

# Investigating the Characteristics Needed by Scrum Team Members to Successfully Transfer Tacit Knowledge During Agile Software Projects

Deon Takpuie and Maureen Tanner

Department of Information Systems, University of Cape Town

[TKPDEO001@alumni.uct.ac.za](mailto:TKPDEO001@alumni.uct.ac.za)

[mc.tanner@uct.ac.za](mailto:mc.tanner@uct.ac.za)

**Abstract:** The purpose of this study is to propose a theoretical model describing what makes Scrum team members successful at transferring knowledge. Twelve semi-structured interviews were conducted at two Scrum companies in Cape Town, South Africa. Participants interviewed ranged from project managers and Scrum masters to software developers, business analyst and testers. The interviews were all transcribed, then analysed using thematic analysis. Past studies have already identified factors (i.e. characteristics that enable people to transfer knowledge) that are known to impact knowledge transfer. This study further extends the body of knowledge by revealing how these existing factors are interrelated while impacting knowledge transfer. In addition, new factors (i.e. empathy and articulation skills of the source) are proposed, which were found to further impact knowledge transfer in Scrum teams. The results have shown that recipients perceive team members who are able to successfully transfer knowledge as having the following characteristics: motivation, capability, credibility, empathy, articulate and ability to communicate enough. The contribution of this study to practice is a list of team member characteristics, that HR managers could foster through appropriate training, to help improve the knowledge transfer within Scrum teams. This paper offers new contributions and a theoretical model to the under researched area of knowledge transfer within Scrum teams.

**Keywords:** Agile software development, scrum, motivation, tacit knowledge, knowledge transfer, teams

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## 1. Introduction

Agile methods are a family of methodologies characterized by light documentation, iterative and rapid software delivery and quick response to change (Conboy & Fitzgerald, 2004). One of the key differences between Agile methods and the Waterfall approach pertains to the knowledge management principles that underpins them (Chau, Maurer & Melnik, 2003). The Waterfall approach is “plan-driven” and heavily relies on documentation (explicit knowledge) for capturing and transferring knowledge. In contrast, agile approaches favour individuals and interactions over processes (Fowler & Highsmith, 2001). This induces a shift towards informal communication amongst team members and a heavy reliance on tacit knowledge which needs to be transferred amongst the team members to prevent project failure (Boyatzis, 1998).

According to Lyytinen and Robey (1999), knowledge management is one of the main remedies to software project failures. Knowledge transfer in particular, is essential to knowledge management. Knowledge transfer is the process of transmitting a message from a source/sender to a recipient in a specific context (Szulanski, 1996). Knowledge transfer is often investigated in relation to inter and intra-organizational transfer but there has been little research done on that topic within Agile teams (Zellmer-Bruhn, 2003) and agile projects (Davenport, David & Beers, 1998). There is also limited evidence of success factors that promote knowledge transfer in agile methodologies (Levin, Lesser, Cross & Abrams, 2005).

Knowledge transfer is important, particularly in Agile software development as its core principles include the involvement of collocated teams to increase communication and more efficiently disseminate project information (Chau et al., 2003). Agile projects emphasise project-related tacit knowledge (i.e. difficult to articulate or write down) transfer through frequent verbal communication and team interaction (Cockburn & Highsmith, 2001).

This study addresses this gap by investigating knowledge transfer in Scrum, the most popular agile methodology (VersionOne, 2013). Scrum heavily relies on tacit knowledge transfer throughout the project. For instance, regular Sprint meetings are held to enhance knowledge transfer between the team, Scrum master, Product Owner and sometimes the client (Karlsen, Hagman, & Pedersen, 2011). Furthermore, South Africa (SA) has low stakeholder satisfaction in Agile development projects and it has been recommended that more case study research be conducted to investigate knowledge transfer in SA Scrum teams (Ferreira & Cohen, 2008).

The purpose of this study was to develop a model highlighting particular characteristics of Scrum team members that enable them to successfully transfer tacit knowledge during a software project. In particular, the study seeks to determine how **perceived motivation, perceived capability, perceived credibility, and perceived communication extent** of team members affect the perceived extent of tacit knowledge transferred within a Scrum team. Perceived capability, perceived credibility and perceived communication extent variables were derived from Joshi, Sarker & Sarker (2007)'s model of knowledge transfer in Information Systems Development. This model was extended to include perceived motivation in line with Joshi et al. (2007)'s recommendation to examine more factors that contribute to knowledge transfer. Motivation was considered a relevant construct as it is one of the core principles in the Agile Manifesto (Fowler & Highsmith, 2001). Moreover, if teams are not motivated, they might not be able to take advantage of the numerous opportunities to transfer knowledge in Scrum. This was investigated using twelve semi-structured interviews at two Agile software companies in Cape Town, South Africa. Thereafter, the results were analysed using thematic analysis and synthesised. Other relevant characteristics emerging from the data were then also incorporated in the final model.

The study contributes to practice by providing better insights on how to enhance knowledge transfer within Scrum teams, to Agile project managers, Scrum Masters and HR Practitioners. In particular, the findings could assist them in identifying team members with relevant skillsets and mindsets to initiate and transfer knowledge. This could be relevant to organisations that promote both intrinsic and extrinsic motivation to transfer knowledge. Team members could also be trained, enabling them to acquire the relevant skillsets.

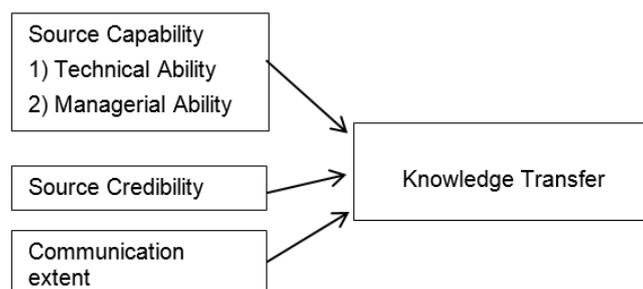
The study contributes to the IS research community by proposing a theoretical model (adapted from Joshi et al., 2007) pertaining to knowledge transfer within Scrum team. Even though Joshi et al.'s (2007) knowledge transfer model was unique because it was actually specific to software development, it was not specific to Scrum and agile software development. Therefore, this current research goes further to extend the model to an agile-specific setting, which does not seem to have been done before. The model also depicts how existing characteristics are interrelated while impacting knowledge transfer and has been extended through the introduction of new key constructs. It is anticipated that the model can be further tested and extended by other researchers.

The outline of this paper is as follows. In the next section, the literature review of previous studies on knowledge transfer are explored, from which a preliminary model is derived, as well as research questions. In Section 3, the research methodology comprising of the data collection and data analysis techniques are discussed. In Section 4, the findings are presented in the context of the research questions whilst being compared to the relevant literature. In Section 5, the conclusion finalizes the paper by restating the aim, what was achieved and then points to future research areas.

