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Perspectives on knowledge integration in cross-functional teams in information systems development

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Abstract

Purpose – The purpose of this paper is to provide insights into cross-functional team (CFT) members' points of view on knowledge integration.

Design/methodology/approach – This study was conducted using Q methodology. The 22 respondents were members of CFTs in information systems development within 7 agencies of the Flemish Government administration.

Findings – The study resulted in three distinct perspectives. To the CFT player, the benefits and added value of information and knowledge diversity of CFTs outweigh the challenges of knowledge integration. By contrast, the CFT sceptic is doubtful that knowledge integration in CFTs can ever work at all. Finally, the organization critic highlights the lack of support from the organization for efficient and effective knowledge integration in CFTs.

Research limitations/implications – The findings of this study suggest that CFT configurations have important implications for the development of shared team mental models and for teams' cognitive performance.

Practical implications – Making CFT members aware of their peers' mental models, ways of working and priorities could help strengthen knowledge integration. To improve knowledge integration in teams, managers should reduce knowledge boundaries that are the result of organizational structuring and power play between departments.

Originality/value – By focusing on daily experiences with knowledge integration, this study reveals that members of CFTs in information systems development hold contrasting perspectives on, and diverging attitudes towards, knowledge integration.

Keywords Information systems development, Knowledge integration, Team cognition, Knowledge boundaries, Team mental models, Cross-functional teams

Paper type Research paper

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Introduction

Cross-functional teams (CFTs) are an increasingly common phenomenon in contemporary organizations. In CFTs, team members, who represent different organizational functions, work together to achieve specific organizational goals. The team members have access to highly differentiated knowledge and skills, which is necessary to tackle the team goals (Huang and Newell, 2003; Stipp *et al.*, 2018). CFTs, however, are not a panacea; 75% of CFTs are dysfunctional, the major reason for failure being difficulties in making specialists from different domains work together (Tabrizi, 2015).

An example of CFTs is information systems development (ISD) teams. These teams largely consist of information technology (IT) specialists and business domain representatives, working in collaboration while sharing and integrating the relevant knowledge of their respective specialities (Eason, 2018; Ghobadi, 2015). The low success rate of ISD projects – less than 50%, compared to 80% in general business projects (Jenkin *et al.*, 2019; Lee *et al.*, 2015) – often leads to decreased organizational productivity and financial losses (Eason, 2018). One of the success factors for ISD projects is for key stakeholders to create a mutual understanding of their joint task and of the way to approach this task together (Jenkin *et al.*, 2019; Meslec and Graff, 2015). In interaction, project team members may build a collectively shared, actionable team mental model, which is necessary for the team to operate in effective ways (e.g. Kneisel, 2020; Santos and Passos, 2013).

However, there is a risk for diverse teams to run into coordination problems because of a lack of common ground (e.g. Srikanth *et al.*, 2016). In this respect, Srikanth *et al.* (2016) reject the traditional perspective that diverse teams fail to effectively process increased access to information because of social cohesion problems occurring as soon as the group is formed. Instead, they argue for a more dynamic perspective in which the intensity of social categorization and its effect on informational diversity benefits fluctuates over time. This resonates with a dynamic, process-oriented perspective on knowledge structures in teams, in which team cognition is not a static property of the team but an emergent state residing in team members' social interactions (Cooke *et al.*, 2013; Curseu and Pluut, 2018; Grand *et al.*, 2016; Kneisel, 2020).

The aim of our research is to reveal perspectives on knowledge integration from CFT members in ISD projects in a public sector context. The application of CFTs is not uncommon in the public sector (Pakarinen and Virtanen, 2017). However, public organizations, such as government administrations, are especially sensitive to problems with CFTs, as they are still very much structured in bureaucratic, command-and-control ways (Piercy *et al.*, 2013). Nevertheless, research on CFTs in a public sector context is surprisingly limited (Piercy *et al.*, 2013). By delineating views on knowledge integration dynamics from the perspective of CFT members, we may better understand to what extent, and in what ways, functional diversity is perceived to hinder knowledge integration.

