The Role of Collaborative Knowledge Building in the Co-creation of Artifacts:

Influencing Factors and Propositions

Abstract

Purpose – This article assesses the role of collaborative knowledge building in the co-creation of artifacts in the knowledge management field.

Design/methodology/approach – Fifty-eight articles published in six knowledge management-related journals were analyzed. The framework for analysis included thirteen codes. Articles were analyzed using qualitative and quantitative methods.

Findings – Findings showed that several factors influenced the co-creation of artifacts in collaborative knowledge building. At the micro level, individual motivation, capabilities and reflexivity seemed to play a central role in co-creation processes. At the meso level, teamwork and shared understanding were identified as two key major factors. At the macro level, structural, behavioral and cognitive factors were identified; they included organizational rules and workplace setting, organizational culture, and learning and memory. Managerial agency, characteristics of artifacts, and knowledge brokers and boundary spanners also seemed to have an influence at the inter-organizational levels of analysis.

Research limitations – This study has limitations related to scope of contribution, covered time span (17 years), and restrictions in journal subscriptions.

Practical implications – The study will help managers understand the intricacies of collaborative knowledge building practices to increase organizational overall effectiveness and performance.

Originality/value – This article is a first attempt to systematically assess the role of collaborative knowledge building in the co-creation of artifacts, and therefore it represents a

primary reference in the knowledge management field. It proposes some initial propositions that can guide future empirical studies.

Keywords – Artifacts, Knowledge Management, Collaborative Knowledge Building, Organizational Knowledge, Knowledge Sharing, Knowledge Transfer, Knowledge Creation, Knowledge Management Systems, Information Technology, Information Systems

Article type – General Review

Introduction

Collaborative knowledge building refers to social collective processes carried out to produce artifacts in organizations (Singh *et al.*, 2009). Artifacts represent crucial vehicles of human activities as well as mediated interactions (Kajamaa, 2011). They contribute to knowledge-related processes such as knowledge creation (Nosek, 2004), accumulation (Cacciatori, 2008), transfer (Szulanski, 1996), sharing (Di Maio, 2013), or reproduction (Martin de Holan and Phillips, 2004). Research in artificial intelligence (Steels, 1993), computer science (Carroll and Campbell, 1989), information system (Orlikowski and Iacono, 2006; Benbasat and Zmud, 2003), organization studies (Szulanski, 1996; Szulanski and Jensen, 2004) as well as cognitive science (Clark, 1999) and practice-based activities (Dougherty, 2004) has long investigated the role and use of artifacts. For instances, artifacts have been discussed in relation to their instrumentality, aesthetics, and symbolism (Vilnai-Yavetz and Rafaeli, 2006); linked to brand and identity (Schultz *et al.*, 2006) and emergent and situated uses (Orlikowski, 2000); and have been related to knowledge negotiation across domains (Carlile, 2006).

In the knowledge management field, artifacts have been studied to better understand, for instance, how they contribute to knowledge transfer in shift work practices in the manufacturing

and educational sectors (Bosua and Venkitachalam, 2015); or how boundary objects contribute to sharing practices and group cognition and sensemaking (Nosek, 2004), enabling knowledge to be mobilized to develop collaborative work at the group (Mueller, 2012) or organizational level (Brichni *et al.*, 2014). More recently, artifacts have been assessed in the knowledge management debate (Mariano and Awazu, 2016) and several avenues for future research have been suggested. In particular, the way to which artifacts can be collaboratively co-created by the members of an organization has been proposed as a fruitful area of future investigations (Mariano and Awazu, 2016; see also Singh *et al.*, 2009; Kimmerle *et al.*, 2010), since the majority of previous work has focused on already existing artifacts but has not yet formed enough insights on how these artifacts can be produced through purposeful co-creation processes. This investigation could contribute to a better understanding of those factors involved in the successful development of artifacts in social collective processes referred to as *collaborative knowledge building* (see, for instance, Singh *et al.*, 2009). This distinctive view diverges from previous conceptualizations focused on the role of artifacts in knowledge management processes because it takes the converse approach and aims to investigate the role of collaborative knowledge building in the co-creation of artifacts. This view is not a new debate in the field of computer science (see, for instance the work of Stahl, 2000, 2006; Cress and Kimmerle, 2008; Scardamalia and Bereiter, 1992; Kali, 2006). Similarly, many studies in the innovation and strategic management fields have analyzed the role of co-creation, investigating the dynamics and outcomes of co-innovation (Lee et al., 2012; Bossink, 2002; Romero and Molina, 2011), and the interactions between organizations and their customers to increase value creation (Prahalad and Ramaswamy, 2004), especially in knowledge intensive industries (e.g., Aarikka-Stenroos and Jaakkola, 2012; Hertog, 2000; Vargo et al., 2008). However, these studies have not predominantly focused on the role of

