & Walz, 1999; 2000) extended previous research, which primarily considered skills and knowledge requirements of IS professionals, to take into account personality characteristics. However, no study, to our best knowledge, has directly investigated the important characteristics of software developers in the team context. Given the complexity of working in team context for IS development (Ang & Slaughter, 2000), the findings of those prior studies may not be directly applicable to answer our research question.

Other researchers have studied the characteristics of software development team members at the team level. These studies are often driven by theories in psychology and managerial cognition, and mainly focusing on the team composition. Various composition variables have been investigated, such as personality (Kaiser & Bostrom, 1982; Bradley & Hebert, 1997; Gorla & Lam, 2004), expertise (Faraj & Sproull, 2000), and professional orientations (Klein *et al*., 2002). However, the specific composition variables are conceptually scattered across different studies. In addition, some issues have not yet been addressed by these studies. On one hand, the relative significance of these composition variables is not known. On the other hand, other composition variables, such as attitude, motivation, and interpersonal skills, have not been adequately examined. These issues hinder us from achieving a comprehensive understanding on the important characteristics of good software development team members.

Given that no existing IS literature can provide a direct answer to our research question (i.e. what are the important characteristics of software development team members?), we conducted an empirical study to identify and understand these characteristics.

Experienced IS professionals, who have extensive working experience in software development team environments, are the most appropriate data sources to obtain a comprehensive and in-depth understanding of the traits of good team members. Through their prolonged experience in software projects, they are able to form salient opinions about important characteristics of good team members. Therefore, in this study, we interviewed a group of experienced IS professionals to elicit these characteristics. The interviews were guided by an established psychological technique – Repertory Grid (RepGrid). We then qualitatively analysed the identified characteristics in order to conceptualize them to categories at a higher level of abstraction, which are both theoretically parsimonious and practically complete.

The rest of the paper is organized as follows. In section 2, we provide the background of the RepGrid technique. Section 3 describes our research method, including a description of our research participants and the interview process. In section 4, we report our research findings and discuss in detail the similarities and differences of our findings with prior related studies. In section 5, we elaborate on the managerial and research implications of our study. Section 6 summarizes the limitations and future research directions, and concludes the paper.

2. PERSONAL CONSTRUCT THEORY AND REPERTORY GRID

This study was conducted primarily following an established psychological technique, known as Repetory Grid (RepGrid). In this section, we introduce its theoretical foundation – personal construct theory, the typical process of RepGrid, and the appropriateness of this technique for our study.

2.1 Personal construct theory

The personal construct theory was first proposed by Kelly (1955). In his work to help individuals analyse their own interpersonal relationships, Kelly (1955) treats these individuals as 'scientists' and argues that individuals, based on their experience, would devise a system of personal constructs to assist them in understating and interpreting events that occur around them. The function of a personal construct system is to interpret the current situation and to anticipate future events (Tan & Hunter, 2002). Individuals can share and appreciate the personal construct systems of others. The extent of similarity of psychological processes between two individuals is dependent on the similarity of their personal construct systems (Kelly, 1955).

Kelly (1955) further contends that personal constructs are bipolar in nature. For example, IS professionals may organize their clients into those who have good IT knowledge and those with poor IT knowledge, or those who are good communicators and those who are poor communicators. 'Good IT knowledge – poor IT knowledge' and 'Good communicator – poor communicator' are the two bipolar constructs generated by IS professionals based on their experience, and are used to categorize their clients. The use of bipolar labels increases understanding of how a construct may be utilized by an individual to facilitate interpretation (Tan & Hunter, 2002).

2.2 Repertory Grid

Repertory Grid (RepGrid) was developed by Kelly (1955) to operationalize his personal construct theory. The technique can reliably elicit the respondent's cognitive structure, i.e. personal construct system, which is not biased by the researcher's frame of reference and worldview (Reger, 1990). In addition, the semi-structured approach associated with the RepGrid is more efficient than unstructured approaches (Moynihan, 1996).