Theoretical background

Cross-functional teams

We define CFTs as project teams that have been assigned a specific organizational goal which cannot be achieved without the collaboration of the individual team members, who represent different organizational functions and therefore have access to highly differentiated knowledge and skills (Daspit *et al.*, 2013; Huang and Newell, 2003; Stipp *et al.*, 2018; Wang and He, 2008). CFTs have been used in both the public and private sector for initiatives that involve creativity and innovation and for enhancing the performance of product and service delivery or the implementation of new technological solutions (Athanasaw, 2003; Daspit *et al.*, 2013; Gelderman *et al.*, 2017; Huang and Newell, 2003). More specifically, even in the absence of formal organization-wide arrangements for CFTs, software-based ISD almost always happens through cross-functional collaboration between business domain representatives and IT specialists (Eason, 2018; Ghobadi, 2011; Ghobadi, 2015).

Often-cited benefits of the use of CFTs are the enhanced quality of decision-making stemming from the diversity in perspectives, skills, information and resources (Gelderman *et al.*, 2017; Ghobadi, 2011; Huang and Newell, 2003; Srikanth *et al.*, 2016; Stipp *et al.*, 2018); the improved communication of project information and the positive effect this has on organizational learning (Lopes Pimenta *et al.*, 2014; Piercy *et al.*, 2013; Stipp *et al.*, 2018; Wang and He, 2008); and the all-round contribution to organizational performance in both the private and public sector (Daspit *et al.*, 2013; Pakarinen and Virtanen, 2017; Piercy *et al.*, 2013; Stipp *et al.*, 2018).

Unsurprisingly, functional diversity and the accompanying differences in perspectives also lead to a lot of problems within CFTs. Authors have cited integration, coordination and cooperation failures; reduced cohesion, communication and information sharing; tension and conflicts caused by conflicting professional philosophies and competing goals; and a decrease in overall performance (Daspit *et al.*, 2013; Gelderman *et al.*, 2017; Ghobadi, 2011; Ghobadi and D'Ambra, 2012; Piercy *et al.*, 2013; Srikanth *et al.*, 2016). Clearly, using CFTs is no guarantee for success (Ehrhardt *et al.*, 2014), especially when applied with insufficient knowledge of its mechanisms and benefits (Lopes Pimenta *et al.*, 2014).

Two recurring and related themes in the literature on CFTs are the importance of managerial support and the risk of individual members' lack of commitment to the team. The relationship between managerial support and the use of CFTs appears to be bi-directional. Managerial support has been shown to be of importance for CFTs (Daspit *et al.*, 2013; Huang and Newell, 2003; Lopes Pimenta *et al.*, 2014; Piercy *et al.*, 2013). The use of CFTs by itself has been shown to have a beneficial effect on obtaining sufficient support from stakeholders (Ghobadi, 2011; Ghobadi and D'Ambra, 2012; Huang and Newell, 2003; Wong *et al.*, 2009). These findings seem to be in conflict with the possibility that individual members might not be committed enough to the CFT because of their commitment to the functional department they belong to. First, there is the simple fact that CFT members report to both the team leader and the manager of the functional department they represent and of which they are expected to defend its functional needs and goals (Gelderman *et al.*, 2017; Ghobadi, 2011; Ghobadi and D'Ambra, 2012; Wong *et al.*, 2009). Second, these types of dual-reporting systems, forcing people to switch back-and-forth between possibly competing goals on the departmental, team and personal level, are not necessarily manageable by each individual team member (Ehrhardt *et al.*, 2014; Gelderman *et al.*, 2017; Ghobadi, 2011; Piercy *et al.*, 2013). Finally, organizational culture, power play and competition between different functional units also impact individual members' commitment to the team (Ghobadi and D'Ambra, 2012; Wong *et al.*, 2009).

Knowledge integration

Huang and Newell (2003) define knowledge integration as "an ongoing collective process of constructing, articulating and redefining shared beliefs through the social interaction of organizational members" (p. 167). Their definition is rooted in social capital theory which acknowledges knowledge as a valuable resource and states that knowledge is essentially created, accumulated, shared and integrated through social construction and relationships. Conceptually speaking, social capital is a three-dimensional construct consisting of structural capital (social interaction ties), relational capital (trust) and cognitive capital (shared vision) (Prieto-Pastor *et al.*, 2018). From a social capital perspective, social relations are preferred over information systems and formal control for sharing and integrating knowledge (Kogut and Zander, 1992; Prieto-Pastor *et al.*, 2018).

