The effects of the relational dimension of social capital on tacit and explicit knowledge sharing: a mixed-methods approach

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Abstract

Purpose – Knowledge sharing among individuals from different teams is rare. Agile methods encourage only the exchange of tacit knowledge within teams. This study aims to analyse the influence of trust, norms of cooperation and reciprocity on tacit and explicit knowledge sharing among individuals from different software development teams.

Design/methodology/approach – Data were collected using a cross-sectional survey involving 205 individuals working in software development teams. The authors adopted a mixed-methods approach involving partial least squares structural equation modelling (PLS-SEM) and fuzzy-set qualitative comparative analysis (fsQCA).

Findings – PLS-SEM shows: the antecedents have different influence in tacit knowledge sharing (TKS) and in explicit knowledge sharing (EKS); trust influences directly TKS, and it only influences EKS indirectly, while reciprocity influences TKS directly and EKS both directly and indirectly; norms of cooperation directly influence TKS, and they only influence EKS indirectly. Overall, the fsQCA findings support PLS-SEM results: TKS contributes to EKS; reciprocity or trust is a sufficient condition for TKS and EKS; norms of cooperation are a sufficient condition for TKS; larger firms without high levels of reciprocity and trust cannot expect TKS and EKS. The quantitative and qualitative results are aligned.

Research limitations/implications – The results cannot be generalisable because snowball sampling was used, and most of the respondents were Brazilians.

Practical implications – This study should help managers and scholars: to appreciate the relevancy of TKS among individuals using agile methods to nurture EKS and to understand the different effects of reciprocity, trust and norms of cooperation on both TKS and EKS.

Originality/value – Considering three constructs, this study uses a mixed-methods approach to investigate the potential of the relational dimension of social capital theory to leverage TKS and EKS, to

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overcome the limitations of agile methods. The originality of this study regards that it shows the constructs of relational social capital influencing TKS and EKS differently.

Keywords Knowledge sharing, Tacit knowledge, Social capital, Agile, Explicit knowledge

Paper type Research paper

1. Introduction

The software development industry is considered knowledge-intensive. The industry adopts conventional methods, involving sequential processes and documentation (e.g. waterfall), or agile methods, involving iterative processes, focusing on tacit knowledge (e.g. scrum). Although agile methods (AMs) originated in the information technology (IT) field, the use of AMs has expanded into other, usually knowledge-intensive, areas such as finance, health, education and construction – which also seek to minimise the risks related to projects (González-Cruz *et al.*, 2020).

The AMs approach encourages the exchange of tacit knowledge within teams. However, this often leads to a lack of documentation to support future projects and the loss of knowledge in the event individuals leave the team. Moreover, often, there is very little exchange of knowledge between teams, which can negatively impact organisational learning. Furthermore, difficult relations among individuals within an organisation may constitute a barrier to knowledge sharing (KS).

The social capital of individuals is important for organisations because individuals with abundant social capital are more likely to share knowledge and can, thus, generate benefits for organisations, such as reducing the cost of obtaining knowledge and improving productivity (Lee, Park and Lee, 2020; Lin, 2011). For example, Ganguly *et al.* (2020) identified the influence of relational social capital in the quality of KS. Ha and Nguyen (2020) examined the influence of three dimensions of social capital on explicit and tacit KS. Nevertheless, these authors used social capital dimensions without considering which constructs form these dimensions. Thus, this research investigates the potential of three constructs within/of the relational dimension of social capital to leverage tacit and explicit KS, to identify their relevance in the context of software development using AMs.

This article aims to analyse the influence of trust, norms of cooperation and reciprocity on tacit and explicit KS among individuals from different software development teams. The unit of study is the individual working as a team member, while the phenomenon under study is the KS behaviour among individuals from different teams within the same organisation.

This paper has even sections. Following this introduction, Section 2 presents the main concepts related to social capital and KS and the hypotheses. Section 3 reports the methodological procedures adopted. Sections 4 and 5 describe the main results of the quantitative and qualitative approaches, respectively. Section 6 discusses the results, and Section 7 presents the conclusion/s, limitation/s and suggestions for future research.

2. Theoretical foundation

Researchers have used several theoretical perspectives to study KS behaviour, such as the theory of reasoned action, social capital and the knowledge-based view of the firm, among others (Maheshwari *et al.*, 2020). In the KM literature, several authors consider social capital to be a channel that facilitates the flow of knowledge (Lee *et al.*, 2020; Chang and Chuang, 2011; Inkpen and Tsang, 2005).

2.1 Social capital

Social capital is "the sum of the real and potential resources embedded within, available through and derived from the network of relationships maintained by an individual or social unit. Social capital comprises both the network and the assets that can be mobilised through that network" (Nahapiet and Ghoshal, 1998, p. 243).

The research conducted by Oparaocha (2016) emphasises the role of human resource departments in encouraging the development of social capital while highlighting the importance of those relationships in project teams, as they are critical not only for the success of any project, but also allow the dissemination of the knowledge among teams. To achieve its objective, the present study analyses social capital at the level of the individual and in the relation with individuals from other teams within the organisation in which the individual works.

