Team Barriers to Tacit Knowledge Sharing in Software Development Project Teams

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Abstract: Software Development Projects (SDPs) are being conducted at a rapid rate in response to the Fourth Industrial Revolution (4IR), even though SDPs are associated with very high failure rates. Their failure rate of SDPs has been declared as an International Crisis. SDPs are knowledge intensive in nature, whereby knowledge is essential when performing socio-technical tasks within SDPs. One of the reasons for the failure of SDPs is limited sharing of tacit knowledge within SDP teams. Limited tacit knowledge sharing within SDP teams results in the teams not being in position to perform their socio-technical tasks to the required standards which leads to success of SDPs. The main purpose of this research study was to identify the team-oriented barriers that limit the sharing of tacit knowledge within SDP teams. The researchers conducted a qualitative study and relied on qualitative data to achieve the objectives of the study. The qualitative data were collected through interviews and thematic data analysis was conducted to generate the results. A total of seven team-oriented barriers were identified includes team-culture, team-orientation, team-dispersion, team-cohesion, team-characteristics, trust, and communication. These issues are related to each other and influence one another in a positive way. These barriers stem from the entire SDP team, which is responsible for ensuring the success of SDPs.

Keywords: Tacit knowledge, Knowledge, Software projects, Knowledge management, Barriers to knowledge sharing

1. Introduction

The current era of the Fourth Industrial evolution (4IR) relies heavily on different elements of Information Communications and Technology (ICT), and one of the essential elements is software (Jones and Pimdee 2017; Ayentimi and Burgess 2019). This era of the 4IR has resulted in a high number of Software Development Projects (SDPs) being conducted by different organisations, in different disciplines such as health, education, and banking to name few. The main aim of conducting SDPs is to develop software solutions that enable organisations to compete in the 4IR era. Software enables organisations to have efficient and effective ways of conducting their operations (Khan and Keung 2016). The biggest challenge with SDPs is the alarmingly high failure rate of SDPs, which has been declared an international challenge, as acknowledged by academia as well as the software development industry (Lehtinen *et al*. 2014; Niazi *et al*. 2016).

Despite the high failure rate of SDPs in the current era, different organisations are investing heavily in SDPs by commissioning more SDPs. The number of SDPs being conducted has increased significantly, to the extent that there is more investment in the form of financial resources. It is estimated that organisations in the Republic of South Africa (RSA) have invested a total of R14 billion on different SDPs in 2011. Joseph and Marnewick (2014), forecasted an investment of R150 billion in 2014 which would result in a total loss of R18 billions because of the high failure rate of SDPs. This conclusion was based on the failure rate documented in 2014 (Niazi *et al*. 2016; Marnewick 2016). This indicates that the failure of SDPs is a real challenge for different countries, including developing countries such as the Republic of South Africa (RSA). This is a global phenomenon.

SDPs are human oriented in nature, with the human beings who form the SDP team playing a crucial role in ensuring the success of SDPs. The SDP team members require a wide variety of resources to ensure the success of the SDPs (Sudhakar, Farooq and Patnaik 2011). One of the prominent resources required is knowledge, because SDPs are knowledge intensive. Knowledge is used to perform socio-technical tasks to the required standard, which lead to the success of SDPs. SDP teams require both explicit knowledge, and tacit knowledge to perform socio-technical tasks within ISDPs. Socio-technical tasks are the tasks that are conducted within SDPs which consists of technical elements and socio elements which are human oriented in nature. These two types of knowledge complement each other throughout the process of conducting socio-technical tasks within SDPs (Paraponaris *et al*. 2015; Lee, Park, and Lee 2020). SDP teams do not have a challenge with access to explicit knowledge, but there is a challenge of limited access to tacit knowledge within the SDP teams (Smith 2001). The

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challenge of tacit knowledge access becomes more evident where teams fail to perform socio-technical tasks to the required standard and ensuring the success of SDPs.

The limited access to tacit knowledge is an indication that there are barriers to sharing tacit knowledge within SDP teams which has not been uncovered. The limited access to tacit knowledge is more SDP team-oriented challenge in nature whereby SDP teams plays a role in the limitation of sharing of tacit knowledge. These challenges limit SDP teams from accessing sufficient tacit knowledge required for SDP team to perform socio tasks to the required standard which incorporates quality standards (Mtsweni and Mavetera 2018). Therefore, the main objective of this research study was to identify team-oriented barriers to sharing tacit knowledge within SDP teams.

It is evident that there are barriers of knowledge sharing, in the literature are the barriers formulated based on explicit knowledge and/or knowledge in general. This is because there is still limited sharing of tacit knowledge within SDP teams. This shows there is a lack of or limited research studies on the barriers of tacit knowledge sharing within SDP team. The main research question for this research study is: What are the barriers of tacit knowledge sharing within the SDP team? This article starts with a review of the existing literature, followed by an outline of the research methodology used to achieve the research objectives. The results of the study are then provided. The article is concluded by discussing the contribution of the study to research.

2. Literature Review

SDPs are characterised with a high failure rate. In the 1960s, the term "International Crisis" was coined to acknowledge this challenge of higher failure rate of SDPs. This was an agreement between industry experts and researchers (Zahid *et al.* 2018). It was an indication that the high failure rate of SDPs was a challenge for all countries irrespective of their economic status. This failure of SDPs is still a challenge in the current era, and it poses a risk to the success of the 4IR especially for different organizations that still want to be competitive in this era of 4IR (Ayentimi and Burgess 2019). SDP failures result in organisations not realising the full potential and benefits that are offered and exist within this era of the 4IR, where organisations rely on technology to be competitive (Khan and Keung 2016).