Although the social capital perspective has been widely applied to demonstrate the mechanics of knowledge integration (Bhandar *et al.*, 2007), Prieto-Pastor *et al.* (2018) found that only the cognitive dimension of social capital has a direct impact on knowledge integration. While these authors focused their study on knowledge integration between projects, we believe their conclusions also hold in the context of CFTs, and this for three reasons. First, in project-based collaboration, trust generally is fragile, because it takes time to build trust, time that members of temporary projects, sometimes working on several projects simultaneously, most likely lack (Prieto-Pastor *et al.*, 2018). Second, social interaction ties are expected to be weak because members of CFTs are in the first place committed to the functional department they represent (Gelderman *et al.*, 2017). And finally, and most importantly, in line with our definition of CFTs, in cross-functional projects team members are tasked to fulfil a specific organizational goal by combining their diverse knowledge and skills, thereby reaching a shared vision.

Therefore, in researching knowledge integration within cross-functional project teams, the focus should be on the mechanisms for bridging team member diversity in terms of knowledge and skills "so that individuals are able to see the larger picture beyond their areas of specialization" (Prieto-Pastor *et al.*, 2018, p. 1819). We already know that diversity positively influences CFT performance, but that it also has the potential to create communication barriers and conflict (Daspit *et al.*, 2013; Majchrzak *et al.*, 2012; Srikanth *et al.*, 2016). We therefore adopt the research pathways of Bhandar *et al.* (2007), who define knowledge integration as "the process of combining, applying, and assimilating disparate specialized knowledge" (p. 264).

Knowledge boundaries

From a knowledge boundary perspective, failure in problem-solving and knowledge creation in CFTs stems from the difficulties collaborators experience in accommodating the specialized knowledge of others within their own mental models (Chu and Chiu, 2017). Theories on cross-boundary knowledge management identify three types of boundaries, which are as follows:

(1) physical boundaries, such as organizational structures, rules and regulations;

(2) social boundaries, relating to different identities and interests; and

(3) cognitive boundaries, relating to differences in ideas and understandings (Pan and Mao, 2016).

Broniatowski and Magee (2017) and Chu and Chiu (2017) further elaborate on this by advancing the Carlile (2004) typology of the following cognitive boundaries:

- syntactic knowledge boundaries, which may lead to inaccurate information processing and understanding;
- semantic knowledge boundaries, which may lead to interpretation differences; and
- pragmatic or political knowledge boundaries, which refer to those situations where neither novelty nor specialization is high and experts continue to rely on their existing knowledge (the so-called competency trap) or differences in goals exist between communities of practice (Broniatowski and Magee, 2017; Chu and Chiu, 2017).

A proper understanding of cognitive boundaries provides a basis for choosing appropriate boundary spanning tactics for the different phases of a project (Carlile, 2002, 2004; Chu and Chiu, 2017), with varying stages possibly requiring different boundary spanning mechanisms (Adenfelt and Maaninen-Olsson, 2007). These mechanisms are called boundary objects: "concrete or abstract bridges that allow groups with different perspectives and different aims to contribute to a more comprehensive objective" (Adenfelt and Maaninen-Olsson, 2007, p. 4). Whiteboards, mockups and prototypes can be effective knowledge boundary objects (Pershina *et al.*, 2019). A more advanced knowledge boundary object is for team members to engage in so-called knowledge traversal before the actual start of the project: a process of metacognition, deep-knowledge dialogue and reflection which allows team members to identify mutual knowledge differences, to gain more common ground (Keestra, 2017; Majchrzak *et al.*, 2012; Srikanth *et al.*, 2016).

Majchrzak *et al.* (2012) found empirical evidence that under certain circumstances, CFTs are able to generate novel solutions by transcending knowledge differences without explicitly identifying and addressing differences in expert knowledge between team members. The teams in their study approached knowledge integration by avoiding interpersonal conflict, through rapid and iterative co-creation of the shared mental model, by encouraging creative engagement and by making every member responsible for adding personal knowledge to the collective knowledge (Majchrzak *et al.*, 2012). The possibility that knowledge boundaries collapse or that they are explicitly ignored does shed a different light on classic knowledge boundary theory (Broniatowski and Magee, 2017; Majchrzak *et al.*, 2012). It may mean, for instance, that boundary spanning through upfront knowledge traversal may not be beneficial to every type of CFT in every type of situation (see Keestra, 2017; Majchrzak *et al.*, 2012).