Nahapiet and Ghoshal (1998) identify three dimensions within social capital; they are: structural – representing the general pattern of relations between the parties, i.e. how and with whom you connect; relational – the type of relationship that people develop among themselves over time; and cognitive – including the interpretations, representations and meanings shared between the parties. These dimensions are composed of constructs that define the characteristics of each of the dimensions. For example, Ha and Nguyen (2020) study the relationship between the three dimensions and tacit and explicit KS. While, Lee *et al.* (2020) used one construct from each dimension to represent social capital in their research model.

The present study considers three constructs (reciprocity, norms of cooperation and trust) to represent the relational dimension of social capital. The criteria used to select the constructs are the frequency with which they have been studied in the context of KS, as well as the confirmation of their link with KS in previous studies.

2.2 Knowledge sharing and agile methods. Knowledge is a relevant asset (Goswami and Agrawal, 2018), and it is classified into two types: tacit – based on actions, commitment and involvement in a context; and explicit – codified knowledge, which can be formally expressed and transmitted systematically (Polanyi, 1966). In his paper on the theory of creation of organisational knowledge, Nonaka (1994, p. 14) states that "organisational knowledge is created through a continuous dialogue between tacit and explicit knowledge". The fact that tacit knowledge is based on the abilities and experiences of individuals, their beliefs and values makes it personal and more difficult to transmit (Nonaka and Konno, 1998). Tacit knowledge is considered strategic from the organisational point of view, as its more exclusive nature increases the possibility of it constituting a differential factor in the generation of innovation and competitive advantage (Nonaka, 1994).

The sharing process is seen by many authors as having a vital role in organisations (Balle *et al.*, 2020). The sharing process can occur at the individual and collective levels, through groups or organisations (Lee, 2001). Sharing at the individual level refers to peer-to-peer exchange, e.g. to make some activity more efficient. By contrast, organisational sharing is characterised by the capture, organisation and reuse of knowledge, making it available to the business (Lin, 2007). When it comes to organisations, the range of sharing can occur within an organisation, intra-organisational; or beyond organisational boundaries, inter-organisational (Nonaka and Takeuchi, 1995). Intra-organisational sharing can take place within the same team, or between different teams, within the same area or between areas.

Some specific features were identified in studies of KS involving tacit and explicit knowledge and AMs. In terms of explicit knowledge, previous studies (Montazemi *et al.*, 2012) have highlighted the importance of this knowledge, especially in global projects, as informal communication can be hampered due to cultural issues, language barriers and time zone differences. On the other hand, difficulties managing explicit knowledge in repositories

have been reported in other studies. The specific features presented in relation to explicit knowledge suggest that whilst there is a need for this type of knowledge, it is difficult to manage.

Although the use of agile practices facilitates tacit KS within a team, there are limitations regarding the transfer of knowledge to other teams, clients or with the rest of the organisation (Kuusinen*et al.*, 2017). Another example of difficulty in terms of tacit KS was shown in the meta-analysis from Montazemi *et al.* (2012) where global team managers experienced difficulty transferring new tacit knowledge to the globally distributed teams of their affiliates. Tacit KS, inherent in AMs, is shown to be challenging in contexts where people are not physically close. Social interaction facilitates the flow of tacit knowledge (Nonaka, 1994), and informal communication creates a less structured and more flexible environment for tacit KS (Boehm and Turner, 2004). Studies into the use of social media for tacit KS suggest that while technology facilitates interaction between people who are not in the same location, factors such as the degree of complexity of the knowledge and the seniority of the parties play an important role in how effective it is in tacit KS (Panahi *et al.*, 2016).

The study by Kuusienen *et al.* (2017) on KS in large-scale organisations applying AMs points out that the complexity of the organisational environment and the deficiency or lack of guiding strategy for KS needs beyond the team boundaries are some of the challenges for organisational learning.

2.3research model hypotheses. The definition of each construct included in the research model is presented in Table 1.

Social capital's relational dimension focuses on the nature and quality of the connection between individuals as a function of a history of interactions (Bolino *et al.*, 2002; Nahapiet and Ghoshal, 1998).

Trust is often used in research involving KS in various contexts (Göksel and Aydintan, 2017; Wu and Lee, 2016; Chang *et al.*, 2012) and suggests that the degree of trust individuals have regarding their peers and superiors affects their attitude towards KS (Kmieciak, 2020; Gillani *et al.*, 2018; Rahman *et al.*, 2016; Rahman *et al.*, 2018). Conversely, the lack of trust between parties is considered a barrier to KS (Bakker *et al.*, 2006). *H1a* and *H1b* represent the construct "trust" in the present study:

H1a. Trust positively influences tacit KS among individuals from different teams within the organisation.

Table 1.
Research constructs

Construct	Definition	Reference
TR – trust	The degree to which an individual is willing to be susceptible to the actions of other individuals	Chow and Chan (2008)
REC – reciprocity	The belief that a current contribution of knowledge generates the receipt of knowledge in response to a future request	Kankanhalli *et al.* (2005)
NCO – norms of cooperation	The existence of rules of teamwork, collaboration, appreciation of diversity, openness to conflicting opinions and tolerance of failures	Kankanhalli *et al.* (2005)
TKS – tacit knowledge sharing	The extent to which an individual is willing to share their tacit knowledge in the organisation	Chow and Chan (2008), Shao *et al.* (2012)
EKS – explicit knowledge sharing	The extent to which an individual is willing to share their explicit knowledge in the organisation	Chow and Chan (2008), Shao *et al.* (2012)

H1b. Trust positively influences explicit KS among individuals from different teams within the organisation.