SDPs are human oriented in nature. This means that human beings ensure the success of SDPs by conducting socio-technical tasks to the required standards (Mtsweni, et al., 2016; Mtsweni and Mavetera 2018). These human beings are members of SDP teams who require a wide variety of skills and resources to perform their socio-technical tasks during the lifespan of SDPs. This is done to ensure the success of the SDPs. The required resources include knowledge, which is one of the reasons why the members of the SDP team are selected to be part of the SDP teams. The knowledge among members of SDP teams is an essential element that makes the members of SDP teams and its members to be competitive within their respective SDP teams (Chen *et al.* 2018). This indicates that members of the SDP team require some level of knowledge irrespective of the type of knowledge, to successfully perform socio-technical tasks (Chen *et al.* 2018; Dreyer, Wyn and Bown 2020).

SDPs are knowledge intensive, and knowledge is often equated to the success of SDPs. In other words, members of the SDP teams use knowledge to perform socio-technical tasks to the required standard. This makes knowledge essential, and the potential solution in addressing the high failure of SDPs (Mtsweni and Mavetera 2018; Chen *et al*. 2018). All the socio-technical tasks are conducted in SDPs require either tacit knowledge, or explicit knowledge, or both. This makes knowledge to be the driving factor, and essential resource in performing socio-technical tasks within SDPs to the required quality standard (Smith 2001; Ryan and O'Connor 2013). This makes it essential that all the members of SDP teams have access to both types of knowledge and have a balance between tacit knowledge, and explicit knowledge (Mtsweni and Mavetera, 2018).

In fact, it is imperative that SDP teams, and their members have access to both types of knowledge to perform their socio-tasks to the required standards. Explicit knowledge and tacit knowledge complement each other. Explicit knowledge and tacit knowledge focus on different elements of socio-technical tasks but are both needed to perform these tasks to the required standard. Explicit knowledge is strongly associated with technical tasks because explicit knowledge is technically oriented in nature while tacit knowledge is socially oriented. This indicates that explicit knowledge and tacit knowledge make a different contribution in ensuring socio-technical tasks are performed to the required standard (Mtsweni and Mavetera 2018; Chen *et a*l. 2018). Explicit knowledge and tacit knowledge contribute significantly to ensuring that socio-technical tasks are performed to the required standard especially quality standards, which is required for ensuring the success of SDPs. This is the main goal of any SDP team (Chen *et al.* 2018; Dreyer, Wyn and Bown 2020).

Access to explicit knowledge is not a challenge, because of the development of technology, which created different platforms for sharing and storing explicit knowledge. These platforms allow members of the SDP team to contribute and share explicit knowledge which is technical in nature and is required more so, to perform technical tasks of SDPs (Ryan and O'Connor 2013; Dreyer and Wynn 2016). This is evident because SDPs are not failing with reference to technical issues. Most SDPs are found to have good functional technically, but do not address the needs of the primary customer. This indicates that technical tasks are performed to the required standard but are not sufficient to ensure the success of SDPs (Ebad 2016; Gupta *et al.* 2019). This is a good indication that members of SDP team have access to adequate explicit knowledge, which is sufficient for them to perform their technical tasks for the success of the SDPs (Chen *et al.* 2018). Thus, it becomes evident that there is a challenge regarding the performance of socio-tasks, which is the result of access and sharing of tacit knowledge that is required to perform socio-tasks.

In an attempt to address the high failure rate of SDPs, new interactive methodology was introduced to SDP teams – known as the Agile methodology. Agile methodology had been in place for a limited period of time. Agile methodology relies heavily on tacit knowledge (as opposed to explicit knowledge), especially when it is used within SDP teams (Ryan and O'Connor 2013; Takpuie and Tanner 2016). Agile methodology relies on verbal communication, as opposed to written communication which is used within traditional methodologies. This approach has enabled SDP teams to share more tacit knowledge, which is required within SDP teams. This has resulted in SDP team that use Agile methodology having better opportunities of ensuring the success of SDPs. The Agile methodology has a better success rate than traditional methodologies which rely on written communication, while Agile methodology rely on tacit knowledge and verbal communication (Ryan and O'Connor 2013). This indicates that tacit knowledge is required to address the failure of SDPs.

Despite the existence and adoption of Agile methodology which its adoption is at a rapid rate in the current era, the higher failure of SDPs remains a challenge in the current era (Gupta *et al.* 2019). This indicates that there is still a challenge when it comes to the sharing of tacit knowledge within SDP teams, which contributes to the high failure of SDPs and is a global challenge. Thus, it becomes more evident that there is challenge in sharing of tacit knowledge because Agile methodology relies heavily on tacit knowledge (compared to explicit knowledge) and yet the failure of SDPs remains a challenge (Ryan and O'Connor 2013). This makes it essential to identify the barriers of tacit knowledge within SDP teams, because SDP teams need tacit knowledge on top of explicit knowledge to ensure the success of SDPs.

Tacit knowledge exists among the members of SDP teams, and they are the custodians of tacit knowledge. This makes tacit knowledge to be their personal asset (Takpuie and Tanner 2016). However, the only way that the members of SDP teams can make their tacit knowledge available to the entire SDP team is through sharing of tacit knowledge within SDP teams. The sharing of tacit knowledge is a responsibility and task of the entire SDP teams and its members to enable the SDP team and its members to perform all the tasks to the required standard, which leads to the success of SDPs (Ebad 2016; Dreyer, Wynn and Bown 2016). The high failure rate of SDPs indicates that there are barriers that limit the sharing of tacit knowledge within SDP teams.

There are numerous barriers of knowledge sharing that were identified that limits the sharing of knowledge such as trust, culture, personal, technology to name few. The limitation with these barriers were based on the context of knowledge in general. There was no separation between explicit knowledge and tacit knowledge. There are some of the barriers which were developed and tested in a context of explicit knowledge (Ghobadi and Mathiassen, 2016). Explicit knowledge has different attributes as compared to tacit knowledge. This indicates that they cannot be treated in a similar way (Mtsweni and Mavetera, 2018). This led to the gap whereby the barriers of tacit knowledge were not explored in detail especially with the team-oriented barriers especially where teams are used heavily in performing things such as SDPs team which rely on knowledge when performing socio-technical tasks.