## 2. Literature Review

In this section, the theoretical model underpinning the study is discussed. In particular, a theoretical model of knowledge transfer within ISD teams from Joshi et al., (2007) has been chosen as basis for this study (see Figure 1). Joshi's model has been extended to include additional constructs relevant to this study. The literature review will first discuss the constructs from Joshi's original model. The relevant adaptations for the purpose of this study are then detailed.

### 2.1 Joshi, Sarker and Sarker's Model of Knowledge Transfer



**Figure 1:** Source attributes affecting knowledge transfer in information systems development (ISD) teams (Joshi et al., 2007)

Various theoretical perspectives could be used to identify factors that affect knowledge transfer in Scrum teams. These can be categorised as either cognitive or connectionist theories. The cognitivist perspective views knowledge as being universal data, thus easily transferable from source to recipient (Venzin, von Krogh & Roos, 2000). The Theory of Planned Behaviour (Ajzen, 1991) as well as the theory of Theory of Reasoned Action (Ajzen & Fishbein, 1980) are examples of cognitive theories. However, cognitive models do not consider the complexities of the actual knowledge transferred (Kogut & Zander, 1992). They therefore do not consider the capabilities of the knowledge sender/source as important, while some empirical studies found them critical (Faraj & Sproull, 2000).

In contrast, the connectionist perspective sees knowledge as contextual and naturally difficult to convey (Venzin et al., 2000) and was thus chosen as basis for this study. Models based on communication theory fall within the connectionist perspective and are relevant to IS studies (Joshi et al., 2007). In particular, Szulanski (1996) model of knowledge impediment and Joshi et al. (2007) model of knowledge transfer within IS are underpinned by communication theory.

Joshi, et al., (2007)'s model was chosen as it specifically investigates knowledge transfer within software development teams. Though, this model is not as comprehensive as Szulanski's (Szulanski, 1996) knowledge management model, but it covers the relevant attributes of knowledge transfer for ISD teams. Furthermore, this research will also refer to the constructs in Szulanski's model, in a simplified form as cited in Joshi et al. (2007)'s study, such as the use of terms like *Source Credibility*, instead of reliability of the source. This is because most of the new knowledge management literature use these new terms when referring to Szulanski's model.

### *2.1.1 Knowledge Transfer*

Knowledge management is multidisciplinary in nature and various perspectives need to be considered while investigating and defining this field of study (Grossman, 2007). Dalkir (2005) even referenced over 100 different definitions of knowledge management. One of the main views on knowledge management is from Polanyi (1958, as cited by Grant (2007)) who stated that knowledge cannot be exclusively classified as either tacit or explicit but ranges instead on a continuum. In his view, all knowledge carries some tacit components and can be made more explicit in some situations. For example, Nonaka and Toyama (2005) claim that in order for individuals to share and synthesise tacit knowledge, it has to be externalized into an objective explicit form. This new form of knowledge is then embodied by the recipients who then further enrich their existing tacit knowledge. This can be viewed as a social process through which 'truth' is validated (Nonaka, 1994; Nonaka & Takeuchi, 1995).

Polanyi (1958) relates tacit knowledge to one's ability to achieve something or solve a problem through personal experience and learning. He further claims that this knowledge could, to some extent, be made more explicit through language and communication. He further posits that in some cases it is not possible to articulate that knowledge and uses the term "ineffable" to define such types of knowledge (Grant, 2007).

Jakubic (2011, pg. 393) sought to broaden the view of knowledge creation and transfer by Knowledge Management Scholars (e.g. Nonaka et al., 2008) by proposing a model that "could better highlight the social, human, interactive, evolutionary, and dynamic nature of knowledge creation". Jakubic (2011)'s model shows that knowledge creation happens within a specific context and at a specific moment in time. Recipients would explore and experience the knowledge ecosystem and would then embark in a process of thinking and sense making, resulting in a learning and knowing process which is social, time and context dependent.

Software development projects have both explicit and tacit knowledge. Explicit knowledge is easy to express such as knowledge about technology tools and user requirements gathering. Tacit knowledge is difficult to articulate and relates to managerial and relationship knowledge (Joshi et al., 2007). There are various knowledge types in ISD, such as technical, managerial, organisational and behavioural (Lindvall & Rus, 2002). Technical and managerial knowledge are depicted in Joshi et al. (2007)'s model. Technical knowledge refers to programming, testing, designing, database and requirements gathering knowledge (Lindvall & Rus, 2002) and is explicit as it is easily transferable (Goh, 2002). Managerial knowledge refers to planning, deadline handling, dealing with staff and directing a project (Lindvall & Rus, 2002). This knowledge is more tacit as it gained

through experience (e.g. how to handle staff) and is usually transferred through observations (Bassellier, Reich, & Benbasat, 2003).

### *2.1.2 Source Capability*

The amount of knowledge transferred by a source is positively related to the source's capability (Joshi et al., 2007). Studies have shown that the experience and knowledge gained over time improves a person's ability to transfer knowledge (Faraj & Sproull, 2000). Furthermore, in Szulanski's (1996) model of knowledge impediment, casual ambiguity, which is when a source does not have the capabilities to reproduce knowledge, was found to be of the top three knowledge transfer impediments within companies.

In the context of ISD (including Agile development), capability of the source (as perceived by the recipient) refers to the ISD-related knowledge of a team member and consists of technical and managerial capability (Joshi et al., 2007). Technical capability relates to programming, database and general computer knowledge of a team member while the managerial capability refers to the leadership, planning and relationship management abilities (inter-personal skills) of the team member (Lindvall & Rus, 2002). Past studies have validated the positive correlation between the perceived capability of the source and the extent of knowledge transferred within IS teams. It was found that team members who were perceived as capable were more inclined to transfer knowledge (Bock & Kim, 2002). In turn those who were perceived as having lesser expertise than others were less likely to transfer knowledge (McHugh, Conboy & Lang, 2011).

### *2.1.3 Source Credibility*

Credibility of the source refers to the extent to which a team member is perceived by other team members as trustworthy and reputable (Joshi et al., 2007). Trust and trustworthiness are closely related, in that a trustworthy person is a source that can be trusted (Tsai & Ghoshal, 1998). It can thus be stated that this construct has two dimensions: Trustworthiness and Reputation (Joshi et al., 2007). The impact of trust in the source on the knowledge within teams has been showed by other studies. When the source is not perceived as trustworthy, i.e. someone who can be trusted (Tsai & Ghoshal, 1998) or credible by the recipient, their knowledge may be questioned or even rejected (Szulanski, 1996). Trust has been labelled as a precondition to knowledge transfer (Rolland & Chauvel, 2000) and as a "magic ingredient" to knowledge transfer (Cockburn & Highsmith, 2001). In Agile (so too Scrum) methodologies, trustworthiness of a source has been found to be key for the transfer of tacit (or difficult to explain) knowledge which is the dominant knowledge type in Agile methodologies (Karlsen et al., 2011).