Norms represent another aspect of the relational dimension presented by Nahapiet and Ghoshal (1998). The authors build on the Coleman concept and define norms as a representation of consensus regarding the social system. Norms may moderate an individual's behaviour in accordance with the group expectations (Kankanhalli *et al.*, 2005; Adler and Kwon, 2002).

Different terms and specific features are found for the "norms" construct, such as "social norms", "norms of cooperation" and "norms of reciprocity". Putnam *et al.* (1994) use the term norms of reciprocity to refer to the expectation a donor has that someday someone will return something (a favour, for example) to him/her, i.e. the reciprocal act does not necessarily come from the same person who received something. Reciprocity is seen as an important extrinsic motivator for facilitating KS, which favours long-term relationships and mutual cooperation, where sharing behaviour presupposes future requests will be met (Lin, 2007).

Reciprocity has been shown to positively influence KS among geographically separated people, a situation that is also found in software development teams. Recent examples are two studies in the context of KS among global teams (Rode, 2016; Dijk *et al.*, 2016). Reciprocity has also been positively related to KS in virtual communities (Kankanhalli *et al.*, 2005). Nevertheless, according to Maheshwari*et al.* (2020), "empirical research on the effect of reciprocity on KS shows conflicting results". Hence, the following hypotheses are presented:

H2a. Reciprocity positively influences tacit KS among individuals from different teams within the organisation.

H2b. Reciprocity positively influences the explicit KS among individuals from different teams within the organisation.

Also derived from the "norms" aspect presented by Nahapiet and Ghoshal (1998), the term "norms of cooperation" describes an environment that facilitates sharing, where collaboration rather than competition prevails (Choi, 2016; Chua, 2002). This type of environment stimulates social relations that help strengthen the basis for knowledge creation (Chua, 2002). Norms of cooperation cover situations such as teamwork, the appreciation of diversity, openness to contrasting opinions and tolerance of failure (Kankanhalli, Tan and Wei, 2005).

Although only one of the analysed articles uses the specific term "norms of cooperation", the fact that the present study is concerned with individuals working in teams suggests *H3a* and *H3b*:

H3a. Norms of cooperation within an organisation positively influence tacit KS among individuals from different teams within the organisation.

H3b. Norms of cooperation within an organisation positively influence the explicit KS among individuals from different teams within the organisation.

Previous studies that have also validated KS according to the types, tacit and explicit suggest that an individual who shares his/her tacit knowledge also shares explicit knowledge (Chumg *et al.*, 2015), and in organisations where tacit knowledge is shared, explicit knowledge will also be shared. To test the influence of tacit KS on explicit KS, we have the following hypothesis:

H4. Tacit KS positively influences explicit KS among individuals from different teams within an organisation.

3. Research method

This research adopts a mixed-methods approach (quantitative and qualitative) following a sequential strategy (Johnson and Onwuegbuzie, 2004). Mixed-method research offers a deeper and richer analysis compared to the use of either quantitative or qualitative methods alone (Schulze, 2003; McKim, 2017). We start by testing the conceptual model presented in Figure 1 using structural equation modelling (SEM). Subsequently, we apply a configurational approach to data to identify configurations of conditions (distinct behaviours and contextual settings) of firms that generate alternative pathways to tacit and explicit KS. Based on previous contributions on antecedents of KS, we use mixed methods to expand existing knowledge. Qualitative research methods have been criticised for lacking objectivity and the capacity to be generalised (Nagel, 1986; Gelo *et al.*, 2008), whereas quantitative research methods are often perceived as neglecting study participants and lacking appropriate interpretation. Thus, the mixed-methods research options add value, give greater validity to the results and help in the creation of new knowledge (McKim, 2017). As mixed-methods studies that combine qualitative comparative analysis are scarce (Cragun*et al.*, 2016), this approach is pioneering, as it provides multiple lines of analysis to deliver more complete findings. To fully implement a mixed-methods approach, we include both methods in the sequence of research phases (Creswell and Tashakkori, 2007):

- Data collection – we use the same questionnaire to collect data. The scales used to measure the constructs for the SEM approach also provide the conditions in the configurational analysis.
- Data analysis – both the quantitative and qualitative analysis follow the same sequence: the SEM addresses antecedents of both tacit and explicit KS, as well as proposing that tacit KS impacts on explicit KS. The configurational analysis associates sequential sub-models leading to tacit and explicit KS to uncover alternative pathways generating each of the KS dimensions.
- Integration – we use results from the two approaches to better expand on the knowledge regarding the antecedents of KS dimensions. Additionally, we complement those results by uncovering alternative pathways that lead to the absence of both KS dimensions.