Knowledge boundary spanning

ISD projects may be observed as instances of a cross-functional collaborative knowledge integration process in which business-specific knowledge is fused with knowledge about IT (Bhandar *et al.*, 2007; Lee *et al.*, 2015). Effective knowledge boundary spanning can have a significant positive effect on the quality of a project and its deliverables (Hsu *et al.*, 2014). In ISD projects, user representatives can play a pivotal role in spanning knowledge boundaries in the pursuit of knowledge integration within the project (Pan and Mao, 2016). In many ISD project teams, instead of limiting their role to that of the information source, user representatives act as co-creators together with their technology-oriented peers, to the extent that the distinction between business domain experts and IT experts becomes less apparent (Eichhorn, 2014). If spanning knowledge boundaries on the syntactic, semantic and pragmatic level may positively influence ISD project performance and product quality (Wang *et al.*, 2016), we need more insights on how to approach knowledge boundary spanning in ISD projects.

Method

Q study design

Q methodology combines quantitative and qualitative data and analytical techniques (Ramlo, 2016) to transform individual perspectives into a limited number of coherent patterns of opinions about a topic (Webler *et al.*, 2009). Respondents are asked to sort a collection of statements about the research subject at hand, depending on how much the statements represent the way they think about the topic, in a forced, quasi-normal distribution (Ramlo, 2016; Webler *et al.*, 2009). The resulting Q sorts are then subjected to an inverted factor analysis to reveal correlations among them. The resulting factors form the foundation of the delineation of the shared perspectives on the research subject (Watts and Stenner, 2005; Webler *et al.*, 2009).

Research instrument

The Q set is a collection of statements on the research subject that are straightforward and easy to understand (Webler *et al.*, 2009). The Q set is a subset from the concourse, which stands for all possible opinionated statements that can be made about the research subject (Van Exel and De Graaf, 2005). In our study, the source for concourse statements were quotes from articles identified during our literature study focusing on understandings of our research subject. These quotes were clustered based on two dimensions: theme (e.g. CFTs, knowledge integration, knowledge boundaries) and perspective (e.g. knowledge boundary spanning, knowledge diversity, social capital). This clustering, inspired by the balanced-block technique for maintaining concourse representativeness (Stephenson, 1953), enabled us to handle a large amount of candidate statements in a structured way while making sure that the selected Q set represented the entire concourse. The statements were translated into Dutch, the first language of our respondents. The translation process also involved some rephrasing so that the translated statements were all in the same voice and used comparable terminology. Based on the results of peer-reviews of the draft Q set by three IT specialists from the public sector, we adjusted and finalized the Q set consisting of 45 statements (Appendix).

Sample and procedure

The P set is the group of respondents who are queried for their points of view on the research subject. It is important that the P set consists of people with clearly different and well-formed opinions so that a broad range of perspectives may be captured (Ramlo, 2016; Watts and Stenner, 2005; Webler *et al.*, 2009). For the purpose of our study, we were interested in the understandings of ISD practitioners with either business or IT expertise and responsibilities. Invitations were sent by email to 52 candidates from 7 agencies of the Flemish Government administration, covering policy areas such as foreign affairs, environmental affairs and internal affairs. The 22 candidates that accepted to participate had been involved in ISD projects in the past three years. The distribution of the respondents' membership to either an IT department or a business department as part of the agencies was 50/50.

Respondents were given the option of conducting the Q sort either individually with written guidance or while being guided in person by the researcher. About half of the respondent group chose the first option and the others chose the latter option. We made use of the web-based QMethod Software application that allows for online Q sorts and for capturing additional qualitative data through questionnaires (Lutfallah and Buchanan, 2019). The questionnaires queried respondents for demographic data as well as for motivations behind the placement of statements during the Q sort.

Analytical strategy

To allow for a hands-on factor analysis, we opted to export the sorting data from the QMethod Software application and import it into KenQ analysis desktop edition, an interactive desktop application that supports advanced Q factor analysis, including manual factor rotation (Banasick, 2019). Using fit-for-purpose software reduced the risks of making mistakes during the stages of data gathering, data manipulation and factor analysis (Lutfallah and Buchanan, 2019). The different Q sorts produced by the respondents were subjected to an inverted factor analysis. This resulted in three factors that account for 44% of the total explained variance, which is considered acceptable (Kline, 1994; Watts and

Stenner, 2012). The number of defining variables per factor (9, 9 and 4) exceed the minimum of two defining Q sorts per factor (Brown, 1980; Watts and Stenner, 2012). The viewpoints of the three factors were interpreted following the crib sheet method proposed by Watts and Stenner (2012). The qualitative data, providing information on the respondents and insights on the motivations underlying their Q sort choices, were used for developing a deep understanding of the perspectives and building the three "stories."