The perceived reputation of a source (by the recipient) is also key to any knowledge transfer (Joshi et al., 2007). Davenport et al. (1998) found that potential recipients often evaluate the knowledge that can potentially be transferred by a source based on the latter's reputation. Sources with no specific reputation were perceived as having less valuable knowledge (Davenport et al., 1998). This may be why in Agile and Scrum teams, members of similar levels of experience were said to exhibit a high amount of knowledge transfer, as they members probably saw each other as equally reputable (Levin & Cross, 2004).

### *2.1.4 Communication Extent*

This construct relates to the extent and frequency to which a team member has communicated, as perceived by other team members (Szulanski, 1996). Joshi et al. and several other researchers (Ferreira & Cohen, 2008) agree on the positive impact of communication extent on knowledge transfer in teams. Literature finds team communication to be one of the core factors enabling knowledge transfer success (Chau et al., 2003). For example, communication frequency has been found critical in knowledge transfer of product development teams and the lack of communication frequency and ease of communication between the source and recipient were one of the top 3 impediments to knowledge transfer within firms (Szulanski, 1996).

## **2.2 Extending Joshi, Sarker and Sarker's model**

The model was extended by incorporating the motivation factor of the source/sender, in line with Joshi, et al., (2007) recommendation. Motivation of the team is also key to knowledge transfer within Agile and Scrum teams (McHugh, et al., 2011). Various aspects of motivation relevant to this study are further discussed below.

### 2.2.1 Source Motivation

Motivation is what moves a person to do something. The motivation of an Agile team has always been said to be key to their knowledge transfer (McHugh et al., 2011), as motivation is one of the core principles in the Agile manifesto (Fowler & Highsmith, 2001). Both intrinsic and extrinsic motivation appear to influence knowledge transfer in Agile teams (McHugh et al., 2011).

- *Intrinsic Motivation*

Intrinsic motivation relates to the willingness to perform an activity for its inherent satisfaction as opposed to the consequences of completing it. Ryan and Deci (2000) argue that intrinsically motivated individuals are moved to act because of the challenge or the fun experienced by engaging in that activity as opposed to pressure or reward.

Intrinsic motivation has been said to be important to tacit knowledge transfer, which is the focus of Agile team's (Karlsen et al., 2011) as managers need to rely on employee's natural desire and intrinsic motivation to transfer unseen/tacit knowledge between each other (Osterloh & Frey, 2000). Intrinsic motivation has also been seen to influence knowledge transfer more strongly than extrinsic motivation. This relates to the motivational crowding out concept, which says that if someone is incentivized to do something, they will have less interest in it and potentially work less hard at it (Frey & Jegen, 2001).

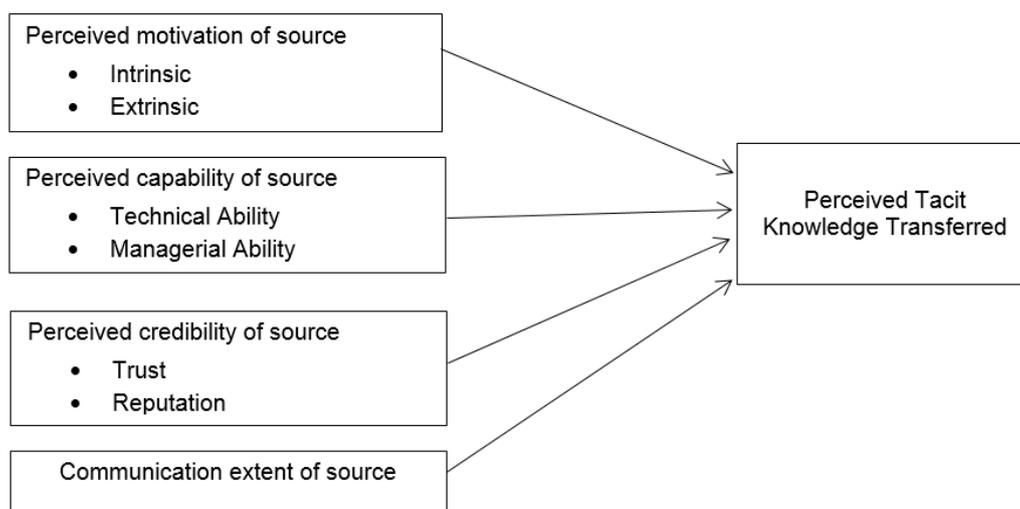
- *Extrinsic Motivation*

Extrinsic motivation relates to the completion of an activity as a means to attain some outcome (Ryan & Deci, 2000). Within Scrum teams, extrinsic motivation may be in the form of Scrum team members contributing to daily Scrum meetings in order to look reputable in front of their peers (McHugh et al., 2011). The motivation crowding out effect, says that those who are extrinsically motivated might appear to be less intrinsically motivated/interested in the task itself and may work less hard at it (Burroughs, et al., 2011).

People are often also motivated to transfer knowledge based on external rewards, such as money and social/peer recognition (Bock & Kim, 2002). Financial rewards have often been said to successfully motivate employees to transfer knowledge, however many recent studies have found this not to be the case (Bock & Kim, 2002). Social rewards such as badges or the possibility of being recognized as an expert in a field, have also been seen as good motivators for knowledge transfer (Schenk and Lungu, 2013).

### 2.3 Extended Theoretical Model

The extended theoretical model underpinning this study is presented in Figure 2. Since it is difficult to measure knowledge transfer (Karlsen et al., 2011), the recipients' perception of the extent of knowledge they have gained has been investigated.



**Figure 2:** Source attributes affecting knowledge transfer in Scrum teams – Extended model

The model has been contextualised to co-located Scrum development teams (see Table 1) and has been qualitatively tested using semi-structured interviews in a Scrum organization in South Africa. Furthermore, the variable of knowledge transferred has been explicitly articulated as 'perceived tacit knowledge transferred'.

**Table 1:** Contextualisation of Research Model

Theoretical Models Concepts	Application
The team	Usually software developers, documenters and testers (Schwaber, 1995)
Perceived tacit knowledge transferred	The tacit (or difficult to articulate) knowledge that one Scrum team member perceived to have acquired from another team member (Chau, et al., 2003; Joshi et al., 2007). Agile projects often emphasise tacit knowledge transfer through frequent verbal communication and team interaction (Cockburn & Highsmith, 2001)
Motivation of source (as perceived by recipient)	Motivation is what moves a person to do something. Motivation can be either intrinsic or extrinsic (Ryan & Deci, 2000)
Capability of source (as perceived by recipient)	This is the ISD knowledge of a team member and consist of technical (programming, database and general computer knowledge and managerial capability (leadership, planning and relationship management abilities) (Joshi et al., 2007)
Credibility of source (as perceived by recipient)	This refers to the extent to which a Scrum team member is perceived by other team members to be trustworthy and reputable (Joshi et al., 2007; Szulanski, 1996).
Communication extent of source (as perceived by recipient)	The extent to which a Scrum team member has communicated, as perceived by other team members (Leenders, Van Engelen, & Kratzer, 2003; Szulanski, 1996).