The RepGrid contains three major components: elements, constructs and links (Fransella & Bannister, 1977). *Elements* are the objects of attention in a scientific investigation. For example, a study to identify the quality of excellent system analysts can use system analysts as elements in the RepGrid (Hunter, 1997). *Constructs* represent the research participant's interpretations of the elements. Constructs are often elicited by bipolar labels, such as 'good rapport – poor rapport' and 'good communication skills – poor communication skills'. These example constructs are used by the research participants to interpret system analysts whom they know. *Links* show how the research participants interpret each element relative to each construct.

A RepGrid process involves three major activities: element selection, construct elicitation, and linking elicited constructs to elements. Following is a brief introduction to the procedures involved in RepGrid.

2.2.1 Element selection

Elements are the objects of attention within a specific domain. Depending on the research questions, elements may be people, such as systems analysts (Hunter, 1997), or activities, such as systems development projects (Moynihan, 1996). In prior studies applying the RepGrid, researchers have chosen between two ways of selecting elements. One way is to provide a list of elements to research participants, so that every research participant elicits constructs based upon the same set of elements. The other way is to ask the research participants to choose their own elements. In this situation, research participants work on different sets of elements.

After the element selection step, each research participant will face a pool of elements, which should be representative of the area to be investigated (Stewart & Stewart, 1981). The pool of elements should also provide sufficient variability in the subsequent construct elicitation step (Hunter & Beck, 2000).

2.2.2 Construct elicitation

Construct elicitation is an activity to identify the constructs when the research participant interprets the elements. There are several methods of eliciting constructs (Stewart & Stewart, 1981; Reger, 1990). The classical approach to generating constructs is known as the triadic sort method (Tan & Hunter, 2002). In this method, three elements (a triad) are randomly selected from the pool at a time. For each triad, the research participant will be asked to identify a way in which two elements are similar yet different from the third element. The elaboration should be within the scope of discourse. This method of 'triading' promotes a discussion of similarity and contrast, which was recommended by Kelly (1955). According to Kelly, the similarity and contrast represent a dichotomous construct that people use to interpret the outside events or objects.

Another approach to eliciting constructs, although uncommon, is that the researchers provide the constructs (Tan & Hunter, 2002). This approach allows for the comparison of individual RepGrids statistically.

The third elicitation technique is known as 'full context form' (Tan & Hunter, 2002). In this technique, the research participant is required to sort the whole pool of elements into any number of discrete piles based on whatever similarity criteria chosen by the research participant. After the sorting, the research participant will be asked to provide a descriptive title for each pile of elements. This approach is primarily used to elicit the similarity judgments.

The fourth approach is group construct elicitation (Stewart & Stewart, 1981), which is similar to the triadic sort method. A group of research participants first seek consensus on the elements to be used in the RepGrid. Then bipolar constructs are elicited using the triadic sort method. Open discussion allows the research participants to share interpretations with each other.

Laddering process (Stewart & Stewart, 1981) can also be applied in each of the above-mentioned elicitation approaches. Laddering refers to the use of a series of 'how' and 'why' questions, which allows the research participant to elaborate on the elicited construct. Laddering process therefore would help increase the in-depth understanding of what the research participant means by the elicited construct.

2.2.3 Linking elements to constructs

There are three methods of linking elements to constructs: dichotomizing, ranking and rating (Tan & Hunter, 2002). *Dichotomizing* involves the research participant placing a tick against the element if it is closest to the left pole of the construct, or a cross if it is closest to the right pole. This method allows research participants to associate elements with either side of the bipolar construct (Tan & Hunter, 2002). In *ranking*, the research participant places the elements in an order between the two contrasting poles of the construct. Ranking provides much greater discrimination than dichotomizing, thus removing the problem of a skewed distribution by dichotomizing (Stewart & Stewart, 1981).

The most common method of linking elements to constructs is *rating* (Hunter, 1997; Tan & Hunter, 2002). In this method, the research participant will be asked to rate elements along constructs using a rating scale, such as five, seven or nine points. Rating allows the research participant greater freedom when sorting the elements and does not force the research participant to make non-existent discriminations. This is a significant advantage over dichotomizing and ranking.