artifacts, nor have they investigated the contribution of collaborative knowledge building to the co-creation of artifacts, especially from a knowledge management perspective where this still represents a relatively unexplored topic (Mariano and Awazu, 2016). Studying the role of collaborative knowledge building in the co-creation of artifacts may provide valid indications of how and to what extent knowledge management social collective processes contribute to the co-creation of artifacts, and may help sustain newly introduced practices with clear advantages for overall productivity as well as budgetary concerns and limits.

This paper, thus, responds to these calls and assesses the role of collaborative knowledge building in the co-creation of artifacts in knowledge management research. It reviews current studies in the knowledge management field and develops a list of propositions to guide future empirical work.

To accomplish this aim, fifty-eight key articles from six knowledge management-related journals are reviewed (Tranfield *et al*., 2003; Webster and Watson, 2002). The overarching research question guiding this study is:

1. What factors and contextual levels contribute to the co-creation of artifacts in collaborative knowledge building?

This assessment will increase current understanding of collaborative knowledge building in the knowledge management debate, and it will be particularly beneficial to those scholars interested in future empirical investigations. From a practitioner perspective, this assessment will assist managers in the supervision of collaborative knowledge management building to improve internal knowledge dynamics (Mariano and Casey, 2016) as well as increase organizational overall effectiveness and performance.

Findings showed that several factors influenced the co-creation of artifacts in collaborative knowledge building. At the micro level, individual motivation, capabilities and reflexivity seemed to play a central role in co-creation processes. At the meso level, teamwork and shared understanding were identified as key major influencing factors. At the macro level, structural, behavioral and cognitive factors were identified and discussed. These factors included organizational rules and workplace setting (structural factors), organizational culture (behavioral factor), and learning and memory (cognitive factors). Managerial agency, characteristics of artifacts, and knowledge brokers and boundary spanners also seemed to have an influence at the inter-organizational levels of analysis, potentially contributing to all three proposed contextual levels. These emerged findings helped elaborate several related propositions for future testing.

In this paper, collaborative knowledge building is defined as "a social communicative process aimed at the co-creation of knowledge artifacts (Stahl, 2006)" (Singh *et al.*, 2009, p. 225). Knowledge artifacts are defined as "products or objects of thinking and reasoning that can be collectively argued about" (Singh *et al.*, 2009, p. 225). Artifacts are broadly defined as "tools, stories, symbols, websites, and the like" (Wenger, 2003, p. 83). For the sake of generalizable outcomes (Langley, 1999), this paper focuses on the broad definition of artifacts, which also encompasses the more specific instance of knowledge artifacts. Co-creation is defined as *a collaborative work for advancing artefacts* (see Scardamalia and Bereiter, 1994; Singh *et al.,* 2009, p. 225). It differs from traditional definitions of knowledge creation as "a process that 'organizationally' amplifies the knowledge created by individuals, and crystallizes it as a part of the knowledge network of organization" (Nonaka, 1994, p. 17) because it focuses on the more specific acts of artifact production and advancements.

This paper is organized as follows. First, it discusses the research methodology and steps taken to assess existing literature in the knowledge management field. It presents major findings and develops related propositions. Finally, it closes with conclusions, implications for theory and practice, limitations of the study, and future research directions.