Results

Factor 1: the organization critic

Eigenvalue for Factor 1 is 6.88. The factor explains 31% of the total study variance. Nine respondents load significantly on the factor. The factor can be labelled as "IT-oriented": six respondents are part of an IT department, and only two respondents' main area of work does not involve working on IT.

From Factor 1's point of view, ISD benefits from information and knowledge diversity within CFTs and this diversity does not put a burden on knowledge integration. Factor 1 experiences how business domain and IT experts each have their own specific ways of looking at, for example, the intended solution. The specific jargons sometimes get in the way of mutual understanding, but attempts to fix this are modest in scope and intensity. To Factor 1, despite cross-functional collaboration and co-creation, the roles of the business domain and IT experts will not blend into one another any time soon. But while a disproportional focus on the proper expertise domain sometimes gets in the way of efficient team collaboration, no expertise domain is perceived as being more influential than the other nor does the prestige of a particular team member within the own expertise domain get in the way of collaboration or team communication.

When it comes to knowledge boundary objects that enhance shared understanding and knowledge integration, Factor 1 sees the most benefit coming from an agile, collaborative way of working. No effort is invested at the beginning of the project to identify the needed knowledge sources. But when it comes to localizing relevant knowledge during the project, certain team members step-up by facilitating team communication, or other members are relied upon because of their experience with similar projects. No individual team member explicitly orchestrates particular facets of knowledge integration though, but Factor 1 does perceive pockets of effort to make sure team members are aware of the bigger picture they are supposed to contribute to. In terms of enhancing shared understanding, Factor 1 seems to have better experiences with visual methods such as diagramming than with approaches that involve maintaining written documentation. Daily stand-up meetings also seem favorable in this regard.

To Factor 1, clearly, the more shared understanding within the team, the more effective knowledge integration becomes. A positive team spirit, mutual trust and open communication reinforce this process. But according to Factor 1, organizational issues and internal politics stand in the way of knowledge integration. Organizational structures, rules and regulations all but support knowledge integration between the different expertise domains to the extent that the importance of effective knowledge management is not at all shared by team members. As one respondent puts it: "Our organization far from supports collaboration and knowledge sharing (because of) internal politics and lack of time for experts." This situation could be an indication of why team members' abilities to participate in a project's knowledge integration process are relatively low in Factor 1's perception. As stated by another respondent: "It appears knowledge management is seen as a burden by some."

Factor 2: the cross-functional team player

Eigenvalue for Factor 2 is 1.69. The factor explains 8% of the total study variance. Nine respondents load significantly on the factor. The factor can be labelled as "business domain-oriented": seven respondents are part of a business department, and six respondents' main area of work is a business domain.

From Factor 2's perspective, the better the shared understanding of the problem domain or the intended solution, the more effective knowledge exchange becomes. Factor 2 observes three important catalysts for this process: mutual trust, a positive team spirit and open communication, even in the event of interpersonal conflict. Factor 2 acknowledges the added value of CFTs with regard to knowledge integration and sees little disadvantage in having team members with different disciplinary backgrounds. One respondent stated: "Yes, expertise diversity makes knowledge integration challenging at times, but one has to learn to deal with it (and) learn to collaborate (between disciplines)." Another respondent said: "We're a team. No one is better than anyone else. We respect each other's competences and efforts." While iterative co-creation leads to a shared understanding of the problem domain and of the intended solution, Factor 2 will not go as far as to say that through collaboration the roles of the business domain and IT experts fade into one, nevertheless, this collaboration happens between equals.

Ideas or proposals are treated in the same way regardless of the originator's expertise domain. Business domain experts have no bigger influence on shared understanding than other team members, and no team member hinders collaboration for reasons of prestige in his or her own discipline, or because of a disproportional focus on the proper expertise domain. For Factor 2, while the influence particular individual team members may have on team knowledge integration awareness and efficacy is modest, somehow it is ensured that the team is aware of the big picture that the intended solution is supposed to be part of.

Factor 2 deems team members as sufficiently skilled to effectively participate in knowledge integration processes, and it assumes team members all share the importance of knowledge management regardless of which part of the organization they belong to. However, Factor 2 points out that organizational issues do get in the way of knowledge sharing and, more so, rules and regulations are not in support of knowledge integration.