In some instances, elements and constructs may not be linked. Such an example is Moynihan (1996), in which the researcher was primarily interested in the themes or categories underlying the constructs elicited by the research participants. In such a scenario, linking elements to constructs serves no purpose.

2.3 Appropriateness of RepGrid for our study

Our research question is 'what are the important characteristics of good software development team members?' Therefore, the nature of this study is not confirming and testing an established theory. Instead, we intend to inductively identify the important characteristics of good software development team members. RepGrid is an evocative research method (Hunter, 1997) that fits our research objective appropriately. RepGrid is also an established psychological technique. Many researchers, both in IS area and in other social science fields, have applied RepGrid to investigate a research participant's opinion regarding the subject of discourse (e.g. Stewart & Stewart, 1981; Ginsberg, 1989; Reger, 1990; Phythian & King, 1992; Moynihan, 1996; Hunter, 1997).

Another advantage of RepGrid is that it is a semi-structured yet flexible method for collecting interview data (Hunter, 1997). This method is superior to unstructured interview techniques, which tend to either overly constrain participants' responses or produce excessive researchers' biases (Moynihan, 1996).

In our study, we took the variant of RepGrid applied by Moynihan (1996). The objective of Moynihan's (1996) study is to identify the situational factors that managers of IS development projects took into account when planning new projects for new customers. The nature of that study is similar to ours. We adopted RepGrid to capture idiographic personal construct systems, and then qualitatively analysed the individual RepGrids to identify the categories underlying individual constructs.

3. RESEARCH METHOD

In this section, we describe our research method in more details, including the information of the research participants and the interview process.

3.1 Research participants

By using RepGrid technique in interviews, we are able to identify the characteristics of good IS development team members from the perspectives of the interviewees. A relatively small sample size (10–25 research participants) is often sufficient to elicit a comprehensive list of constructs (Ginsberg, 1989; Tan & Hunter, 2002). Creswell (1998) suggests using maximum variation as a strategy in a qualitative study to capture diverse perspectives about the issue. We followed this advice and carried out purposeful sampling by contacting potential research participants. The objective of purposeful sampling is to ensure that research participants had heterogeneous backgrounds. Twenty-one IS professionals, all located in the USA, took part in our study. Table 1 depicts the aggregated demographic information of these participants. The average experience of the research participants, at the time of interviews, is 9.9 years in software development. Every participant has a bachelor or higher degree. The gender composition is similar to that of the software industry (Chabrow, 2005). The industries represented by our research participants include manufacturing, higher education, public sector, software and agriculture. The typical size of software development team ranges from four to 10 members.

Table 1. Demographic information of the research participants

	Number of participants
Age range (years)	
21–30	3
31–40	8
41–50	7
51+	3
Gender	
Female	6
Male	15
Experience in IS development	
1–5 years	3
6–10 years	10
11–15 years	5
16+ years	3

IS, information systems.

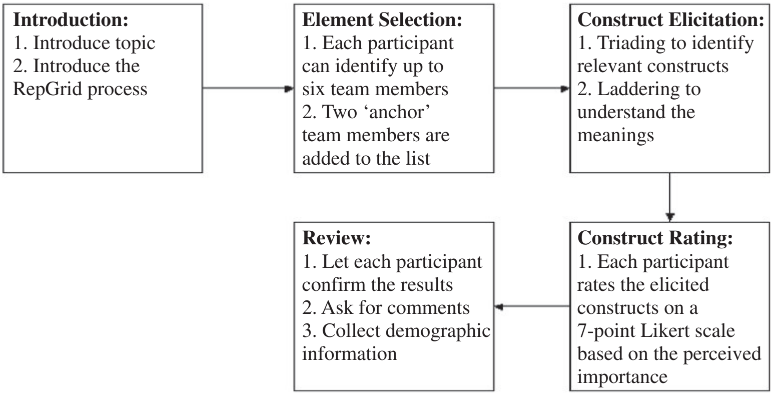

Figure 1. The interview process.

3.2 The interview process

Figure 1 shows an outline of the interview with each research participant. The interview is based on the RepGrid technique, involving five specific steps – introduction, element selection, construct elicitation, rating of elicited constructs, and review.