## 2.4 Research Questions

The research questions have been formulated as follows:

Main Research Question:

- What characteristics are associated with team members who are able to transfer tacit knowledge successfully in Scrum projects?

Sub-Research Questions:

- How does perceived motivation affect the perceived extent of tacit knowledge transferred by a team member?
- How does perceived capability affect the perceived extent of tacit knowledge transferred by a team member?
- How does perceived credibility affect the perceived extent of tacit knowledge transferred by a team member?
- How does the perceived communication extent of a team member affect their perceived extent of tacit knowledge transferred?
- What other characteristics are associated with team members who are able to transfer tacit knowledge successfully?

## 3. Methodology

The study employed an interpretivist epistemology as it is well suited to complex human issues such as tacit knowledge transfer. Through interpretivism, one can construct/interpret how the team members perceive the extent to which tacit knowledge transfer occurs (Rodriguez-Ulloa & Paucar-Caceres, 2005). In contrast, a positivist paradigm might not have been suitable as it is difficult to measure tacit knowledge transfer quantitatively (Karlsen, Hagman, & Pedersen, 2011).

In addition, only qualitative data was used as this correspond with the interpretive epistemology, which supports getting rich and in-depth qualitative information on a small sample (Voss, Tsiriktsis, & Frohlich, 2002).

The research was mainly descriptive in nature as it sought to describe the characteristics that a team member should have to successfully transfer knowledge to other Scrum team members. This allowed the first 5 sub-research questions, which are descriptive in nature, to be answered. The research was also exploratory in that it enhanced the theoretical model based on findings that emerged. This allowed the final research question which was exploratory in nature, to be answered.

### **3.1 Data Collection**

The research strategy chosen was semi-structured interviews. The interview questions were first piloted with three participants. The results of the pilot led to questions being refined and new questions added so richer information could be gathered. The interview questions were based on the research questions. Twelve semi-structured interviews were then conducted at two Scrum development companies (Company A and Company B) in Cape Town, South Africa, over a three-month period. Cape Town was suitable, being diverse and technologically advanced and one of the three largest metropolitan cities in South Africa, (Booyens, 2012). The researchers did not have any prior relationship with neither of the companies, and they were each invited to participate in the study via email.

Company A focused on providing business consulting and software solutions to corporate organisations. Company B focused on software solutions, business intelligence as well as usability and design services to mainly insurance and financial companies. These two distinct companies were chosen as they specifically employed Scrum as software development methods for their projects and had been doing so for several years. Literature often samples different companies when looking at knowledge transfer in software development teams as different companies may have different project types which may influence team context (Björnsön & Dingsøyr, 2008). To this end, the participants for this study were selected from two Scrum companies in Cape Town, South Africa, each focusing on different project types. This further allowed for triangulation (Hussein, 2009) whereby the findings from one case was further verified in the second case (Baxter & Jack, 2008; Hussein, 2009).

Participants thus belonged to two distinct teams from two distinct companies. In particular, all participants from Company A belonged to one team and the same applies for Company B. In line with the maximum variation sampling strategy, these participants covered all Scrum roles: software developers, business analyst, testers, project managers, Scrum masters (Schwaber, 1995). The group of participants also consisted of both male and female, as well as African, Asian and Caucasian ethnicities. This allowed for multiple perspectives on which characteristics make a person transfer tacit knowledge successfully, building a more holistic picture (Patton, 2005).

The interview length ranged from 30-50 minutes per interview. In line with Guest, Bunce and Johnson (2006), not much information emerged after twelve interviews, implying that saturation had been reached for this research.

To provide more contextual information pertaining to this study, a profile of the respondents and a narration of their company context is provided in Table 2. In line with Schwaber (1995)'s description of Scrum teams, the table indicates that the respondents belonged to various job positions. The diversity of the respondents' job description does not impact the generalisability of the results as the study specifically investigates tacit knowledge transfer in relation to the Scrum methodology skillset and not specific job related skillsets.

Participants answered questions based on their experiences related to knowledge transfer within their respective teams; however, where necessary they also drew on past experiences of work in companies that were mostly from the finance, banking, and manufacturing industries. This was because some of them had not been working at their current companies for a long time.

**Table 2:** Participants Profile

Alias	Company	Job Position	Project Team Role	Experience
P1	A	Junior Software Developer	Software Developer	<1 Year
P2	A	Test Manager	Test Manager and Quality Assurance Tester	8 Years
P3	A	Head Project Manager	Project Manager and was a former Software Developer	6 Years
P4	A	Project Manager and Business Analyst	Project Manager	4 Years
P5	A	Business Analyst	Business Analyst and Scrum Master	2 Years
P6	A	Project Manager	Project Manager	20 Years
P7	B	Scrum Master	Scrum Master	4 Years
P8	B	Software Developer	Software Developer	3 Years
P9	B	Lead Software Developer	Software Developer	3 Years
P10	B	Software Architect	Software Architect and Software Developers	8 Years
P11	B	Intermediate Software Developer	Software Developer	3 Years
P12	B	Head Project Manager	Project Manager	20 Years

The unit of analysis was each individual team member, which consisted of the programmer/software developer, tester, documenter/business analyst, product owner, project manager and Scrum master (Schwaber, 1995). There were not inclusion or exclusion criteria (such as age) as this was not found relevant in other Scrum studies (Karlsen et al., 2011).

**3.2 Data Analysis**

All the interviews, were recorded, to retain all the information, transcribed and then analyzed with thematic analysis, a systematic yet simple to use qualitative method. Atlas TI (version 7) was used as analysis tool. The exact type of thematic analysis method used was Braun and Clarke (2006) and involved: (1) Familiarising oneself with the data, (2) Generating initial codes, (3) Searching for themes, (4) Reviewing themes, (5) Defining and naming themes and (6) Producing the report.

The analysis process was iterative in that as the results were written, more analysis took place to refine them, until they began to form more of a narrative and story for the reader. Furthermore, both deductive and inductive thematic analysis were used to examine the evidence in the light of the existing theoretical model (Boyatzis, 1998) but then also to allow new characteristics to emerge. Deductive thematic analysis was used to address the first five descriptive research questions and inductive thematic analysis was used to generate new constructs to address the exploratory research questions (Braun & Clarke, 2006). This helps in that the qualitative research can build on the knowledge of prior theory but then also modify this based on what participants say (Walsham, 1995). An overview of the various thematic analysis phases are given in Table 3.