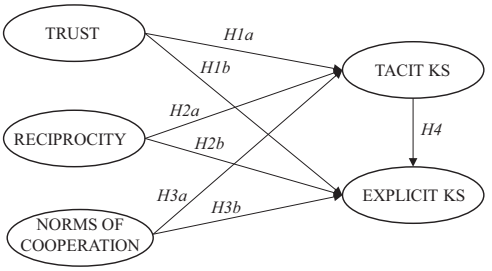

Figure 1.
Research model

3.1 Data collection and sampling

This research adopts a quantitative approach in which a survey was applied via an electronic questionnaire. Snowball sampling was used to find respondents (employees working in software development team/s), because there was no list of respondents available. Posts were made in social media tools such as Facebook and LinkedIn inviting members of software development teams to complete the survey and share the link. Respondents from diverse countries and locations were also contacted via e-mail and social media.

The survey instrument, based on pre-existing scales (Appendix), used a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". According to Cooper and Schindler (1998), a seven-point scale facilitates sensitive measurement of the variance. The instrument has 15 demographic questions. All the scales were originally written in English; as the questionnaire was also made available in Portuguese, the items were translated to Portuguese and back-translated to English by a bilingual translator, and then compared to the original items. The items in Portuguese were pre-tested by five specialists who suggested some adjustments. The sample characterisation, according to the socio-demographic variables, is detailed in Table 2.

As demonstrated in Table2, 73.6% of the respondents are male; this is typical of the IT area (Moghaddam, 2010). Approximately 15% of the teams have more than five years' experience working with agile methodologies, meaning most of the teams are less experienced in such methods. In terms of the organisations they work for, 66.8% have more than 500 employees, and majority are private. The respondents occupied a range of functions in the IT departments of firms in the technology or other business sectors.

4. Quantitative approach

4.1 Exploratory factorial analysis

Initially, the exploratory factor analysis using the principal component analysis (PCA) with the varimax rotation method was adopted, within the SPSS. The scales were clustered in different factors, thus confirming they are different constructs. The factor loading of each item was greater than the recommended 0.70, except REC1, NCO4, NCO5, TKS2 and EKS2. These five items were removed.

4.2 Measurement model

Loadings are above 0.708 and the associated *t*-statistic above ±1.96, as recommended by Hair *et al.* (2020). Table 3 shows loadings and significance.

The reliability of the constructs was checked using Cronbach's α and composite reliability (CR). The values obtained were within the range recommended by Hair *et al.* (2020). The convergent validity was checked using the analysis of variation extracted (AVE) and CR. According to Bagozzi and Yi (1988), AVE should be higher than 0.5, and according to Koufteros (1999), CR should be higher than 0.8. The results can be seen in Table 4.

The discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio of correlations, as recommended by Hair *et al.* (2020). Table 5 shows the HTMT ratio of correlation. The maximum HTMT value is below 0.85 (for conceptually different constructs) and 0.90 (for conceptually similar constructs) (Hair *et al.*, 2019; Hair *et al.*, 2020). Considering the HTMT, discriminant validity was established for this model.

4.3structural model. The model presented no collinearity problem, as the variance inflation factor (VIF) is below 5, as recommended by Hair *et al.* (2019). VIF test values under 3.3, as per Kock (2015), suggest there is no common method bias. In this model, all the values for VIF were under 1.2.

Table 2.
Characteristics of the sample

		Frequency	(%)			Frequency	(%)
Gender	Male	151	73.7	Role of the team	Developer	44	21.5
	Female	54	26.3		Test analyst	38	18.5
Age	≤	12	5.9		Project manager	33	16.1
	26–30	31	15.1		Product owner	20	9.8
	31–40	103	50.2		System analyst	18	8.8
	41–50	45	22.0		Scrum master	18	8.8
	>50	14	6.8		Business analyst	11	5.4
Nationality	Brazilian	186	90.7		Other	23	11.2
	Indian	15	7.3	Org. number of employees	<20	16	7.8
	Chinese	1	0.5		20–99	14	6.8
	Others	3	1.5		100–499	38	18.5
Professional experience	<2	6	2.9		≥ 500	137	66.8
	2–5	26	12.7	Type of economy	Private	150	73.2
	6–10	31	15.1		Public	22	10.7
	11–15	50	24.4		Mix	33	16.1
	>15	92	44.9	Sector of the organisation	Technology	59	28.8
Experience of the team with agile	<2	58	28.3		Software	44	21.5
	2–5	109	53.2		Government	25	12.2
	6–10	26	12.7		Trade and services	15	7.3
	>10	5	2.4		Financial	14	6.8
	Does not know	7	3.4		Hardware	13	6.3
Team's geographic distribution	Global	107	52.2		Telecommunication	8	3.9
	Local	98	47.8		Others	27	13.2

The Shapiro–Wilke and Kolmogorov–Smirnov tests in SPSS showed the data distribution to be non-parametric, which was later confirmed using the kurtosis and skewness tests. Given that the data is non-parametric, the partial least squares – SEM (PLS-SEM) method and the statistical software Smart PLS 3.0 were used to estimate the model. The significance of the relationships was assessed using a bootstrapping algorithm. The hypotheses are considered supported when *t-values* are above 1.96. The model was tested and the results of the *t-values* for the NCO → EKS and TR → EKS showed the relationships were not supported. These relationships were removed, and the model was tested again, and all the relationships were found to be significant. Table 6 summarises the results of the hypothesis test.