3.2.1 Introduction

At the beginning of the interview, the interviewer introduced the objective of the study to the research participant. The research participant was informed that he/she would be asked to elaborate his/her opinions on the important characteristics that IS development team members should have in software development teams. The introduction allowed the research participant to focus his/her thinking around the research topic. Then, the interviewer introduced and explained the RepGrid process. After the research participant expressed his/her understanding of the research topic and the RepGrid method, the interview proceeded to the element selection step.

3.2.2 Element selection

In the element selection step, each research participant was requested to identify up to six IS professionals with whom the participant had worked in IS development projects. The identified team members could be in the participant's current or previous teams. The identified team members could be from a single team or from different teams. The bottom line is that the research participant should be able to form an opinion regarding the characteristics of these IS development team members. To reduce potentially limiting influence on the participants, we encouraged them to use initials or aliases when referring to the identified elements. We also added two 'virtual' team members – 'Ideal' and 'Incompetent' – to the list of identified team members. These two virtual team members would be used as comparison 'anchors' in the subsequent construct elicitation step. They also increase the variability in the elements (Stewart & Stewart, 1981). All the team members (actual or virtual) would be the elements in RepGrid technique. In other words, each research participant would face a pool of elements after this step. As suggested by Hunter & Beck (2000), seven elements would provide sufficient variability in the subsequent construct elicitation step. In this study, 12 participants came up with eight elements each; seven participants identified seven elements each; two participants had six elements each for this step.

Table 2 is an example of RepGrid developed from the interview. In the example, the research participant considered eight elements – six team members they have known and two virtual members (i.e. 'Ideal' and 'Incompetent'). Each element is represented using the initial(s) of the team members identified by the research participant. For the two virtual members, 'ID' represents 'Ideal' and 'IN' represents 'Incompetent'.

3.2.3 Construct elicitation

Construct elicitation was conducted using the classical approach – the minimum context form, also known as the triadic sort method (Tan & Hunter, 2002). Three elements (actual or virtual team members) as a triad were randomly selected at a time. For each triad, the research participant was asked to identify, *with regard to a characteristic of IS development team members, how two of them were similar, yet different from the third*. We requested the research participant to think from a peer's perspective. The research participant was encouraged to verbalize his/her reasoning process. The narrative comments were audio-recorded and documented by handwritten interview notes.

Table 2. An example RepGrid based on the interview with a research participant

Constructs	Elements								Rate
	V	K	C	S	L	M	ID	IN	
1. Leader/commanding . . . follower/passive	√	√	√						4
2. Good tech ability . . . insufficient tech ability				√	√	√			1
3. Good learning ability . . . inadequate learning ability			√	√				√	4
4. Sensitive/caring for others . . . not concerned about others	√		√		√				6
5. Able to resolve conflicts . . . arrogant/stubborn		√		√		√			6
6. Honest/ethical . . . dishonest/deceptive		√					√	√	2
7. Positive general attitude . . . negative general attitude				√			√	√	2
8. Detail oriented . . . confused about details	√				√		√		6
9. Good communication skills . . . poor communication skills		√		√		√			1
10. Good at problem-solving . . . not good at analytical/logical thinking			√			√	√		3
11. Creative . . . play it safe	√				√	√			3

In the RepGrid example (Table 2), the three checked team members (elements) on each row represent a triad, on which a construct was elicited by the interviewee. The corresponding construct on the same row is expressed by a bipolar phrase. For example, when the interviewee was given team members 'V', 'K' and 'C', the interviewee identified 'Leader/commanding . . . follower/passive' as the construct to distinguish them into two groups.

The construct elicitation step was then repeated until the research participant could not elicit any additional constructs. Then, the interview proceeded to the constructs rating step.

3.2.4 Construct rating

In the construct rating step, the interviewer reviewed all the elicited constructs and listed them on a piece of paper. The research participant discussed these constructs with the interviewer to confirm the elicited constructs. Then the research participant was asked to provide a score for each elicited construct in terms of the relative importance using a 7-point Likert scale (1 represents the most important, and 7 represents the least important). As the researchers were primarily interested in the constructs and the labels participants attached to these constructs, rather than the research participants' evaluation on specific elements (team members), the research participants were not requested to rate each element based on each elicited construct. This is an accepted variant of RepGrid adopted in Moynihan (1996).