3. Research Design and Methodology

The main objective of this study was to identify the team-oriented barriers of tacit knowledge sharing within SDP teams provided the direction on the nature of the research study. The researchers conducted qualitative research. The qualitative research approach was chosen because of the nature of the study. The objective of the study required the researchers to use qualitative data to achieve the research objective of the study (Singh 2006; Opoku, Ahmed and Akatia 2016). Most of the already conducted studies did not focus on SDP teams, but rather on organisational settings, especially knowledge-intensive organisations which do not have similar characteristics to SDP teams. This made the results not applicable to SDP teams. This also meant there was limited literature on the barriers to tacit knowledge sharing within SDP teams (Opoku, Ahmed and Akoita 2016).

A qualitative research approach was further appropriate because the researchers needed to uncover the issues or team-oriented barriers to tacit knowledge sharing within SDP teams (Silverman 2020). The researchers relied on qualitative data to achieve the research objectives of this study. The qualitative research approach enabled the researchers to uncover the team-oriented barriers that limit the sharing of tacit knowledge within SDP teams (Fletcher 2017).

3.1 Data Collection

The researchers had the option of conducting interviews or using an open-ended questionnaire to collect relevant primary qualitative data to achieve the research objectives of this study. The researchers conducted semi-structured interviews to collect the qualitative data. Semi-structured interviews were conducted because the researchers were able to interrogate in detail, issues raised during the interviews and were able to follow-up on issues of the great interest to the researchers, focusing on the objective of this study (Silverman 2020; Fletcher 2017). The researchers were able to apply flexibility during the interviews in that they rephrased questions to get clear answers which were required to achieve the research objectives (Opoku, Ahmed and Akotia 2016).

The researchers conducted a total of 28 face-to-face interviews. The interviews were between 30 and 55 minutes long. The interviews were conducted over a period of four months, which were consecutive months to ensure that the researchers had enough time to reflect on the available qualitative data. The interviews were conducted, recorded, and transcribed. The data was collected in the year 2019, towards the end of the year. The researchers used Atlas Ti software to analyse the qualitative data toachieve the results of the study. It was important for the researchers to use Atlas Ti as a tool because Atlas Ti has the capability of handling huge amounts of qualitative data. Atlas Ti enabled the researchers to organise large amounts of data into meaningful chunks of qualitative data, especially when the qualitative data increased during further interviews.

One of most important elements for the researchers was to know when to stop conducting further interviews as part of the qualitative data collection for this research study. It was imperative that the researchers collect sufficient and quality data to achieve the research objectives of this research study. The researchers relied on data saturation, or thematic saturation to stop conducting further interviews. Data saturation is when the interviews conducted by the researcher(s) do not yield any new information in the form of themes or concepts, as compared to the ones at the disposal of the researchers (Aldiabat and Navenec 2018). Data saturation was an indication that there was no need for the researchers to conduct further interviews with the intention of collecting qualitative data for this research study (Saunders *et al.* 2018). The researchers achieved data saturation after conducting a total of 28 interviews.

It was important for the researchers to interview participants who were in a good position to provide accurate and relevant information to achieve the research objectives of this research study (Opoku, Ahmed and Akoita 2016). The participants were individuals who were working on SDPs and had a minimum of two years being part of SDP teams at the time of conducting this research study. The participants were working within different SDP teams based in the RSA. The participants were invited from different organizations that were focusing on software development as their core-business and they were selected considering their work experience within SDP industry. This was done to ensure that the participants had experienced the phenomenon of interest of this research study. The researchers used purposive sampling, which enabled them to choose the type of participants, and outline the requirements for the participants before they could participate in this research study. It further enabled the researchers to collect accurate qualitative data with rigor required to achieve the research objective of this research study (Etikan and Bala 2017).

The researchers stopped collecting data after the achievement of thematic saturation. Thematic saturation occurred when the researchers were not able to develop new themes and observations compared to the ones that were existing in the repository in relation to the objective of the research study (Green and Thorogood 2018). Thematic saturation was achieved after conducting a total of 28 interviews. Thematic saturation was achieved without outlining or discovering the fullness of relationships among different themes identified during the thematic data analysis of this research study (Kerr, Nixon and Wild 2010).

3.2 Data Analysis

After the completion of the qualitative data collection, the researchers conducted thematic data analysis consisting of six phases/steps of data analysis. The researchers started reading the qualitative data to familiarise themselves with it. The main aim was to understand what was happening within the qualitative data (Braun and Clarke 2006; Hertzog, Handke and Hitters 2019). This included the researchers transcribing the qualitative data.

The researchers started performing theoretical thematic analysis by generating initial codes (Braun and Clarke 2006). The researchers then highlighted the qualitative data, which included organising the data, and generating meaning from the qualitative data. This led to the researchers reducing the qualitative data into small chunks of qualitative data that were relevant to this research study (Peel 2020)

The researchers started searching for themes that were relevant to this research study. They examined the initial codes generated during the thematic data analysis, which means they relied on the results of the previous phase of the thematic data analysis. The researchers ensured that the initial codes clearly fit into a theme generated from the data analysis. The end results of this phase were different codes within a particular theme of the research study (Terry *et al*. 2017; Spiers and Riley 2019; Braun and Clarke 2006). The researchers started to review the themes generated from the previous phase of the thematic data analysis. They reviewed and modified the themes to reflect the context of this research study (Braune and Clark 2006; Peel 2020). The phase included gathering relevant data supporting the themes identified in this research study. The researchers ensured that the relevant themes were used in this research study (Terry *et al.* 2017; Hertzog, Handke and Hitters 2019).