From Factor 2's perspective, knowledge integration benefits mostly from traditional boundary objects, such as formal written team documentation, team member experience about where knowledge resides in the organization and visual representations, but much less from knowledge boundary-spanning approaches that are popular in agile project approaches such as daily stand-up meetings. Finally, Factor 2 seems rather unimpressed with interventions in favor of a shared understanding of terminology and jargon.

Factor 3: the cross-functional team sceptic

Eigenvalue for Factor 3 is 1.18. The factor explains 5% of the total study variance. Four respondents load significantly on the factor. The factor can be labelled as "IT-oriented": three respondents are part of an IT department and one respondent is a business domain expert.

Factor 3 seems doubtful of the possibility of effective knowledge integration in CFTs, at least within the context of ISD. According to Factor 3, IT and business domain experts have their own distinct way of conceptualizing the intended solution while differences in expertise and in perspectives and the use of jargon lead to communication problems. One respondent told us that "business domain and IT experts are really worlds apart; I cannot imagine how both roles would ever blend into one," whereas another respondent stated that "every individual makes his own "truth" and continues to work from there." Making sure all team members interpret terminology in the same way is not much of a priority for Factor 3, while its support for the added value of knowledge diversity within CFTs is relatively low. The idea that, through co-creation, the roles of business domain experts and IT experts might blend into one is difficult to conceive for Factor 3. When effective knowledge integration is happening, Factor 3 attributes this mostly to a positive team spirit and mutual trust leading to better-shared understanding, by itself a lever for more effective knowledge sharing.

Despite the perceived divide between disciplines, according to Factor 3, business domain experts do not necessarily play a bigger role in advancing the shared understanding, whereas a lack of business domain knowledge among IT experts does not particularly hinder knowledge sharing. An idea or proposal is generally treated in the same way regardless of the originator's discipline. Team members, in general, seem to agree that effective knowledge management is important, no matter what part of the organization they belong to, but Factor 3 sees the organization itself and its rules and regulations as obstacles to effective knowledge integration. Matters of individual prestige, interpersonal conflicts or a disproportional focus on the proper expertise domain rarely get in the way of team collaboration.

Interestingly, for a factor on which three out of four loading respondents reside within an IT department, Factor 3 is critical of the fact that little effort is made to make sure that IT terminology is known to everyone involved. Apparently, relatively more effort is made to make sure that business domain terminology is known to all team members, possibly with the help of a well-maintained and shared list of terms.

The positive effect on a shared understanding of daily stand-up meetings or formal reflection at the beginning of a project on what expertise is needed is not apparent (if at all present) to Factor 3. Factor 3 has a slight preference for written documentation over visual representations to further shared understanding. From Factor 3's experience, an iterative co-creational approach has a positive effect on shared understanding as does working in the same physical space to improve team communication and spanning knowledge boundaries. Factor 3 warns though that while team members generally bring adequate expertise to the table, overall skills for effective participation in knowledge integration appear to be less than sufficient. In addition to this, individual team members who encourage the team toward more effective knowledge integration are but rarely encountered.

Discussion

While the three perspectives revealed by our Q study stand on their own, they have in common an acknowledgment of the role of physical and social knowledge boundaries. It should not come as a surprise that we found indications of a negative impact on knowledge integration of organizational structures, rules and regulations. Power play and competition between departments may hinder individual team member commitment toward the CFT (Ghobadi and D'Ambra, 2012; Wong *et al.*, 2009). Government administrations, in essence still structured and managed in bureaucratic ways, have been found to be more sensitive to the aforementioned issues (Pakarinen and Virtanen, 2017; Piercy *et al.*, 2013). To our first perspective, the organization critic, the perceived lack of organizational support for knowledge sharing and integration in general leads to the perception that the importance of effective knowledge management is far from being shared by all team members. In addition, the IT-oriented professionals in general seem to be more critical than the business-oriented professionals with regard to the knowledge integration skill level of fellow team members. In other words, in our study, team members related to different organizational subgroups often not only have different attitudes toward knowledge (Pan and Mao, 2016) but also have different attitudes and ambitions toward knowledge integration.