In the same RepGrid example (Table 2), the scores in the column 'Rate' are the relative importance of the constructs perceived by the interviewee. This interviewee rated 'good communication skills . . . poor communication skills' and 'good tech skills . . . insufficient tech skills' as the most important constructs.

3.2.5 Review

At the end of each interview, each research participant was asked to review the constructs that were derived from the interview, as well as the relative importance of each construct. The purpose of the confirmation process is to ensure that the elicited constructs are accurate, complete, and not misinterpreted by the interviewer. The total amount of time for each interview ranged from 45 to 75 minutes.

4. RESEARCH FINDINGS AND DISCUSSIONS

The 21 interviews result in 21 RepGrids, representing a huge amount of data relating to research participants' perceptions about the characteristics of good IS development team members. The rich and in-depth narratives by research participants were the basis of our qualitative content analysis.

4.1 Data analysis

A total of 275 raw constructs were collected from the 21 RepGrids. The average number of constructs per RepGrid is 13.1, with a minimum of 6 and a maximum of 24 (standard deviation = 4.6). This is consistent with prior studies using RepGrid (Reger, 1990; Tan & Hunter, 2002).

RepGrid may yield both quantitative and qualitative representations of a research participant's personal construct system (Reger, 1990). Depending on the specific method applied, RepGrid elicited by each research participant can be aggregated across participants either quantitatively, using statistical techniques such as multidimensional scaling, or qualitatively. In our study, the elements (team members) used in each interview were different across participants. Thus, it does not allow for multidimensional scaling technique to aggregate individual RepGrids. Instead, we conducted a qualitative analysis on the rich, in-depth, and narrative data regarding the dichotomous constructs. This qualitative analysis is based on the open coding approach (Strauss & Corbin, 1990). Strauss & Corbin (1990) define open coding as 'the process of breaking down, examining, comparing, conceptualizing, and categorizing data' (p. 61). We used a two-layer classification scheme to categorize the elicited constructs, namely *construct class* and *category*. Construct class is intended to remove redundancy among the elicited constructs. In other words, a construct class represents a unique characteristic of good software development team members. Category was used to conceptualize the unique construct classes to a higher abstraction level.

Following the principles of open coding (Strauss & Corbin, 1990), two of the authors went through all the elicited constructs, the related interview notes, and the interview transcripts. By eliminating redundant or overlapping constructs, the two researchers identified 59 unique *construct classes* through consensus. Then the two researchers worked together to generate conceptual categories that were relevant to the construct classes. Eight categories were identified, namely *teamwork orientation*, *values/attitudes*, *knowledge*, *personality*, *working/cognitive ability*, *interpersonal/communication skills*, *management skills*, and *professional orientation*. The two researchers then worked independently to categorize the 59 construct classes into the eight categories.[1] Table 3 depicts the construct classes and categories, as well as the average importance score for each category.

In addition to the qualitative content analysis, we incorporated a quantitative analysis by averaging the importance scores for each construct class and category. In this way, we were able to obtain a holistic view of the relative importance of each category as perceived by the research participants.

4.2 Point of redundancy

Even though Tan & Hunter (2002) suggest that the 'intensive nature of the RepGrid technique often means a relatively small sample size', the point of redundancy is used to verify the comprehensiveness of the results.

In qualitative research, the researcher 'cannot state at the outset of his research how many [subjects] he will sample during the entire study; he can only count up the [subjects] at the end' (Glaser & Strauss, 1967, p. 61). When subsequent interviews could not yield any new findings, it can be concluded that the 'point of redundancy' has been reached. This is the standard 'stopping rule' used in qualitative research (Yin, 1994), similar in nature to the notion of 'theoretical saturation' (Strauss & Corbin, 1990).