Mediation was also tested through the analysis of indirect effects. As per Hair *et al.* (2014), a bootstrapping algorithm with $p < 0.05$ indicates valid mediation. Analysing the results of the *p*-value along with the adjusted model, there can be said to be partial mediation in the relationship REC → TKS → EKS (*p*-value = 0.023) and full mediation between NCO → TKS → EKS (*p*-value = 0.047) and TRU → TKS → EKS (*p*-value = 0.000).

Table 3. Loadings and significance

	Loading	*t*-statistics	*p*-values
EKS1	0.794	18.403	0.000
EKS3	0.825	16.675	0.000
EKS4	0.840	29.216	0.000
TKS1	0.820	23.163	0.000
TKS3	0.863	36.831	0.000
TKS4	0.740	13.718	0.000
TRU1	0.861	32.390	0.000
TRU2	0.883	43.239	0.000
TRU3	0.860	34.578	0.000
NCO1	0.897	7.894	0.000
NCO2	0.924	9.321	0.000
NCO3	0.910	18.610	0.000
REC2	0.877	34.214	0.000
REC3	0.919	49.409	0.000
REC4	0.913	61.896	0.000

Table 4. Reliability and convergent validity

	NCO	TR	REC	TKS	EKS
AVE	0.829	0.753	0.816	0.655	0.672
CR	0.936	0.902	0.930	0.850	0.860
Cronbach's α	0.899	0.836	0.889	0.741	0.756

Table 5. HTMT ratio of correlations

	EKS	TKS	NCO	REC	TRU
EKS	–				
TKS	0.851	–			
NCO	0.142	0.230	–		
REC	0.502	0.438	0.178	–	
TRU	0.530	0.694	0.099	0.411	–

According to the results, 35.2% of the variance in the tacit KS (TKS) can be explained by the constructs norms of cooperation, reciprocity and trust; and, 48.3% of the variance in the explicit KS (EKS) can be explained by the constructs TKS, reciprocity, norms of cooperation and trust (Figure 2).

According to Hair *et al.* (2020):

- the TKS → EKS relationship had an $f^2 = 0.585$, indicating it is large;
- the TRU → TKS relationship had an $f^2 = 0.304$, which is medium; and
- the remaining relationships had f^2 value above 0.02 and below 0.15, indicating they are small.

Q^2 is a metric used to assess prediction and should be higher than zero to be meaningful (Hair *et al.*, 2020). Q^2 is 0.313 (medium) for EKS and 0.216 (small) for TKS.

5. Qualitative approach

We used fuzzy-set qualitative comparative analysis (fsQCA) (Ragin, 1987) in the qualitative phase of the study because it is suitable for analysing high levels of causal complexity (Ziemiańczyk *et al.*, 2017). The capacity of traditional quantitative methods to uncover complex interactions between variables is limited (Osabutey and Jin, 2016), as they merely offer a single estimated solution regarding the dependent variable in the study (Rihoux and Ragin, 2009). Moreover, fsQCA is an innovative methodological approach (Pickernell *et al.*, 2019) that can be applied to small, medium-sized (Ragin, 2000) and large samples (Witt and Jackson, 2016). This technique can be used to identify multiple configurations of causal conditions leading to outcomes. Additionally, fsQCA accepts that conditions may be causally related to only one configuration while possibly being either unrelated or inversely

Table 6. Results of the hypothesis test

Path	Coefficient	*t*-value	Result
H1a – NCO → TKS	0.120	1.961	Supported
H1b – NCO → EKS	–	–	Not supported
H2a – TRU → TKS	0.477	6.649	Supported
H2b – TRU → EKS	–	–	Not supported
H3a – REC → TKS	0.177	2.336	Supported
H3b – REC → EKS	0.205	2.932	Supported
H4 – TKS → EKS	0.592	9.832	Supported

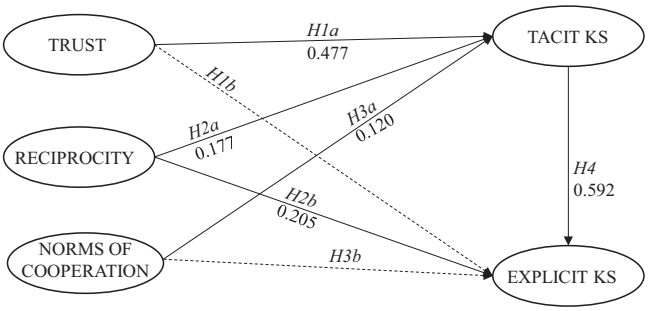

Figure 2. Structural model

related in others (Meyer *et al.*, 1993). It explores and examines complex causality, given that fsQCA (Fiss, 2011): allows for more than one configuration of conditions leading to the outcome (equifinality); provides alternative configurations for the same outcome (results are not limited to a single configuration, which is in contrast to traditional quantitative statistical methods that only provide one estimated solution); solutions may use conditions, leading to the outcome that differs from the conditions that lead to its absence (asymmetry).