**Table 3:** Description of the Analysis Phases

Phase	Description of Phase
Familiarising oneself with the data	Transcribe and read over data. This was the start of the interpretive process and meanings of the data began to emerge in the researchers’ head. Notes were taken for future coding.
Generating initial codes	Codes are just a few words long and are the most basic elements that label the data (Boyatzis, 1998). They help researchers arrange the data so that potential themes can emerge (Braun & Clarke, 2006). The coding process was conducted based on whether the themes were data or theory driven (Braun & Clarke, 2006). Theory-driven codes were derived from the theoretical framework. Examples of such codes for this study include <i>Interest, Enjoyment and Passion</i> , which relate to the <i>Intrinsic Motivation</i> construct in the theoretical framework. For data-driven codes, the researcher had the liberty to assign codes to the data without any framework constraint. Examples of such codes for this study include <i>Empathy, Willingness to Listen and Patience</i> .

Phase	Description of Phase
Searching for themes	Themes are significant patterns in the data that are related to a research question (Braun & Clarke, 2006). In this section, codes were being combined to find potential themes and sub-themes. This was done based on the researcher’s judgement and similarity between codes. Furthermore, codes were combined differently for the deductive and inductive research questions. In the inductive case, the themes did not have to relate to constructs in a pre-existing theoretical framework, whereas in the deductive, theory-driven case, they had to.
Reviewing themes	During this analysis phase, themes were refined by checking them against the coded extracts and against each other to see if they could be combined. It was important to ascertain whether the themes identified were distinct/different from each other, coherent and fitted with the empirical data and the research questions.
Defining and naming themes	In this phase, each theme was refined in order to collectively form a story. Consequently, what was important here was to ensure that themes flowed with each other, did not claim too much, too little and were related to the research questions.
Producing the report	A succinct report of results was then produced, which related back to research questions and literature

#### 4. Findings

This section describes the findings. This includes discussing the results in relation to the existing constructs of the a-priori theoretical model and the new constructs that emerged such as empathy, the articulation of the source (communication skills) and personal trustworthiness of the source. The final model is shown in Figure 3.

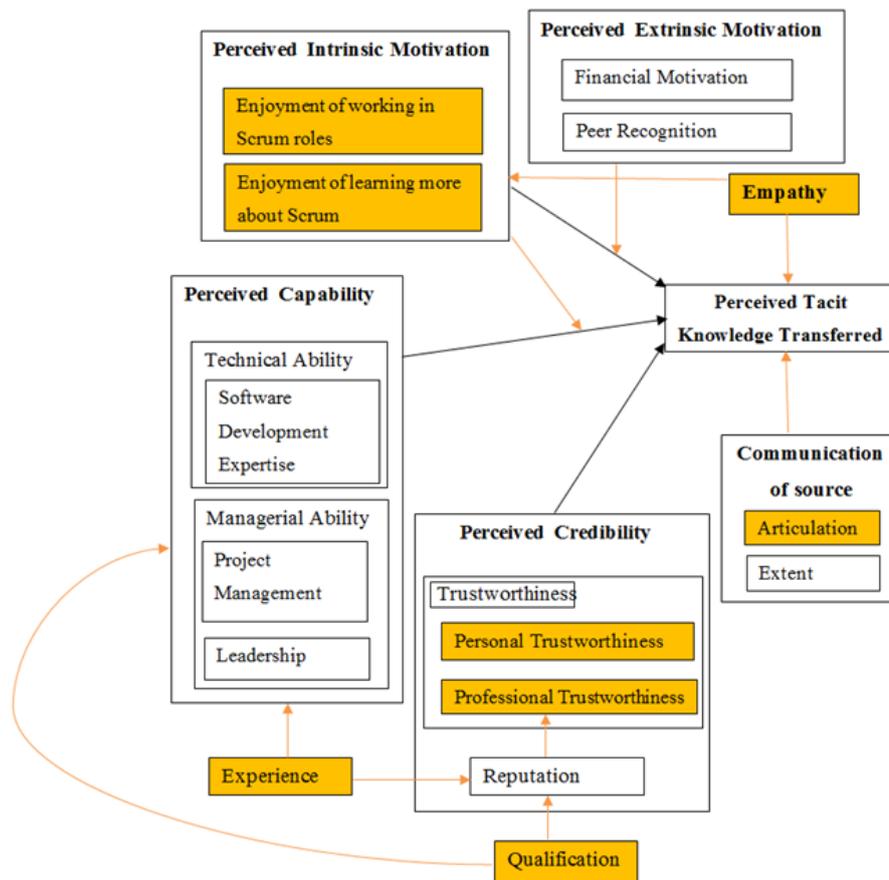


Figure 1: Proposed Theoretical model derived from Findings

##### 4.1 Perceived Motivation

The themes identified relative to the perceived motivation construct and the corresponding sample evidence are displayed in Table 4.

**Table 4:** Themes for Perceived Motivation

Sub-category	Themes	Incidents	Sample evidence	Source
Intrinsic Motivation	Enjoyment of working in Scrum roles.	15	"With ___ he loves it he lives it he breathes it, he enjoys Scrum"	P1
	Enjoyment of learning more about Scrum	6	"Yeah, I think he enjoys it, he is always on his phone and all that kind of stuff, he is always monitoring his phone with the news on Scrum"	P2
Extrinsic Motivation	Financial	11	"Financial rewards to a degree, there is obviously a trade-off between enjoying your job and how much are you earning"	P11
	Peer recognition	2	"Ja, I think peer recognition motivates anyone , so definitely"	P2

#### 4.1.1 Intrinsic Motivation

The two themes identified around the intrinsic motivation construct related to the enjoyment of working in Scrum roles and also learning about Scrum. Both were found to enable individuals to transfer more knowledge.

- Enjoyment of working in Scrum role

The enjoyment and passion demonstrated by team members while working in their respective Scrum roles enticed others in acquiring knowledge from them. This can be shown through the following statement from Participant 1, a junior software developer, talking about the lead developer's passion for his work. Through that statement, it can be deduced that the passion demonstrated by the lead developer, promoted others' willingness and desire to gain knowledge from him.

*"So the qualities he has in that, is that he is passionate, so he gets excited about that, and I want to know what he is excited about."*

- Enjoyment of learning about Scrum

The study also found that team members found it easier to acquire knowledge from those who enjoyed keeping up to date with Scrum latest best practices and news. Such is the case because even though the source might not have the answers to particular questions, they would be willing to research and impart the new knowledge that they found. Participant 11, a software developer, mentioned:

*"If someone is motivated to learn, you can ask him a question, and even if they do not know the answer, they will still look it up and give you an answer."*

#### 4.1.2 Extrinsic Motivation

The two types of extrinsic motivation participants identified from the study are financial motivation and peer-recognition. The perceived extrinsic motivation of a team member did not seem to impact much on the extent to which they could transfer knowledge, as will be shown in the subsequent sections.

- Financial Motivation

Participants found it difficult to detect whether other team members were financially motivated and if this could affect the extent of knowledge that could be transferred. Participant 9, a lead software developer, echoes this when he says:

*"It is difficult to determine someone else's financial motivation but a person can enjoy a bit of both."*

Instead, participants found it easier to recognise when a person is intrinsically motivated to transfer knowledge, but they also acknowledged that there could be some financial motives for people to transfer knowledge in teams.