The researchers started by defining and naming themes generated in this research study. The researchers refined the themes, which was all about revising the results of the previous phase of the thematic data analysis. The researchers performed the final refinement of the themes and sub-concepts of the themes. Researchers concluded by creating relationships among different themes identified in this research study (Braun and Clarke 2006; Hertzog, Handke and Hitters 2019; Terry *et al.* 2017). The researchers concluded the thematic data analysis by producing the final report. This is where the researchers communicate the results to the community and the participants of this research study to validate the results of this research study (Terry *et al.* 2017).

3.3 Rigour of Research Results

It was important for the researchers to produce results that were not misleading to the population of this research study. The researchers relied on trustworthiness because this is a qualitative research study, and it is associated with evaluating the rigour of the results of a qualitative research study (König and Jucks 2019). The researchers relied on the elements outlined by Lincoln and Guba (1986), which include the confirmatory, transferability, authenticity, credibility, and dependability elements.

Confirmatory is the ability of the researchers to show that the qualitative data represent the views of the participants in the research study, which include ensuring that the researchers did not show any bias in the research study (Lincoln and Guba 1986). The researchers conducted member checking with the participants in this research study to ensure that they presented the views of the participants. They discussed the results of the research study in group discussions with professionals who had worked in SDP teams. The researchers also outlined the methodology used to generate the results of the study for other researchers to have way in which to validate how the results of the study were generated.

Transferability is the ability to apply the results of the research study in another environment with similar settings and characteristics of the original environment of the research study. Transferability is the replication of the results of the research study (Krefting 1991). The researchers conducted group interviews to validate the results and checking with other participants of the research study through a member checking process. The researchers discussed the results with other professionals that had experience working in different SDP teams.

Authenticity is the ability of the researchers to express the feelings, emotions, and experiences of the participants of the research study (Connelly 2016; Schwandt, Lincoln, and Guba 2007). The researchers relied on qualitative data to generate and support the results of this research study. The researchers quoted from the qualitative data to support the results of this research study. The researchers further discussed the results of this research study with members of other SDP teams who did not participate in this research study. The researchers observed the gestures as well as the reactions of the participants during the interviews, to see if they added any meaning and value to the results.

Credibility refers to the truth of the qualitative data and the expressing views of the participants of the research study in a coherent manner (Connelly 2016). The researchers relied on qualitative data to generate and support the results of this study. They conducted member checking and quoted from the qualitative data to support the results of the study. Quoting from the qualitative data made the researchers grounded in the qualitative data when generating the results of this research study.

Dependability refers to the consistency of the results of the research study, especially when reporting the results of the research study. Dependability ensures that one can rely on the results of the research study (Schwandt, Lincoln and Guba 2007). The researchers outlined the process followed to generate the results especially research methodology, including data collection and data analysis which were performed in this research study. This was done to ensure transparency in this research study so that other researchers can know how the results of the study were generated and so that they will be able to replicate the research study. This allows other researchers to critique the process followed to generate the results and whether the process was conducted in a proper way especially ensuring golden threat or there were any errors in generating the results of this research study.

3.4 Ethical Issues

The researchers conducted this research study in an ethical manner or complied with ethics or ethical requirements. Ethics were instrumental in protecting the participants in this research study and other stakeholders from harm in any form (Resnik 2018). The researchers started by applying for an ethical certificate to conduct this research study and it was granted. The researchers further ensured that the participants in the research study understood their rights as participants. The researchers requested the participants to sign the consent letter prior to conducting the interviews during the data collection or participating in this research study. Furthermore, the researchers explained the rights of the participants prior to conducting the interviews. The email message used to invite the potential participants to participate in this research study which outlined the rights of the participants. The researchers used pseudonyms when reporting the results of this research study to ensure the anonymity and privacy of the participants of this research study.

4. Results of the Research Study

The thematic data analysis yielded a total of seven team-oriented barriers to tacit knowledge sharing within SDP teams. These barriers were team culture, team orientation, team dispersion, team cohesion, team settings, trust, and team communication.

4.1 Team Culture

The SDP team culture encourages the members of the SDP teams to complete their work on time so that they can meet deadlines instead of encouraging the sharing of tacit knowledge. It makes the members of the SDP team to work as individuals at meeting their respective deadlines. This results in them prioritising meeting deadlines instead of doing other things such as tacit knowledge sharing. The elements of team culture that were identified in this research study were SDP team's attitude to sharing tacit knowledge, values, and social behaviour.

> *P2 said: "… I have worked in teams that were only concerned about meeting the deadlines and delivering the tasks. I am not even encouraged to share my knowledge … team leaders are only concerned with meeting the deadlines."*

The SDP team culture on its own drives the way things are being conducted within SDP teams. It becomes those practices that are inherited by other members of SDP team such as prioritizing meeting the deadlines. Most of the cultures of SDP teams encourages the members of SDP to meet their deadlines not giving any attention to other important things such as sharing of tacit knowledge. This leads to lack of sharing of tacit knowledge within SDP team which results in SDP team not being able to perform their socio-technical tasks to the required standard to ensure the success of SDPs. Culture within SDP teams should be structured in such a way that incorporates and encourages the sharing of knowledge especially tacit knowledge

4.2 Team Orientation

SDP teams are heavily oriented towards meeting the milestones and goals of SDPs, which leads to ignorance of other elements such as tacit knowledge sharing. The orientation is deadline driven, with SDP teams heavily focused on the goals of the SDPs and SDP teams. The elements of team orientation were collaboration, and SDP team goals.