In this study, the point of redundancy was reached at the 10th subject. This was calculated by starting with the RepGrid of the first research participant and then adding one additional RepGrid at a time to find the additional construct classes identified by each additional participant. The cumulative construct classes converged at 59 at the 10th participant, indicating that the point of redundancy was reached. In other words, the construct classes were exhausted by the time we reached research participant number 10. This finding suggests that the sample size of 21 is adequate to capture all the construct classes.

4.3 Rigour of the study

In qualitative research, rigour of the study is required to generate credible and trustworthy results (Lincoln & Guba, 1985; Lee, 1989; Strauss & Corbin, 1990; Miles & Huberman, 1994; Yin, 1994). The present study ensured its rigour in the following aspects.

[1]The inter-rater reliability was 93%. The discrepancy on the four construct classes was resolved through discussions.

Table 3. Results of qualitative analysis

	Frequency	Mean importance	SD
Working/cognitive abilities	74	2.57	1.31
Reliable/dependable . . . unreliable	15	1.93	1.03
Able to work independently . . . count on others to do work	8	2.75	0.89
Able to understand the whole picture . . . unable to see the whole picture	7	2.29	1.25
Strong learning ability . . . slow learner	7	2.29	1.25
Good problem solver . . . poor problem solver	6	1.83	0.98
Innovative/creative . . . not creative	6	2.67	1.03
Organized/systematic . . . have no structure in work	6	3.17	2.04
Knows details . . . not detail oriented	5	2.6	2.07
Able to make decisions . . . weak in decision-making	4	3.25	1.71
Able to identify problems . . . unable to identify problems	3	3	0
Able to deliver quality work . . . unable to deliver satisfying work	1	3	Null
Able to do research . . . unable to do research	1	3	Null
Able to learn from other team members . . . unable to learn from other team members	1	3	Null
Able to work with different people . . . unable to work with others	1	5	Null
Productive/efficient . . . inefficient	1	3	Null
Smart/sharp . . . slow	1	4	Null
Strong analytical skills . . . poor analytical skills	1	5	Null
Attitudes/motivation	42	2.38	1.29
Motivated to work . . . unmotivated	13	2.23	1.01
Hardworking . . . lazy	7	1.86	1.21
Concerned about results . . . do not care about results	5	2.6	1.82
Motivated to learn . . . unwilling to learn	4	2	0.82
Positive general attitude . . . negative general attitude	4	2	0.82
Share/take responsibilities . . . avoid responsibilities	3	2.33	0.58
Authoritative/powerful . . . lack of authority/power	2	4	1.41
Willing to put extra effort . . . unwilling	2	3.5	0.71
Energetic/active . . . passive	1	6	Null
Willing to take risks . . . play it safe	1	1	Null
Knowledge	39	2.31	0.95
Strong technical knowledge . . . poor technical knowledge	27	2.15	0.99
Sufficient work-related experience . . . insufficient experience	6	2.83	0.41
Understand business functions. . . do not understand business	6	2.5	1.05
Teamwork orientation	39	3.26	1.53
Team player . . . not a team player	8	2.5	1.6
Open to inputs/criticism . . . unwilling to take suggestions	6	3.17	1.6
Supportive . . . work on his/her own part	6	3.33	1.51
Committed to team/project . . . indifferent/uninterested	5	3.6	1.67
Cordial/considerate in exchanging ideas. . . arrogant/offensive	5	4.4	1.82
Easy to reach consensus . . . hard to compromise	5	3.4	0.89
Share ideas/outspoken . . . keep to self/uncommunicative	3	2.33	1.53
Respect others' expertise . . . look down on others	1	4	Null
Interpersonal/communication skills	32	2.47	1.16
Effective communication with team members . . . ineffective	24	2.42	1.21
Good listener . . . poor listener	4	2.25	1.26

Table 3. cont.