Cognitive boundaries bring another commonality between the three perspectives to our attention. None of the three perspectives seem to make much of the efforts made to enhance a team's shared understanding of terminology, such as maintaining a shared list of terms and definitions. CFT members showed that, in their experiences, formal knowledge traversal before the start of a project was not common. As one respondent put it: "actively expressing interest in another domain has a better effect on the shared understanding of relevant terminology than maintaining a list of terms." This resonates with the notion that social relations are considered more efficient than information systems and formal control for sharing and integrating knowledge, which underlines the significance of social capital for successful knowledge integration (Kogut and Zander, 1992; Prieto-Pastor *et al.*, 2018).

The importance of social capital and lack of apparent formal mechanisms for bridging cognitive boundaries point to what Majchrzak *et al.* (2012) call transcending knowledge differences: accepting knowledge diversity in the team as a given and taking an iterative and co-creational approach to shared understanding without formally negotiating knowledge differences between team members. Judging from the results of our analysis, the organization critic and the CFT player seem to embrace this reality or at least take it for granted, whereas the CFT sceptic is far from being a supporter.

Theoretical implications

First, this paper adds to the literature on team mental models. The typology of perspectives on knowledge sharing revealed by the results of this study underlines that different CFT members may, on top of having different attitudes toward different types of knowledge – hence knowledge differentiation, also have different attitudes toward the value and relevance of integrating these different types of knowledge within the team, hence toward knowledge integration. This finding suggests that (cross-functional) team configurations have important implications for the development of shared team mental models, and, in that way, for problem-solving and performance by teams (Kneisel, 2020). Team mental models are emergent states that change and evolve over time as a consequence of internal and external team developments and in the interaction among team members (Santos and Passos, 2013). For teams that consist of members with different perspectives on knowledge integration developing a shared, actionable team mental model seems inevitably a goal difficult to reach.

Second, this paper adds to the literature on team cognition. Traditional taxonomies regarding team configurations often fail to explain the cognitive performance of teams. The results of our study suggest that a generic team member taxonomy directly related to perspectives on knowledge differentiation and integration in teams may help explain teams' cognitive performance. Teams' configurations of perspectives on knowledge integration will have an influence on team members' social interactions that shape the emergent knowledge structures within the team (Cooke *et al.*, 2013; Grand *et al.*, 2016). In other words, our typology seems to have a direct link to the emergence of team cognition and teams' cognitive performance.

Limitations and areas for future research

Our focus was on ISD projects, which are temporary by definition. However, project duration ranges from several weeks to several years. If team-configuration remains stable, we would expect fluctuations in the effectiveness of knowledge integration processes over time (Cooke *et al.*, 2013; Curseu and Pluut, 2018; Grand *et al.*, 2016; Kneisel, 2020;

Srikanth *et al.*, 2016), but potentially a noticeable improvement in the long term, nevertheless. Longitudinal research could gauge the differences in knowledge integration and knowledge boundaries between short-term and more long-term cross-functional ISD teams.

ISD teams follow a particular ISD project methodology. Some of these methodologies are more explorative and iterative in nature, such as the so-called agile methods. Other, for example, waterfall-style, approaches are more incremental and planned. Research using focus groups, case studies or Q methodology might lead to insights on whether different ISD project methodologies require different knowledge integration and boundary-crossing tactics.

Our study has revealed existing perspectives on knowledge integration in CFTs in ISD within the public sector in Flanders, Belgium. Similar Q studies to be conducted in other types of CFTs in other countries or sectors, for example, in health care or the creative industries, could further enhance our insights into different perspectives on knowledge integration dynamics.

Practical implications

Cross-functional collaboration is given in ISD (Eason, 2018; Ghobadi, 2015), meaning knowledge diversity and boundaries must be dealt with. Educating team members and managers alike in the mechanisms, benefits and challenges of cross-functional teamwork, might help to overcome some of the CFT challenges (Lopes Pimenta *et al.*, 2014). In addition, managers should make an effort of restricting the impact of physical and social knowledge boundaries related to organizational structures and power play between departments. These boundaries may hinder team members' commitment to the CFT, which is a prerequisite for cross-functional knowledge integration. Finally, considering that business domain representatives and IT specialists have different mental models, different ways of approaching challenges and different sets of priorities, individual CFT members could demonstrate which information they have used and what their reasoning was, each time they state their opinion or make a decision. This communication behavior would undoubtedly benefit mutual understanding, social relations within the team and successful knowledge integration.