> *P3 said: "… I have worked in teams that were only concerned about meeting the deadlines and delivering the tasks. I am not even encouraged to share my knowledge … team leaders are only concerned on meeting the deadlines."*

The orientation of SDPs is closely influenced by the culture of SDPs which became the culture of SDP teams. The orientation of SDP team is all about giving more emphasis, priority, and attention in completing the tasks on

time. It is all about prioritizing the performance of socio-technical tasks to completion because they were given more the notion that they are more important than other activities. This had led to be the culture within SDP teams. This had become well-known phenomenon within SDPs and SDP teams. This led to lack of sharing of tacit knowledge within SDP teams. This made the sharing of tacit knowledge and other things being less important and not given priority. The orientation of SDP team drives the direction on which elements are given more priorities as compared to others (Khan and Keung, 2016). If the orientation of SDP team does not include the sharing of tacit knowledge, the members of SDP team will not prioritize the sharing of tacit knowledge in SDP teams.

4.3 Team Dispersion

SDP teams are usually in different geographical locations such as different office blocks and other locations, which makes the SDP team to rely on written communication. It has become a norm for SDP team members to work from home because of the Covid-19 pandemic and lockdowns imposed in different countries such as RSA. This made it challenging for members of SDP teams to share tacit knowledge because they do not rely verbal communication, but they had started to rely on written communication within their respective SDP teams. The standard and most proven way of sharing tacit knowledge is through verbal communication, but SDP team dispersion of members of SDP team makes the SDP team to rely on written communication to share knowledge. The elements of SDP ,team dispersion were geographical separation and remote SDP teams.

> *P8 said: "I once worked in a big project team. It was impossible to share tacit knowledge because you can't write it down. It was impossible to share personal knowledge because the team was big, and it was distributed in three different buildings. We relied on emails to communicate."*

The outsourcing of SDPs is a well-known practice which resulted in members of SDP teams working in the foreign countries or cities even different building in the same vicinity to name few. This made the dispersion of SDP team members to be a norm and it grew more during the lockdowns during the Covid-19 pandemic where members of SDP team were working from home most of the time. This makes the members of SDP team to share limited tacit knowledge because the sharing of tacit knowledge relies on interpersonal relationships. The interpersonal relationships require face to face interaction among the members of SDP team. The members of SDP team are not able to do that because are working remotely all the time and that norm are adopted even after the lockdowns were removed.

4.4 Team Cohesion

The extent and the strength of the interpersonal relationships of the members of the SDP team are important in driving the sharing of tacit knowledge within SDP teams. Lack of cohesion among members of the SDP team results in a lack of tacit knowledge sharing. The strengths of the SDP team cohesion and interpersonal relationships especially among members of the SDP team increases the rate of sharing of tacit knowledge within SDP teams. The elements of team cohesion that were identified included common interest, team loyalty and satisfaction of SDP team members.

> *P16 said: "…. in one of the teams, I worked within, there was no good relations there then it was impossible to share knowledge. They were always ready to criticise each other's which were personal attacks."*

Tacit knowledge sharing is relational in nature which means personal relations needs to exist among the members of SDP team (Mtsweni and Mavetera, 2018). This indicates the relationships among the custodian of tacit knowledge and other members of SDP team is important and influence the sharing of tacit knowledge within SDP teams. It is important for the interpersonal relationships among the members of SDP team to have great strength. The more strength within interpersonal relationships among the members of SDP teams leads to improved sharing of tacit knowledge within SDP teams. This includes sharing quality tacit knowledge which is required by the members of SDP team to perform their socio-technical tasks to the require standard (Ghobadi and Mathiassen, 2016).

4.5 Team Properties

The settings and characteristics of SDP teams lead to a lack of tacit knowledge sharing especially on how the SDP teams are structured. This includes SDP teams being result oriented, big in size of SDP teams and having limited time to complete socio-technical tasks. SDPs are fast paced, which causes SDP team members not to focus on sharing tacit knowledge within SDP teams. The elements that were identified were size, structure, dispersion, communication, and methods.

> *P9 said: "Software development industry develops fast, and time is always an issue. I am not able to share my knowledge because I am chasing time and I am not sure about the relevance of my knowledge…….. The software project team was big to the extent that I did not know some of the member of team because they were based in other locations"*

The characteristics of SDP teams result in lack of sharing of tacit knowledge. The orientation of SDP team give emphasis on finishing the work within short period of time. The size, structure and dispersion of SDP team makes it challenging to share tacit knowledge because do not encourage verbal communication but encourages written communication. The bigger the SDP team and structure being complicated makes it challenging to have verbal communication. The SDP teams that are using traditional methods use written communication which does not permit the SDP team to share tacit knowledge which is also influenced by the dispersion of SDP teams.

4.6 Trust

Lack of trust among members of the SDP team and within SDP team limits the sharing of tacit knowledge within SDP teams. The members of SDP team do not share their tacit knowledge with another member of SDP team who they do not trust because they regard tacit knowledge as one of their personal assets. The custodian of tacit knowledge Trust is influenced by identification, openness and honesty, benefits, consistency, and relationships.

> *P13 said: "… I need to trust someone before I can start sharing my knowledge with that person because this knowledge is one of the most important assets in my life."*

Trust is one of the important elements when it comes to the sharing of tacit knowledge in general including within SDP teams. Trust needs to be part of the interpersonal relationships within SDP teams to drive the members of SDP team to share their tacit knowledge. The trust makes the source of tacit knowledge to have the assurance that the tacit knowledge will be utilised properly. On the hand the receiver of tacit knowledge also has the trust that the tacit knowledge being shared is accurate and the quality one. This further indicates that the tacit knowledge will yield accurate results when the tacit knowledge applied properly. The stronger the trust within SDP teams results in more tacit knowledge shared within SDP teams.