Additionally, fsQCA works well with a small number of causal conditions because it has no omitted variable bias. As fsQCA draws on Boolean algebra rather than on correlations, leaving out a relevant condition may decrease the explanatory power of the model, but it will not result in an omitted variable bias. Using an fsQCA approach enables the identification of illustrative examples of each of the configurations within the raw data, which provides clear adherence of results to reality (Fainshmidt *et al.*, 2020). fsQCA proposes an interplay involving conditions, combinations of conditions and a given outcome (Ragin, 1987, 2000). We follow a sequential qualitative approach using fsQCA (Lisboa *et al.*, 2016; Skarmeas *et al.*, 2016; Han *et al.*, 2019) to establish the configurations of conditions that lead to TKS and EKS, reflecting the sequential hypotheses tested in the quantitative approach. fsQCA represents a valuable method for exploring and examining complex causality, offering a variety of alternative combinations (equifinality) to the same outcome; alternative combinations of conditions and asymmetry (Fiss, 2011). Thus, it offers an advantage compared to traditional quantitative statistical techniques that only estimate a single solution to the presence of the outcome based on correlations (Rihoux and Ragin, 2009) and have a limited ability to account for complex interactions between variables (Osabutey and Jin, 2016).

Following the best practices, we assessed the necessity and sufficiency of the conditions leading to the outcomes in the study (TKS and EKS). Each condition's degree of necessity indicates the extent to which the condition is required to achieve the outcome. According to Ragin (2000), the necessary conditions must present consistency values that surpass the 0.80 threshold. According to our findings, there is a single necessary condition for EKS, which is TKS (Table 7).

On the other hand, a condition's degree of sufficiency shows the extent to which each condition accounts for the outcome (Fiss *et al.*, 2013). The fsQCA provides three solutions: the complex, the parsimonious and the intermediate solutions (Fiss, 2011). In accordance with the literature (Ragin, 2008), we report the intermediate solutions that are evaluated by consistency and coverage levels. The consistency level reflects the percentage of cases including the specific configuration of conditions in question that result in the occurrence of the outcome. In fsQCA, a model can usually be said to be informative when its consistency is above 0.75 (Ragin, 2008). The coverage level represents the percentage of cases of the outcome that occur because of that specific configuration and the suggested adequate threshold according to the literature is between 0.25 and 0.90 (Ragin, 2008; Woodside and

Table 7. Results of analysis of necessary condition

	TKS		EKS	
Conditions	Consistency	Coverage	Consistency	Coverage
Number of employees	0.642790	0.500438	0.642129	0.482628
Trust	0.787830	0.809226	0.740215	0.734014
Norms of cooperation	0.690418	0.723664	0.664757	0.672661
Reciprocity	0.748359	0.785630	0.723317	0.733071
TKS			0.823832	0.795331

Zhang, 2013). Woodside (2013) stresses the importance of achieving high consistency as opposed to high coverage. Each causal configuration involves one or more conditions. Sufficiency analysis reveals four configurations leading to TKS and seven configurations leading to TKS. The overall solutions respect the 0.75 threshold (Ragin, 2008), and the coverage levels are within the suggested range of 0.25–0.90 (Ragin, 2008; Woodside and Zhang, 2013) (Table 8).

6. Discussion

6.1 Quantitative approach

The findings show that NCO has a positive and significant direct effect on TKS and has no such effect on EKS. TKS requires more time and dedication. An environment that stimulates collaboration rather than competition among people also stimulates social relationships, which, according to Chua (2002), helps strengthen the basis for knowledge creation. Although there is no direct influence on the NCO → EKS relationship, there is indirect influence via TKS (as per *H4*), meaning that people who share tacit knowledge tend to share explicit knowledge.

Reciprocity was found to have a positive and direct influence on both TKS and EKS. These results suggest individuals who donate their knowledge expect to be reciprocated someday by someone, and this applies to both tacit and explicit knowledge. This result is aligned with Maheshwari *et al.* (2020) on reciprocity influencing attitude towards KS.

Trust was found to have a positive effect on TKS. This result is aligned with earlier research that suggests an individual's level of trust in his/her peers and upper management affects his or her KS behaviour (Göksel and Aydintan, 2017; Wu and Lee, 2016; Chang *et al.*, 2012). As tacit knowledge is considered the most valuable, the existence of trust-based relations will likely facilitate access to more restrictive knowledge (Chugh, 2017). Analogous to the NCO → EKS relationship, there is an indirect influence between TRU and EKS, suggesting that as trust leads to people sharing tacit knowledge, it will also induce EKS.

The support for *H4* is in accordance with previous studies, such as Chumg *et al.* (2015). In addition, the TKS → EKS relationship has been shown to have a strong influence (β = 0.592) on the context of this research. These facts indicate that individuals who are inclined to share more personal and strategic knowledge would have few reasons not to share what is already documented.

The results related to KS among teams are aligned with the characteristics of AMs, which are based on frequently conversations and sharing of few documents inside the team. The production of documents inside the team is low, which reflects low levels of externalisation and suggests that the socialisation is the way employees from different teams interact. There is one construct, reciprocity, which is able to influence directly TKS and EKS. Reciprocity is focused in the relationship between two individuals, where an individual action is expected to generate a similar one from the other individual in the future. The phenomenon is not related to AM practices; it is related to individual expectations of the others future behaviours. Trust, considering the scale used in this research, is focused in the relationship between colleagues; however, it is less specific than reciprocity, more vague in terms of actions. On the other hand, norms of cooperation are more associated with the organisation and the agile practices. Figure 3 shows the relationship among the three antecedents and KS.