- Peer Recognition

The same could be said of peer recognition. Some felt that peer recognition *“motivates anyone”* (Participant 2, test manager). Yet others felt that intrinsic motivation or a natural passion for something is the only real motivator to transfer knowledge. For example, Participant 1, a software developer, felt that if someone was truly motivated by a task, then peer recognition would not play a part. He qualified peer-recognition as *“an old-fashioned interest”*.

Therefore, it appears that intrinsic motivation or natural motivation to do a job seemed to play a stronger role in knowledge transfer than extrinsic motivation. This is because participants had a lot more to report on intrinsically motivated people. However the participants could not rule out the possibility that these intrinsically motivated people might also be extrinsically motivated by money at the same time.

## 4.2 Perceived Capability

As discussed in the literature review, perceived capability was split up into technical and managerial capability. Themes, supporting evidence, and number of incidents for each sub-category can be found in Table 5.

**Table 5:** Themes for perceived Capability

Sub-category	Themes	Incidents	Sample evidence	Source
Technical Capability	Software development expertise.	14	<i>“Yeah, some of the things I learned or we spoke about, was test driven development, and automated testing...”</i>	P5
Managerial Capability	Agile Project Management	14	<i>“I learned how the Scrum infrastructure in Agile worked, that was a big learning curve”</i>	P10
	Agile Leadership	11	<i>“Yes, definitely, part of being on the team, we also got to see what his leadership style is, we also took part in the actual process of Scrum, so we also took turns to run the planning sessions”</i>	P3

### 4.2.1 Technical Capability

Team members with high technical knowledge and experience, who were also motivated to share their knowledge, were said to be able to transfer a high amount of technical knowledge to others in the team. Several participants judged whether the people had technical expertise by the experience they had. If someone had a lot of experience in a particular software or technology, people knew they could go to them for help. This is as illustrated by Participant 1, a junior software developer, talking about the lead developer:

*“... was a really nice guy, with lots of experience because this J2EE type architecture based on Linux CentOS, I had to learn a lot of that type of stuff and that is where his experience fits in.”*

It was also found that those who are technically capable, might not necessarily be motivated to transfer knowledge because they want to protect that knowledge. This was raised by Participant 6, a project manager:

*“Technically competent people believe they must protect their IP [intellectual property], but they do not realize in the fact that they are sharing the knowledge there in lies the power... it is only when you start sharing it out, do people start referring to you, they will pay more money to get to speak to you.”*

### 4.2.2 Managerial Capabilities

Managerial capabilities according to literature can be split into project management and project leadership (Lindvall & Rus, 2002).

#### ▪ Agile Project Management Capabilities

Team members with capabilities related to Agile Project Management were perceived as being good at transferring such knowledge to others in the team. Participants mostly attributed project management capabilities to team members having a Scrum master role. Participant 2, a test manager said:

*“\_\_\_ worked really hard to become an expert in Agile and in Scrum in particular and he, on this project, he was a Scrum master.”*

It can be derived from this statement that team members feel that to be a Scrum master, a person must have expert knowledge in Agile and Scrum project management.

Participants also sometimes acquired project management skills like task estimation during Sprint planning meetings from their peers, as the development team are in charge of task and feature estimation in Scrum projects.

- Leadership Capabilities

Participants also said they were able to easily gain Scrum leadership knowledge from their Scrum masters who possessed such knowledge, enabling them to successfully transfer it to others. This was echoed by Participant 9, a software developer, who mentioned that he learned the following from his Scrum master in terms of communication with clients:

*“You can’t be mean to them, even though I have good intentions, or just trying to correct them, you must approach ... I guess business is business, you have to have certain tact and what not... he is really good at that.”*

The study thus found that a team member’s technical and managerial experiences influence the degree to which others perceive them to be capable in those areas. This can be shown by Participant 4, who regarded his first Scrum master very highly because of her experience:

*“Very highly because one she has got over 20 years in software development experience, and 10 plus years in Agile”*

### 4.3 Perceived Credibility

In most cases team members found each other trustworthy and reputable. Table 6 illustrates the themes found in this section and their supporting evidence.

**Table 6:** Themes for Perceived Credibility

Sub-category	Themes	Incidents	Sample evidence	Source
Trustworthiness	Professional trust	17	<i>“Trust again is another pillar of Agile, another one of the 12 principles is to build teams around individuals, motivated individuals who can be trusted”</i>	P12
	Personal trust	2	<i>“We always saw him as an incredible leader, today he is one of my best friends, he was groomsman, at my wedding.”</i>	P3
Reputation	Reputation	5	<i>“Very highly because one she has got over 20 years in software development experience, and 10 plus years in Agile.”</i>	P4

#### 4.3.1 Trustworthiness

From the interviews, two types of trust emerged, professional and personal trustworthiness. This was one of the new findings to knowledge transfer in Scrum emergent from this study. These are further elaborated below.

- Professional Trustworthiness

As noted by Participant 3, trust is one of the pillars to Agile Software Development and most participants agreed that it is essential to knowledge transfer. Usually, the trust that is referred to in knowledge transfer literature is professional trust, which is essentially the trust one has in a colleague’s professional judgement and ability to deliver work. This can be illustrated by Participant 8, a software developer, who said that he had no reason to doubt his Scrum master’s intentions due to his transparency:

*“ so if I ever had any doubt, which I did not, all the data was always available to me, that I could verify it.”*

This type of trustworthiness is also based on reputation, as it is easier for team members to trust someone with over 10 years of experience as shown by Participant 4:

*“Very highly because one she has got over 20 years in software development experience, and 10 plus years in Agile.”*

- Personal Trustworthiness

Another form of trust that was also found to be important to knowledge transfer in Scrum teams was personal trust. Participants sometimes trusted each other to the extent that they could even share personal information with each other, as can be seen from what Participant 10, had to say about his Scrum master:

*“We always saw him as an incredible leader, today he is one of my best friends, he was groomsman at my wedding.”*

Therefore, the relationship between these two team members went from colleagues to friends, and this could have even made professional knowledge transfer between far easier due to the openness of their relationship.

#### 4.3.2 Reputation

The reputation of a source was shown to be important to successful knowledge transfer. Many participants mentioned that, in their opinion, their team mates were highly capable because of the latter’s reputation of having a lot of experience and having seen them produce good work before. Reputation was also based on the qualification of an individual. Formal qualifications made participants view their team mates as more reputable sources of knowledge. This can be seen from the following quote by Participant 11, a software developer:

*“some did information systems, others do not have a university qualification at all, you find that our passion for the future are different.”*

In the above case, there is an emphasis placed on educational background and qualification and subsequently the knowledge people could expect to gain from others based on these backgrounds.

### 4.4 Perceived Communication Extent

A themes around perceived communication extent are summarized in Table 7.