Lack of trust is one of the main barriers of knowledge sharing within organizations and SDP teams. Trust plays an important role in the sharing of tacit knowledge because members of SDP team regard tacit knowledge as their personal asset. The custodian of tacit knowledge needs to ensure that they share their tacit knowledge with someone whom they can trust. The other thing trust is important when it comes accurateness of tacit knowledge and yielding of accurate results when the tacit knowledge is being applied (Ghobadi and Mathiassen, 2016). This indicates trust is based on the tacit knowledge, custodian of tacit knowledge, the receiver of tacit knowledge and the results that are generated by tacit knowledge when it is being applied.

4.7 Communication

The nature of communication within SDP teams limits the sharing of tacit knowledge within SDP teams. SDP teams that rely heavily on written communication are not in good position to share tacit knowledge. SDP teams that use traditional teams methods SDP and SDP teams working remotely because of the Covid-19 pandemic. Written communication does not allow for the sharing of tacit knowledge. Communication elements identified were communication effectiveness, frequencies, tools, and type.

> *P11 said: "Traditional methods encourage communication to be in the form of written documents, which does not allow me to share my personal knowledge … traditional methods do not support collaboration and interaction … The interaction and collaboration allow me to get more knowledge from the member, since we will have more verbal communication and I can observe the way they are doing things and I can contribute my knowledge in the process."*

One of the important things when it comes to sharing of tacit knowledge is communication especially verbal communication. The most proven approach to share tacit knowledge is through verbal communication and it had not been disputed for long period of time. It is important for the receiver and the source of tacit knowledge to have good communication skills. Communication helps in the articulation of tacit knowledge which makes the receiver of tacit knowledge to understand the tacit knowledge and being able to use the tacit knowledge properly. The articulation enables the source of tacit knowledge to share quality tacit knowledge. This indicates communication result in limiting the sharing of tacit knowledge within SDP teams. This is because of the type of communication within SDP teams, tools that are used and prioritising the written communication within SDP teams.

Tacit knowledge relies heavily on verbal communication because verbal communication is one of the proven approaches of sharing tacit knowledge (Ghobadi and Mathiassen, 2016). This indicates the type of communication that is utilised within SDP team needs to be the one that drives and supports the sharing of tacit knowledge within SDP teams. The members of SDP team need to possess good communication skills especially verbal communication. This include understand the terms and jargons that are being used in the field of SDPs even during the sharing of tacit knowledge. This will enable them share tacit knowledge that is understood and can be applied properly which contributes to the quality of tacit knowledge. It is off utmost importance for tacit knowledge to yield accurate results when it is being applied when performing tasks within SDPs and that leads2 (Akguin et al., 2017).

Table 1 shows the team-oriented barriers to tacit knowledge sharing within SDP teams. They include the elements associated with the barriers of tacit knowledge sharing within SDP teams. The team culture barrier had three elements, namely attitude, value, and social behaviour. The second barrier was team cohesion, which had a total of three elements: common interest, loyalty, and satisfaction. The third barrier was team orientation, which had two elements: collaboration and team goals. The fourth element of team barriers that was identified was team properties, which originates from the characteristics of SDP teams. The fifth barrier was trust, especially lack of trust among the members of SDP teams. Trust had elements such as reliability, identification, openness and honesty, consistency, and relationships. The sixth barrier was communication. The elements of communication include communication effectiveness, communication frequencies, communication tools and communication type. The seventh and last barrier that was identified was SDP team dispersion, and the components of SDP dispersion were remote teams and geographical locations.

Table 1: Team Oriented Issues Limiting Sharing of Tacit Knowledge Within SDP Teams

Team Oriented Issues Limiting Sharing of Tacit Knowledge			
Themes	**Elements**	**Evidence (Participant)**	**Occurrence**
Team Culture	Attitude	P2, P3, P7, P13, P17, P18, P20, P23, P24, P26	10
	Values	P1, P3, P4, P7, P13, P16, P20, P23, P28	09
	Social behaviour	P1, P4, P6, P7, P8, P17, P19, P23, P27	09
Team Orientation	Collaboration	P1, P2, P3, P8, P10, P11, P12, P15, P16, P19, P23, P25	12
	Team goals	P3, P4, P7, P9, P10, P13, P14, P18, P21, P23, P25, P26, P28	13
Team Dispersion	Geographical Location	P2, P4, P5, P7, P9, P11, P12, P15 P18, P19, P20, P25, P28	13
	Remote teams	P1, P3, P6, P7, P8, P9, P11, P13, P12, P14, P18, P21, P23, P27	15
Team Cohesion	Common interest	P2, P3, P4, P6, P8, P12, P10, P13, P15, P19, P23, P25, P27	13
	Team loyalty	P3, P6, P8, P10, P12, P15, P16, P19, P23, P26, P27, P28	12
	Satisfaction within SDP team	P1, P4, P6, P13, P16, P18, P20, P23, P24, P26	10
Team Properties	Team size	P1, P2, P3, P7, P9, P10, P11, P13, P14, P17, P20, P23, P26, P27, P28	15
	Team structure	P3, P7, P8, P10, P11, P13, P14, P16, P24, P26	10
	Team dispersion	P4, P5, P7, P9, P11, P13, P15, P16, P17, P19, P21, P23, P25	13