6.2 Qualitative approach

Regarding the qualitative approach, we have provided a detailed description of the method applied that invites replication while allowing the removal of any possible researcher bias from the study and enabling the assessment of the internal or descriptive validity of the

Table 8. Results from configurational modeling

Causal configurations	Raw coverage	Unique coverage	Consistency	Interpretation of fsQCA results
TKS = f (Number of employees, reciprocity, norms of cooperation, trust): Destination attributes (causal configuration) → TKS (outcome)				
Causal configuration 1: Trust	0.788	0.208	0.809	A high level of trust provides a sufficient condition to high level of TKS
Causal configuration 2: ~Number of employees * Reciprocity	0.258	0.015	0.811	A combination of low number of employees and a high level of reciprocity provides high level of TKS
Causal configuration 3: ~Number of employees * Norms of cooperation	0.209	0.009	0.750	A combination of low number of employees and a high level of norms of cooperation provides high level of TKS
Causal configuration 4: Reciprocity * Norms of cooperation	0.568	0.065	0.845	A combination of high levels of reciprocity and norms of cooperation provides high level of TKS
Solution coverage: 0.888				
Solution consistency: 0.760				
EKS = f (TKS, number of employees, reciprocity, norms of cooperation, trust): Destination attributes (causal configuration) → EKS (outcome)				
Causal configuration 1: ~Number of employees * Reciprocity	0.240	0.013	0.729	A combination of low number of employees and a high level of reciprocity provides high level of EKS
Causal configuration 2: TKS * ~Number of employees	0.300	0.016	0.810	A combination of a high level of tacit KS and a low number of employees provides high level of EKS
Causal configuration 3: Reciprocity * Trust	0.588	0.027	0.791	A combination of high levels of reciprocity and trust provides high level of EKS
Causal configuration 4: TKS * Reciprocity	0.635	0.023	0.820	A combination of a high levels of TKS and reciprocity provides high level of EKS
Causal configuration 5: TKS * Norms of cooperation	0.594	0.019	0.830	A combination of a high levels of TKS and norms of cooperation provides high level of EKS
Causal configuration 6: TKS * Trust	0.674	0.027	0.826	A combination of a high levels of TKS and trust provides high level of EKS
Causal configuration 7: ~Number of employees * ~ Norms of cooperation * Trust	0.207	0.006	0.799	A combination of low number of employees, low level of norms of cooperation and high level of trust provides high level of EKS
Solution coverage: 0.863				
Solution consistency: 0.753				

research (Maxwell, 1992). We applied rigour both in the methods (design validity) and in the interpretation of data (analytical and inferential validities). With regard to design validity; the qualitative component of the study was carefully designed and executed, thus originating credible results. Concerning analytical validity, we collected and analysed data, thus generating consistent and reasonable results. Finally, regarding inferential validity, we provided a clear interpretation of results allowing for validation by others (Venkatesh *et al.*, 2013). Following Bryman and Bell's (2007) method, we ensured the external and internal reliability as well as the internal and external validity of the qualitative findings. The context dependency of qualitative studies prevents generalisation of the results beyond the selected settings, yet the analysis is replicable without restrictions. The results show that the solutions involve four configurations leading to TKS and seven configurations regarding EKS, which seems to indicate the latter is easier to achieve than the former. Among the two solutions, there is a common configuration that leads to both TKS and EKS.

The four configurations that lead to high TKS show how the firms in the study achieve that outcome:

Configuration 1: High levels of trust lead to TKS, regardless of the other conditions (consistent with *H1a*);

Configuration 2: High levels of reciprocity lead to TKS in smaller firms (consistent with *H2a*);

Configuration 3: High levels of norms of cooperation lead to TKS in smaller firms (consistent with *H3a*);

Configuration 4: High levels of reciprocity and norms of cooperation lead to TKS, regardless of the other conditions (consistent with *H2a* and *H3a*).

Additionally, it is noteworthy that TKS is a necessary condition for EKS, which is sustained by literature (Chumg*et al.*, 2015) and consistent with *H4*.

The seven configurations that lead to high EKS show how the firms in the study achieve that outcome:

Configuration 1 does not present an acceptable consistency level – we reject it;

Configuration 2: High levels of TKS lead to EKS in smaller firms (consistent with *H4*);

Configuration 3: High levels of reciprocity and trust lead to EKS, regardless of the other conditions (partially consistent with *H2b* and *H1b*);

Configuration 4: High levels of TKS and reciprocity lead to EKS, regardless of the other conditions (consistent with *H4* and *H2b*);

Configuration 5: High levels of TKS and norms of cooperation lead to EKS, regardless of the other conditions (partially consistent with *H4* and *H3b*);

Configuration 6: High levels of TKS and trust lead to EKS, regardless of the other conditions (partially consistent with *H4* and *H1b*); and