	Frequency	Mean importance	SD
Able to communicate with non-technical people effectively . . . unable	2	2.5	0.71
Easy to get along with . . . difficult to deal with	2	3.5	0.71
Management skills	23	3.83	1.64
Good leadership skills . . . poor leadership skills	7	3.29	1.8
Good project management skills . . . poor project management skills	4	3.5	1.91
Good planning . . . poor planning	3	2.67	1.53
Able to prioritize tasks . . . unable to prioritize tasks	2	5	1.41
Able to synthesize information . . . unable to synthesize information	2	3.5	0.71
Good time management . . . poor time management	2	4.5	0.71
Able to keep project on track . . . unable to keep project on track	1	5	Null
Able to motivate others . . . unable to motivate others	1	6	Null
Able to resolve conflict . . . unable to resolve conflict	1	6	Null
Personality	22	3.36	1.81
People person . . . unsociable	7	2.86	1.77
Extroverted. . . introverted	4	4.75	1.71
Disciplined . . . do not follow rules	3	2	1
Confident . . . lacking confidence	2	5	2.83
Grounded/consistent behaviour . . . unstable behaviour	2	2	0
Honest . . . deceptive	2	2.5	0.71
Mature . . . immature	2	5	0
Professional orientation	4	2	1.15
Customer oriented . . . technology oriented	4	2	1.15

SD, standard deviation.

First, we followed the standard procedures of RepGrid to collect data through interviews. RepGrid, as a systematic approach to articulate and organize individuals' 'personal constructs system', is an established research method that has been widely used in various disciplines. The data analysis followed the guideline of open coding (Strauss & Corbin, 1990). By complying with established data collection and analysis techniques, we ensured the reliability and validity of the research.

Second, prior literature was used for 'supplemental validation', a verification step suggested by Creswell (1998, p. 209). The combination of RepGrid and qualitative analysis in this study aimed to inductively develop constructs based on the elicited opinions of IT professionals. Prior literature was used as additional resources for validation of the research results.

Third, throughout the data analysis, findings were verified by constantly referring back to the data and comparing the data with the emerging construct classes and categories. This is a common verification method used in qualitative research when research results are inductively derived from data (Strauss & Corbin, 1990). In particular, two researchers independently grouped the construct classes into categories. Disagreements were resolved based on consensus.

Fourth, a standard 'stopping rule' for qualitative research with respect to the sample size was used to verify the sufficiency of the sample size. With the point of redundancy at the 10th interview, we could argue that we have elicited a comprehensive list of constructs (characteristics) with 21 subjects.

4.4 Discussions

Among all the categories regarding characteristics of good team members in software development projects, some of the categories are general characteristics that are relevant to teams in any empirical settings. For example, *interpersonal/communication skills and teamwork orientation* are always considered important characteristics of team members in any project (Ford & McLaughlin, 1992; Hyman, 1993). Because software development teams are also project teams, it is not surprising that these characteristics are important to software development teams.

Some categories are relevant to personal competence in social interactions. They include: *personality*, *working/cognitive ability*, and *attitude/motivation*. In general, attitude/motivation and personality are key determinants of the ability of a person to function/fit well in a social structure (Kaiser & Bostrom, 1982). The general working/cognitive ability reflects the way an individual grapples with problems and tasks.

We also found some constructs/categories that are unique to team members of IS development projects, namely *learning ability*, *multidimensional knowledge* and *professional orientation*.

As a type of cognitive ability, learning ability is an important trait of a good IS development project team member. IS development technologies are constantly evolving. More often than not, an IS project needs to incorporate techniques and architectures that are new to team members. Therefore, learning ability determines whether a team member can keep up with new knowledge, stay competent, and contribute to the team project.

An IS development team member must not only master technical knowledge such as programming and modelling, but also be able to understand business – i.e. how a business functions and what business processes are involved. Technical expertise has been constantly regarded as one of the most important traits for IS professionals (Walz *et al*., 1993). Unlike the teams in other areas, software development teams develop software used in different business functions. Without sufficient business knowledge, team members cannot deliver the software applications that meet business needs. Thus, it is not surprising that multidimensional knowledge is perceived as an important characteristic of a good IS development project team member.

This also makes another category – professional orientation – relevant. A good team member must be able to communicate with customers (who will be end-users of the resulting systems), understand the business processes, and focus on delivering systems that satisfy customers.