**Table 7:** Themes for Perceived Communication Extent

Sub-category	Themes	Incidents	Sample evidence	Source
Perceived Communication Extent	Frequency of Communication	11	<i>“Yeah, definitely, co-location is necessary in Scrum, if you are in a room with someone, sitting next to someone, you get to know how they think, you get to know their skillsets and they get to know yours”</i>	P3
	Communication Balance	11	<i>“Yes and no, with communication you need to have a balance... ummm... too little and you will not understand what you are doing and you will be lost and too much you will get to a point where you will just end up getting frustrated.”</i>	P2

#### 4.4.1 Frequency of Communication

A team member’s ability to communicate frequently was said to generally increase the perceived extent of knowledge transferred. Most participants reported frequent communication between team members and this was typically due to the nature of Scrum. Knowledge transfer and communication in Scrum they say, occurs at many points including: the daily Sprint meeting, Sprint planning session, demonstrations, reviews and retrospectives (Participant 5, business analyst and occasional Scrum master). This can be seen from Participant 12, a project manager, who mentioned that:

*“...when you have a planning session...you can encourage or force, well force is the wrong word, but help that person to actually contribute, so even though they were not comfortable, yes, for you to draw them out of their shell.”*

#### 4.4.2 Balanced Communication

One of the new findings of this study was that though Agile methodologies emphasize frequent communication to improve knowledge transfer it must also be balanced so as to not irritate or distract the recipient. This is echoed in the following quote by Participant 2, a test manager:

*“Yes and no, with communication you need to have a balance... ummm... too little and you will not understand what you are doing and you will be lost and too much you will get to a point where you will just end up getting frustrated.”*

Here it is clear that too much communication will indeed lead to the recipient getting irritated, and possibly not willing to listen further or provide feedback to the other party.

#### 4.5 Other suggested characteristics needed to transfer knowledge

Literature states that the greater the communication skills of an individual, the greater the knowledge that will be transferred by that individual (Ko et al., 2005). Therefore, participants were asked what characteristics make people good at communicating. The most popular characteristics suggested were: empathy, articulation and some characteristics that empathy produces (Nonaka & Takeuchi, 2011) – willingness to listen and patience. Sample evidence of these findings is shown in Table 8.

**Table 8:** Other Suggested Characteristics Needed to Transfer Knowledge

Themes	Incidents	Sample evidence	Source
Empathy	8	<i>“He is clear and he is communicating on my level, so he is empathetic”</i>	P1
<ul style="list-style-type: none"> <li>Willingness to listen</li> </ul>	4	<i>“Some people say that a good communicator is a good listener, so, somebody who is able to listen to you when you talk is mostly likely going to be able to answer and give you what you are looking for.”</i>	P11
<ul style="list-style-type: none"> <li>Patience</li> </ul>	4	<i>“Must have the patience , to think about stuff that he communicates”</i>	P6
Ability to be articulate	7	<i>“So the basics, is that you must be articulate, there is no point in communicating if you are not going to make sense when you open your mouth.”</i>	P7

Participant 3, a project manager, defined empathy as the *‘ability to relate with the people you work with’*. Empathy was one of the new characteristics found in this study that is important to knowledge transfer. Empathy was shown to make Scrum team members more motivated and willing to transfer knowledge. Some participants mentioned that they benefited from empathetic team members who communicated without jargon as they understood the recipient’s perspective. For example, from Table 8, it can be seen that empathy makes people more willing to listen patiently and therefore more able to provide their team mates with the answer they are looking for.

Another new finding from this study was that it was not just communication extent which improves knowledge transfer, but rather the quality of communication that also improves knowledge. Many participants complained that their team mates would not articulate themselves clearly and this prevents knowledge transfer. For example, Participant 7, a software developer mentioned:

*“So the basics, is that you must be articulate, there is no point in communicating if you are not going to make sense when you open your mouth.”*

#### 4.6 Comparison with literature

In this section, the findings are compared with literature to highlight the similarities and differences, thus further ascertaining the research contributions of this paper.

##### 4.6.1 Perceived Motivation and Knowledge Transfer

The study found that Scrum team members are inclined to gain knowledge from those they perceive to be intrinsically motivated. In particular, Scrum team members were inclined to acquire knowledge from their peers due to their intrinsic motivation to use Scrum and their passion for learning about the methodology. Literature defines signs of intrinsic motivation more broadly, including enjoyment of job and enjoyment of learning (Nikitina, Kajko-Mattsson, & Strale, 2012) but no studies have related intrinsic motivation to Scrum teams to date. However, studies have found that knowledge transfer depends a lot on how the recipient perceived the source. For example, intention-based theory of reciprocity, confirmed that people will reward actions they perceive to be kind/sincere and will reward them by being willing to listen to and accept their

knowledge (Stanca et al., 2009; Trauth, 2010). The difference in passion therefore becomes obvious to recipients and they would be less inclined to learn from someone who is less motivated and less inspiring to them (Barnes, 2005) which further validates this finding.

The findings also showed that team members who appear to be intrinsically motivated would put more passion and effort into transferring knowledge than someone who appears to be extrinsically motivated by money or regulations. This is in line with past studies which identified that extrinsic motivation does not have as strong of an impact on knowledge transfer (Hung, Durcikova, Lai & Lin, 2011; He & Wei; 2009).

However, a person can be both intrinsically and extrinsically motivated at the same time (Frey, 1997). The study found that when a person is both intrinsically and extrinsically motivated, extrinsic motivation had a moderating effect on the extent to which intrinsic motivation impacted the perceived extent of knowledge transfer. This is in line with Frey and Jegen's (2001) motivational crowding-out effect, which showed that extrinsic motivation (e.g. rewards) usually reduces the intrinsic motivation such as the intrinsic enjoyment of the task for what it is.

#### *4.6.2 Perceived Capabilities of the Source and Knowledge Transfer*

The study found that the perceived capability of a Scrum team member improves their perceived ability to transfer knowledge. If the recipient perceives a team member to be capable, they will go to them to gain knowledge, in line with Joshi et al. (2007)'s findings. In particular, the study found Scrum team members considered those with high experience to be capable and therefore able to transfer knowledge. This perception could be accurate as Ko et al. (2005) also found that well-trained consultants are good at knowledge transfer.

Furthermore, experience was also perceived to influence knowledge transfer in Agile and Scrum teams (Cross, Laseter, Parker, & Valasquez, 2006). Knowledge transfer is said to be high in Agile and Scrum teams of similar experience, since people assume they can trust others who are of similar level of experience and expertise (Cross, et al., 2006; Levin & Cross, 2004). In this study, team members had different levels of experience but in contrast to past studies, it was found that least experienced members often looked up to the more experienced ones and viewed their knowledge as trustworthy. For example, people with experience in a particular area of software development (e.g. Agile test-driven development) were perceived to be able to transfer knowledge in that area.