Conclusion

Based on our Q study among 22 respondents working in CFTs throughout 7 agencies of the Flemish Government administration, we revealed three distinct perspectives on knowledge integration and knowledge boundary spanning. These different perspectives show that the extent to which team members perceive knowledge boundaries within CFTs as hampering knowledge integration differs, and that this is often related to disciplinary orientations. The findings of this study suggest that (cross-functional) team configurations have important implications for the development of shared team mental models and for teams' cognitive performance.

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Appendix

Q set

- Keeping written documentation up to date helps to get and keep everyone on the same page.
- There are team members who facilitate the kind of mutual communication that helps in locating relevant knowledge.
- Care is taken to ensure that the relevant domain terminology is known and clear to everyone.
- A strong group feeling in the team makes it easier to expand and strengthen the shared understanding of the problem domain and/or the intended solution.
- Working together in the same physical place promotes communication and helps overcome knowledge barriers.
- Analogue aids (whiteboards, post-its. . .) are helpful in developing linkages between the different fields of expertise in a visual way.
- It is ensured that the relevant IT terminology is known and clear to everyone.

- Contradictory descriptions of end users' demands and needs get in the way of knowledge sharing.
- At the start of a project, team members mainly reflect and debate the required knowledge and who can contribute which knowledge.
- The use of jargon makes it difficult to understand one another.
- The domain experts play a pivotal role in a team's successful attempt to overcome a new knowledge barrier.
- In unknown territory (new technology, new problem domain) knowledge barriers disappear by themselves: people realize that they will need knowledge from different areas of expertise.
- The stronger the shared understanding of the problem domain and/or the intended solution, the more effective the knowledge exchange will be.
- The stronger the mutual trust between team members, the more knowledge is shared.
- The team members have the right skills to contribute effectively to knowledge integration.
- The team members are well able to share their own relevant knowledge in an effective way.
- The diverse expertise of the team members hinders knowledge integration.
- There are team members who encourage the others to continuously update their knowledge according to the team or organizational objectives.
- To not to jeopardize knowledge integration, interpersonal conflicts are avoided as much as possible.
- IT experts and non-IT experts have a very different picture of, for example, the intended solution.
- Multidisciplinary teams benefit from a variety of information and knowledge.
- Regardless of which part of the organization they belong to, all team members share the importance of good knowledge management.
- The team members are well able to absorb and process the specific knowledge of other experts.
- Written out functional and technical requirements, use cases, user stories etc. help in obtaining a shared understanding of the intended solution.
- The overarching organizational structure and its rules and frameworks promote knowledge integration across fields of expertise.
- The team leader is responsible for organizing and orchestrating the knowledge integration within the team.
- General knowledge is shared more often than knowledge that is specific/unique to a particular expertise.
- A list of terms and definitions, updated and shared regularly, supports speaking the same language.
- Through rapid iterations of creative co-creation, the team comes to a common understanding of the problem domain and of the intended solution.
- Collaboration and co-creation mean that the roles of domain expert and IT expert within the team are blurred.
- Organizational and business policy issues hinder knowledge sharing.

- Mutual communication is hindered because of the prestige that certain team members enjoy within their own field of expertise.
- The domain experts have a greater influence on the structure of the shared understanding of the problem domain and/or the intended solution than the IT experts.
- Team members will give a higher rating to ideas and proposals when they originate from colleagues of their own area of expertise.
- The lack of domain knowledge of IT experts is an obstacle to knowledge sharing.
- In multidisciplinary teams, the diverse perspectives and expectations of team members lead to communication disorders.
- Team members with relevant experience from similar projects develop valuable information about "who knows what."
- Care is taken to ensure that all team members interpret all terminology in the same way.
- All the combined outputs of analogue and digital tools (diagrams, brainstorms, prototypes. . .) form an imaginary collage that helps enhance knowledge integration.
- Collaboration between team members is hindered because of the prestige that certain members enjoy within their own field of expertise.
- It is ensured that all team members are familiar with the broader picture across the boundaries of their own area of expertise.
- Daily stand-ups reinforce team members' shared understanding of the problem domain and the intended solution.
- The team leader ensures that all team members understand what it means to have job and knowledge diversity in the team.
- A disproportionate focus on certain team members' area of expertise prevents smooth cooperation with members from other areas of expertise.
- Open communication has a positive effect on the development of team members' shared understanding of the problem domain and/or the intended solution.

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