Some of the identified categories of the characteristics of good IS development team members in our study can be found in the list of traits developed by Walz & Wynekoop (1997). However, the relative importance of the identified categories that are perceived by our research participants is different from the findings in Wynekoop & Walz (1999). Our research participants viewed attitude/motivation, expertise, working/cognitive ability, and interpersonal/communication skills as the most important characteristics, while the IT professionals in their study rated abstract thinking, creativity, interpersonal skills, technical and business knowledge as having the highest importance. One reason for this difference may be that the context of their study (Wynekoop & Walz, 1999) is not as specific as ours, i.e. the specific environment where the IS professions work – whether they work independently or within a team. In our study, we specifically asked the research participants to think of the important characteristics of IS development team members. Another reason for the difference may be the research participants' experience. The average number of years of working experience in our sample is over 9 years, vs. 4.5 years in the study conducted by Wynekoop & Walz (1999).

5. RESEARCH AND MANAGERIAL IMPLICATIONS

As one of the first research to study the characteristics of a good team member in IS development projects, we adopted RepGrid techniques to explore the personal construct systems of IS professionals. Based on a qualitative analysis of raw RepGrids, we developed a number of categories of good IS team member characteristics, namely teamwork orientation, values/attitudes, knowledge, personality, working/cognitive ability, interpersonal/communication skills, management skills, and professional orientation. The combination of RepGrid as data collection method and open coding in Grounded Theory as data analysis method has proven to be an effective way of developing constructs in a relatively under-studied area.

The results of this study are a step towards developing a theory for effective team staffing and team management in the context of IS development. This is because a good understanding of the important characteristics of IS development team members from a peer's perspective is needed for theory building in this area. Therefore, this study answers the call for theory building in IS research (Klein & Lyytinen, 1995). Because this research was conducted in the USA, all research participants work in US companies. Similar studies can be conducted in other countries so that cross-culture comparisons are feasible. In the current environment of global development, such comparisons will extend our understanding of the important characteristics of team members in IS development projects.

This study can be also viewed as an instrument development effort. The construct classes and categories identified in this study can serve as a framework for designing survey questionnaires. In this aspect, future research can validate the constructs derived in this study by administrating a survey on a large number of IS developers.

This study also demonstrates that techniques derived from social psychology can be effectively applied in IS research. RepGrid is one of many cognitive mapping techniques that are used to identify subjective beliefs and to portray these beliefs externally (Fiol & Huff, 1992). Some other cognitive mapping techniques have also demonstrated usefulness in IS research and practice (Siau & Tan, 2005a,b; 2006a). IS researchers are encouraged to explore, in various sub-disciplines, the potential of cognitive mapping in their research (Siau & Tan, 2006b).

This study also has practical implications to IS professionals. The characteristics of a good team member in IS projects, identified in this study, can be used as guidelines for recruiting and selection, for work allocation, and for identifying training needs (Hunter, 1997). As one participant indicated in the interview, 'I would like to have the results of this study, so next time when we start a new IS project, I can show it to my boss and tell him, "I want people who have those characteristics to be included in my team." ' This research links IS research to practice and produce results of relevance to practitioners.

6. CONCLUSION

This research used the qualitative approach to study the characteristics of good IS development team members. We adopted the RepGrid technique to capture the personal construct systems of our research participants regarding the important characteristics of team members.

Our study yields very rich, in-depth, and narrative data regarding the research participants' perceptions about the characteristics of good IS development team members. Based on the qualitative analysis, we further categorized the raw constructs into 59 construct classes and 8 categories. The aggregated results suggest that *working*/*cognitive ability*, *attitude*/*motivation*, *knowledge* and *interpersonal*/*communication skills* are perceived to be the most important characteristics of good IS development team members.

Our study has significant implications for IS recruiting, IS training, IS staffing, and IS human resource management. The comprehensive list of important characteristics, together with the relative importance from the perspectives of peer team members, can serve as the criteria for managers to select appropriate members for an IS development project. Our study also has implications for future research. For example, are there differences in expectations between team members and end-users with respect to the important characteristics of team members? How about between IS managers and team members? Future research is needed to further analyse these issues and their importance based on the types of projects the team members are working on (e.g. large-scale software package implementation, in-house software development, etc.). To have successful IS development projects, we need to better understand the dynamics within IS development teams.

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