The findings also revealed that the perceived qualification of a Scrum team member is also essential for the knowledge transferred to be seen as credible. Such is the case as qualification usually implies that the person is well-trained and that their knowledge is reliable. Software development qualifications like Java-certified developers or Scrum Master Certifications confirm the credibility of a person. This has also been demonstrated by Ko et al. (2005), Levin and cross (2012) and Szulanski (1996). This is also in line with knowledge-based theory that says that qualification of a source influences knowledge transfer (Sveiby, 2001).

However, the study also found that in spite of people's capability to transfer knowledge they might not be motivated to transfer knowledge to others. For example, they might not be motivated for fear of losing power/exclusivity. This is in line with Szulanski (1996) who found that a lack of motivation of a source to transfer knowledge might occur due to lack of incentives. Therefore, even though Agile teams are supposed to be highly capable (Boehm, 2002), incentives such as rewarding the best individual at transferring knowledge (as voted by peers) with a badge and a prize, could be used to help motivate them to transfer knowledge (Antin & Churchill, 2011).

#### *4.6.3 Perceived Credibility of the Source and Knowledge Transfer*

Credibility is determined by how reputable the recipient finds a team member and how trustworthy they find their knowledge. In line with Joshi et al. (2007), the study found that the perceived credibility of a team member further affected the perceived extent of knowledge they could transfer to others in Scrum development teams.

The experience and qualifications of a team member were shown to influence their perceived reputation. The perceived reputation of a Scrum team member further influenced trust, whereby people who were reputable

were regarded as knowledgeable experts. This is inline with a study of 46 SMEs that used agile methods, which found that credibility of a team member strongly influences the tacit knowledge that they transfer to others (Ryan & O'Connor, 2013).

In this study, Scrum team members also felt that it is not only the professional trust in other's skills that influence perceived extent of knowledge transfer but also personal trust. This concurs with Karlsen et al. (2011)'s study which found that agile and Scrum teams work and collaborate well when they have strong personal ties. Trust, according to social exchange theory (Cropanzano & Mitchell, 2005) is an important component for strong relationships to occur (Emerson, 1976). In particular, personal trust allows for easy communication and knowledge transfer. The Scrum methodology acknowledges the fact that knowledge transfer occurs through strong ties and frequent interaction, and so facilitates this by allowing regular opportunities for tacit knowledge transfer like the daily Scrum meetings (Karlsen et al., 2011).

Ultimately, what can be deduced from the findings is that credibility is key to knowledge transfer in Scrum teams. Without credibility, knowledge transfer cannot happen as the recipients will doubt/not trust the knowledge being transferred (Szulanski, 1996).

#### *4.6.4 Perceived Communication of the Source and Knowledge Transfer*

Past studies have shown that communication extent of the source improves knowledge transfer (Joshi et al., 2011). However, the findings of the present research reveal that it is not only the communication extent that improves knowledge transfer but the quality of communication/articulation is also important. The need to be articulate was found to be essential by most of the participants. For example, some participants reported that some senior developers would use jargon terms, assuming others already knew them. In literature, this is known as the communication encoding competence, which is one's ability to express themselves clearly and be understood (Monge, Bachman, Dillard & Eisenberg, 1982). Agile software development teams that have tried to improve their clarity of communication by speaking more slowly and intentionally, seemed to experience improved knowledge transfer (Dorairaj, Noble & Malik, 2011).

However, this present research also found that too frequent / excessive communication in Scrum teams sometimes irritated the recipients. They felt that a person should communicate just enough to transfer knowledge effectively. To some extent, this finding differs from popular Scrum and agile literature which promotes regular and frequent communication to increase knowledge transfer (Chau et al., 2003). However, some studies have recognised that excessive communication leads to team members distraction and lowers productivity (Leenders et al., 2003).

#### *4.6.5 Empathy*

A new construct which the study revealed to be important to knowledge transfer is empathy. Empathy can be defined as seeing the world from someone else's perspective and sharing their emotions (Duan & Hill, 1996). Empathetic Scrum team members were said to be able to transfer knowledge well as they were concerned with the recipients' understanding of their message. When Scrum team members felt another member was empathetic, they also seemed to find them to be intrinsically motivated to transfer knowledge. This is in line with Van Lange (2008) who found that an empathetic person would also be altruistically motivated to help others. Altruism is a form of intrinsic motivation and it depicts the need to help others without expecting anything in return (Hars & Ou, 2001).

If a team member appears to be empathetic, they will also appear to be motivated, as shown in the motivational theory of charismatic leadership (Lin, 2007). This is beneficial in that Scrum team members are attracted to those who are genuinely motivated and would be willing to accept their knowledge (McHugh et al., 2011).

## **5. Conclusion**

This research sought to identify the characteristics needed in order for a team member to transfer tacit knowledge in Scrum teams. This study contributes to Scrum and Agile research by producing a theoretical model extended from Joshi et al. (2007), describing the characteristics of the source needed for successful knowledge transfer in Scrum. There has also been said to be a lack of empirically based knowledge transfer studies in Agile teams (Karlsen et al., 2011), so this study has made a methodological contribution to Agile

research in this regard as it used semi-structured interviews with a systematic qualitative analysis: the thematic analysis technique.

The study extends the model of Joshi et al. (2007) by adding the construct, 'motivation' as suggested by the authors, due to its importance in knowledge transfer. The study further adds to the growing trend in literature that shows intrinsic motivation to influence knowledge transfer more than extrinsic motivation. Therefore, future research should focus on how to improve intrinsic motivation of Scrum team members, by making the process of knowledge transfer more enjoyable (Deterding, Dixon, Khaled & Lennart, 2011).

Motivation was also identified as a moderating variable to the perceived capability of the source. As Joshi et al. (2007) found, the capability of a team member alone does not improve knowledge transfer. The study found that if the person/source is not motivated to transfer knowledge, others would not want to be around them and gain knowledge from them. Capability, as a construct, was found to further relate to qualification and experience of the source and impacted on perceived extent of knowledge transfer.

The perceived credibility, which is based on the trustworthiness and reputation of the source, emerged as a construct that impacts on knowledge transfer. Reputation of the source was determined by their experience level. For example a team member with over 10 years of experience in the use of Agile methods was found to be highly reputable. Furthermore, Scrum team members seemed to trust each other on a professional and personal level, and both seemed to impact perceived extent of knowledge transferred.

The study also found that it is not just communication extent that improves knowledge transfer in Scrum teams, but also the articulation of the source. Too much communication was also found detrimental to knowledge transfer. Scrum team members expressed the need for communication to be clear and concise, in order to easily comprehend what is being said.

Empathy, was a new construct, which according to participants contributed to knowledge transfer. An empathetic source, which avoided the use of jargon was perceived to be willing/motivated to transfer knowledge. This was an appealing characteristic to the recipients.

This research therefore contributes to practice by proposing a list of factors that Scrum managers can use to identify people who can initiate good knowledge transfer. For example, when it comes to hiring, the management/Scrum masters should ensure that candidates have a good reputation and qualifications, as this influences how credible the team members perceive them to be. It will also contribute to the human resources (HR) team, to help provide them with a list of factors that they can focus on when training people.

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