Team Oriented Issues Limiting Sharing of Tacit Knowledge			
Themes	**Elements**	**Evidence (Participant)**	**Occurrence**
	Team orientation	P1, P3, P6, P8, P9, P11, P12, P14, P15, P19, P24, P28	12
	Team methods and practices	P2, P4, P5, P7, P8, P9, P11, P13, P16, P19, P20, P23, P28	13
Trust	Relationships	P1, P3, P5, P7, P8, P9, P11, P12, P16, P19, P23, P25, P28	13
	Consistency	P5, P9, P13, P15, P16, P23, P27	07
	Benefits	P3, P4, P8, P11, P12, P13, P16, P19, P20, P21, P23, P24, P27	13
	Openness and honesty	P2, P5, P7, P11, P13, P17, P19, P24, P25, P28	10
	Identification	P1, P2, P6, P9, P10, P11, P16, P19, P26	09
	Reliability	P2, P5, P9, P10, P13, P14, P21, P24, P27, P28	10
Communication	Communication type	P1, P2, P5, P6, P9, P11, P14, P20, P23, P25, P28	11
	Communication frequency	P1, P4, P8, P9, P10, P11, P12, P15, P16, P17, P20, P21, P25, P26	14
	Communication tools	P3, P4, P5, P8, P11, P12, P15, P16, P18, P19, P20, P23, P24, P26	14
	Effectiveness of communication	P1, P2, P3, P4, P5, P6, P7, P8, P9, P11, P14, P16, P19, P21, P22, P25, P27	17

5. Discussion of Results

Sharing of tacit knowledge within SDP teams enables the SDP teams to have access to sufficient tacit knowledge, which complements explicit knowledge when the SDP team perform socio-technical tasks (Lee, Park, and Lee 2020). Lack of sharing tacit knowledge within SDP teams became evident because of the high failure rate of SDPs which had been in existence for a long period of time. SDPs are failing because SDP teams do not have access to sufficient tacit knowledge which makes the entire SDP team perform socio-technical tasks to the required standard which are required to ensure the success of SDPs. This indicates that SDP teams are central and drivers of sharing of tacit knowledge because they rely on tacit knowledge to perform socio-technical tasks to a good standard.

These barriers have influence on each other and they have a role they play which leads to more lack of sharing of tacit knowledge within SDP teams. This indicates that these barriers of tacit knowledge sharing cannot be given attention as individual barriers of tacit knowledge instead they need to be treated as a single unit. Their impact result on one thing which is lack of sharing of tacit knowledge within SDP teams which leads to SDP teams not having access to sufficient tacit knowledge. The influence of these barriers on one another shows that there is a need to address all of them instead of focusing on selective barriers when addressing them to increase the sharing of tacit knowledge within SDP teams. This leads to different barriers of tacit knowledge having association among them.

The SDP team culture takes into consideration issues such as the SDP team's attitude to sharing of tacit knowledge, their values, and social behaviour of the members of SDP team. The SDP team culture drives members of SDP teams focus on meeting the deadlines, compared to prioritising other things such as sharing tacit knowledge within SDP teams. This is because SDPs are deadline driven by nature and it is always important meeting those deadlines since they are part of success criteria. SDP team culture makes the members of SDP teams work independently so that they can meet their deadlines because they are prioritizing meeting the

deadlines. Deadlines are given priority over other things such as sharing tacit knowledge which result in lack of sharing of tacit knowledge.

The orientation of SDP teams is heavily focused on meeting the deadlines which is associated with the SDP team culture. These deadlines have an element of time and an element of budget. These elements are part of the success criteria of SDPs. SDP teams want to complete their tasks within the allocated time and budget (financial resources). This makes SDP teams to focus on ensuring that these two elements are met all the time which include completing socio-technical tasks properly. This results in SDP teams not being able to focus on other important elements such as sharing tacit knowledge. In other words, the orientation of SDP teams to meet deadlines results in these SDP teams neglecting the sharing of tacit knowledge and placing more emphasis on meeting the deadlines. This results in SDP teams not having balance between tacit knowledge and explicit knowledge which makes the entire SDP teams not performing socio-tasks properly.

Most SDP teams have members who are based in different locations such as different buildings and different vicinities. Covid-19 pandemic made the current trend of the members of SDP teams working from home or working remotely. SDP team members are also based in different geographical places, even foreign countries, which is driven by outsourcing practices. This results in members of SDP teams not being able to share tacit knowledge because such sharing of tacit knowledge relies heavily on verbal communication and the human presence. It is easier to share tacit knowledge where the members of the SDP team are in the same physical space. A geographical distance between members of the SDP team results in a lack of sharing tacit knowledge within SDP teams. Remote working limits the interaction among the members of SDP teams which also results in lack of sharing within SDP teams.

SDP team cohesion is heavily dependent on the strength and extent of interpersonal relationships within SDP teams especially among the members of SDP teams. Interpersonal relationships within SDP teams are vital to sharing tacit knowledge because the sharing of tacit knowledge is relational in nature. This indicates the members of SDP team who are participating in the process of tacit knowledge sharing needs to have a relationship among them (Ryan and O'Connor 2013). Therefore, relationships are influential in the sharing of tacit knowledge within SDP teams. Interpersonal relationships mean the members of SDP teams need to have shared norms and values and a sense of belonging within SDP team, which makes it easier for them to share tacit knowledge. Therefore, it is important that SDP team members have strong interpersonal relationships because it strengthens the sharing of tacit knowledge within SDP teams and among the members of SDP teams.

Trust within SDP teams and among the members SDP team is an important element when it comes to the sharing of tacit knowledge within SDP teams. However, trust within SDP teams and among members of SDP team is limited because members of SDP team focus on their tasks most of the time whereby the priority is to complete the tasks within allocated time. The members of SDP teams do not to have time to create trust with other members of SDP teams because the priority is placed on completing their respective tasks. This is the result of the SDP teams not having enough social gatherings, which allow SDP teams to create trust and have interpersonal relationships. SDP teams lack of social gatherings because of working arrangements such as working from home because of the lockdown restrictions in different countries and members of SDP team focus on meeting their deadlines within allocated time not prioritizing the sharing of tacit knowledge within SDP teams. A lack of trust results in a lack of sharing tacit knowledge within SDP teams. The higher the trust within the SDP teams and among the members of SDP teams leads to higher of sharing of tacit knowledge within SDP teams (Lee, Park, and Lee 2020). This means that it is essential for SDP teams to have high trust to enable the sharing of tacit knowledge within SDP teams. The trust is further affected by a lack of team cohesion, which makes the SDP team not to have strong interpersonal relationships.