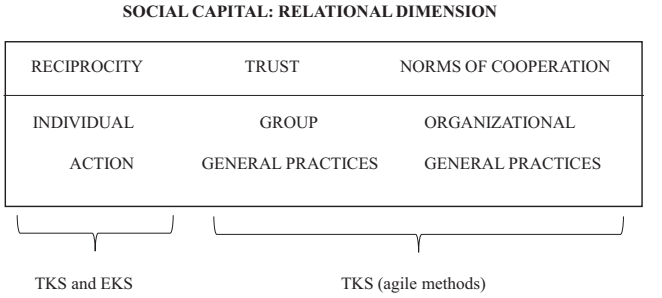

Figure 3.
Relationship among the three antecedents and KS

Configuration 7: High levels of trust and low levels of norms of cooperation lead to EKS in smaller firms (which is consistent with the lack of evidence to support *H3b*).

The qualitative approach enables us to highlight two contributions worth mentioning regarding firm size:

(1) smaller firms seem to offer a more suitable setting for KS (both tacit and explicit); and

(2) larger firms that do not have high levels of reciprocity and trust cannot expect KS to occur (either tacit or explicit).

The findings from the qualitative phase reaffirm the quantitative results that show TKS contributes to EKS.

7. Conclusions, limitations and future research

Regarding the research questions, reciprocity has a direct influence on both TKS and EKS, while the other two validated constructs of social capital's relational dimension, norms of cooperation and trust, have a direct effect on TKS and an indirect effect on EKS. Moreover, TKS was found to strongly influence EKS. By demonstrating the important role of the feeling of reciprocity in promoting TKS and EKS among members of different software development teams that use AMs, this study provides a particular contribution to the literature. The originality of this research lies in showing how the constructs of relational social capital influence TKS and EKS differently.

Overall, the fsQCA findings support PLS-SEM results:

- reciprocity is a sufficient condition for KS (both tacit and explicit), which is present in several configurations;
- trust is a sufficient condition for KS (both tacit and explicit), which is present in several configurations;
- TKS is a sufficient condition for EKS, which is present in several configurations; and
- norms of cooperation is a sufficient condition for TKS, which is present in several configurations.

With regard to the work of team leaders and managers, the study reinforces the importance of cultivating an environment based on cooperation and trust. Considering the strength of the relationships, managers should invest in promoting of TKS among teams and in developing of trust among the employees, especially outside the teams. Having a strategy to guide KS needs beyond the team boundaries is also critical for organisations that make use of AMs. Because TKS largely takes place during social interaction, creating opportunities for people to interact with each other (face to face and/or virtually) and mixing people from different teams are important. Communities of practice may be an effective mechanism for encouraging people to interact and share knowledge. In addition, leaders can stimulate reciprocity by donating their own knowledge to others and the community in general and recognising the importance of knowledge sharers within their teams, as well as highlighting the advantages obtained by the individuals and the organisation from the shared knowledge.

One limitation of this research is associated with the sample used, although the questionnaire was available in Portuguese and English, most of the respondents were Brazilians. In terms of future research, it would be useful to validate other constructs as well as the structural and cognitive dimensions of social capital in the context of software development teams, as well as to analyse the cost/benefit ratio of mobilising social capital within organisations.

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Appendix

Constructs	Items	Authors
Trust	TRU1. I know my colleagues from other software development teams will always try and help me out if I get into difficulties TRU2. I can always trust my colleagues from other software development teams to lend me a hand if I need it TRU3. I can always rely on my colleagues from other software development teams to make my job easier	Hau *et al.* (2013), Chow and Chan (2008)
Reciprocity	REC1. When I share my knowledge with members from other software development teams, I believe that I will get an answer for giving an answer REC2. When I share my knowledge with members from other software development teams, I expect somebody to respond when I am in need REC3. When I contribute with knowledge to members from other software development teams, I expect to get back knowledge when I need it REC4. When I share my knowledge with members from other software development teams, I believe that my requests for knowledge will be answered in future	Kankanhalli *et al.* (2005)
Norms of cooperation	NCO1. There is a norm of cooperation in my organisation NCO2. There is a norm of collaboration in my organisation NCO3. There is a norm of teamwork in my organisation NCO4.There is a willingness to value and respond to developed diversity in my organisation NCO5. There is a norm of openness to conflicting views in my organisation	Kankanhalli *et al.* (2005)
TKS	TKS1. I always share my experience or know-how from work with my colleagues from other software development teams TKS2. I always share my work related know-where or know-whom at the request of my colleagues from other software development teams TKS3. I do not like to provide my work-related expertise with my colleagues from other software development teams (–) TKS4. I am not usually actively involved in work related discussion on complicated issues with my colleagues from other software development teams	Chow and Chan (2008), Shao *et al.* (2012), Hau *et al.* (2013)
EKS	EKS1. I am glad to share my work related reports with my colleagues from other software development teams EKS2. I do not like to provide my work-related personal manuals with my colleagues from other software development teams (–) EKS3. I am pleased to share work-related official documents with my colleagues from other software development teams EKS4. I do not share work-related multimedia files such as media, context, picture or video with my colleagues from other software development teams	Chow and Chan (2008), Shao *et al.* (2012), Hau *et al.* (2013)

Table A1. Scales

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