SDP teams that are using traditional methods, especially the waterfall method, and having remote SDP teams rely heavily on written communication. Traditional methods rely heavily on written communication, as opposed to verbal communication as a form of communication within SDP teams. However, written communication enables the members of the SDP team to share explicit knowledge because explicit knowledge can be written down rather than tacit knowledge which rely heavily on verbal communication to share it. The most proven approach to sharing tacit knowledge within SDP teams is through verbal communication, which is minimal within SDP teams that are using traditional methods and working from different locations (Takpuie and Tanner 2016). Therefore, the type of communication especially written communication can limit the sharing of tacit knowledge within SDP teams. SDP teams need to start to rely heavily on verbal communication and use interactive methods such as Agile methods that enable them to share tacit knowledge because such SDP teams rely on verbal

communication heavily. This will result in SDP teams having good SDP team cohesion and good relationships within the SDP teams which result in more sharing of tacit knowledge.

6. Conclusion

The main aim of this research study was to identify team-oriented barriers that limit the sharing of tacit knowledge within SDP team. A total of seven team-oriented barriers were identified namely SDP team culture, SDP team orientation, SDP team dispersion, SDP team cohesion, SDP team properties, trust within the SDP team and communication within the SDP team. All these team-oriented barriers are depicted in Figure 1. These elements were not given much attention in the literature, especially the focus on tacit knowledge within the context of SDP teams in a developing country in the continent of Africa, even though SDPs are knowledge oriented in nature and team members rely on tacit knowledge to perform socio-technical tasks to the required standard. Tacit knowledge complements explicit knowledge when SDP team members conduct their socio-technical tasks within SDPs.

A theoretical contribution of this research is the SDP team-oriented barriers that limit the sharing of tacit knowledge within SDP teams. These issues were developed based on the context of the developing country, which is the RSA on the continent of Africa. All these issues emanated from SDP teams which rely on tacit knowledge when they perform their socio-technical tasks. This indicates that the entire SDP team contributes to the lack of sharing tacit knowledge within SDP teams. Therefore, SDP teams has a role to play in addressing the limitations of tacit knowledge sharing within SDP teams. The strategies to overcome these issues need to arise from SDP teams and their members. This will enable SDP teams to adhere and ensure effectiveness in sharing tacit knowledge which will result in SDP team having access to sufficient tacit knowledge within SDP teams.

SDP teams need to start using interactive methods such as the Agile Methods. Interactive methods rely on verbal communication, which enable the sharing of tacit knowledge within SDP teams. Verbal communication is one of the best practices and methods that has been proven when it comes to sharing tacit knowledge within SDP teams. Interactive methods enable the SDP teams to have more interaction, collaborations, and interpersonal relationships which makes the sharing of tacit knowledge take place within SDP teams. The interaction and collaboration will result in SDP team members developing interpersonal relationships, which will improve cohesion and trust in the SDP team. The relationships and trust are essential for the sharing of tacit knowledge within SDP teams. The stronger the trust and relationships, the more tacit knowledge will be shared within SDP teams.

This research study was conducted in the RSA, which is a developing country on the African continent. Thus, the results represent a perspective of a developing country on the continent of Africa. This research study focused on SDP teams, which indicates the results reflect project teams especially SDP teams. This can be regarded as a limitation when it comes to the results of this research study. These results do not focus on all SDP teams in the current era of the 4IR. These results are limited to SDP teams in a developing country that conducts the highest number of SDPs on the continent of Africa. RSA further have more investment based on financial resources when it comes to conducting SDPs in the continent of Africa (Marnewick 2016). The results further represent an African perspective (i.e., of the African continent).

It is important to validate the results of this research study, especially team-oriented barriers, using a deductive approach which is used to validate the results because it relies on large numbers. This will result in the results being validated and generalised to a larger population in the current era. The generalisation will be possible because the deductive approach relies on large numbers to generate the results and strength to generalise the results to a particular population. This will result in the results of this research study being validated and accepted by a wider audience in academic research. These barriers will be used more often in the literature by other researchers with different perspectives, which will lead to validations of the results of this research study. This will give other researchers an opportunity to improve on them and make them applicable to the wider community of different project teams, not only SDP teams and giving more attention of tacit knowledge within SDP teams.

There is a need to conduct a research study that will clarify the role of tacit knowledge and the contribution of tacit knowledge within SDP teams, especially in ensuring the success of SDPs and improving the efficiency and effectiveness when performing socio-technical tasks within SDPs. This can be done by conducting an inductive research study. The researchers can rely on qualitative data and observation can be used as a method of collecting the qualitative data. This will ensure that the SDP teams become more aware of where and when tacit

knowledge is required when performing socio-technical tasks within SDP teams and at which stage of SDP tacit knowledge is more required. Therefore, SDP teams will be able to preserve tacit knowledge that is required within SDP teams and work towards turning tacit knowledge into explicit knowledge for documentation to which other members of the SDP team can have access without relying on verbal communication and having geographical location as a limitation of accessing the knowledge.

In conclusion, SDP teams play a role and contribute to the lack of sharing tacit knowledge within SDP teams. This results in SDP teams not having access to sufficient and required tacit knowledge to perform socio-technical tasks to the required standards which leads to the success of SDPs. Limited access to tacit knowledge in SDP teams results in SDP teams failing to perform their social tasks of the software development process to the required standard. The failure of SDP teams to perform these tasks to the required standard contributes significantly to the high failure rate of SDPs, which is the current challenge. Therefore, SDP teams contribute to the high failure rate of SDPs by sharing limited tacit knowledge within SDP teams. In return, lack of access to tacit knowledge contributes to higher failure rate of SDPs in the current era.

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