Research methodology

A systematic literature review of peer-reviewed journal articles was conducted. The period examined covered the 1998–2015 year since some articles started appearing in 1998 (e.g., Shariq, 1998), and included six journals in the knowledge management field. These journals were extrapolated from the list appeared in Serenko and Bontis' (2013) work in the *Journal of Knowledge Management* that, at today, still represents the most widely recognized journal ranking list in the knowledge management and intellectual capital fields. The authors decided to focus on peer-reviewed journal articles only because of their widespread acceptance as scientifically validated resources with high impact on the academic literature (Podsakoff *et al*. 2005), and to model previously published similar articles (e.g., Mariano and Awazu, 2016; Mariano and Walter, 2015; Massaro *et al.*, 2015; Senivongse *et al.,* 2015; Serenko and Dumay, 2015a, 2015b).

The systematic literature review followed the recommendations of Tranfield *et al.* (2003) and Webster and Watson (2002) and included three basic steps of planning, conducting, and reporting findings.

Planning was the first step of the systematic literature review process when the authors identified and decided to respond to a specific call suggesting to investigate the way in which collaborative knowledge building contributed to the co-creation of artifacts (Mariano and Awazu, 2016). From a preliminary review of the knowledge management field, a central article

was identified (i.e., Singh *et al.*, 2009). An evident lack of contributions that highlighted those factors influencing collaborative knowledge building, as well as the absence of propositions to direct future empirical research aimed the authors to fulfill these gaps. Therefore, existing literature was surfaced, a research question was formulated, and a review protocol was developed.

Conducting was the second step of the systematic literature review process when the authors surfaced the EBSCO and Google Scholar online research databases to identify relevant journal articles. Abstracts of full-text articles were inspected, and a list of key search terms was developed. This included terms such as 'artifact*', 'object*', 'boundary object*', 'epistemic object*', 'activity object*', 'material infrastructure*', 'co-creation', and 'collaborative knowledge building' that considered the diversity in terminology existing in the current literature. This was done to capture the extensive and multilayered debate and to maximize the likelihood of including relevant articles.

The initial search yielded 326 articles, which was reduced to a final list of fifty-eight core and major articles in six journals. Each article was carefully reviewed with respect to its overall topic, scope, and employed methodology. The articles that were discarded related to editorials, comments, book reviews, and articles out of scope that did not specifically focus on collaborative knowledge building but discussed other related aspects such as the configuration of knowledge transfer mechanisms or organizational learning processes. The selected articles were organized in dedicated electronically-created folders and managed through the use of Excel© sheets. Crucial passages were highlighted, and all the documents were coded and shared between the authors. Codes were developed using already existing and widely accepted taxonomies (e.g., Nicolini *et al*., 2012). A total of thirteen codes were employed i.e., author(s), title, year of

publication, journal, typology, theoretical lens, categorization, methods for empirical work, relevancy, level of analysis, examined practice, role of collaborative knowledge building in artifacts co-creation, and relevant quotes. Authors particularly looked at the role of collaborative knowledge building and the link with artifacts co-creation practices. If these two key components were not discusses, the examined article was discarded. Emerged themes included characteristics of artifacts, collaborations, culture, agency, and learning among others. Authors performed independent coding and discussed and resolved a few disagreements emerged during the analysis. At the end of the coding process, a total of thirty articles contributed to emerging findings.

Reporting was the third and last step of the systematic literature review process when the authors created tables and figures (Salipante *et al.*, 1982; Webster and Watson, 2002), and performed some descriptive statistics with respect to: distribution of articles among selected journals (Table 1); calculation of frequency and percentages as reported in the following sections; and definition of emerged themes (Figure 1).

Insert Table 1, Figure 1 about here

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Findings

Examined practices

Several related practices have been examined to identify and classify factors that could potentially influence the co-creation of artifacts in collaborative knowledge building. The majority of articles were empirical contributions (n=24, 80%), with a predominance of qualitative studies (n=22, 73%); only a few articles focused on conceptual discussions (n=6,

20%). Examined practices included, for instances, interior and graphic design (Lamproulis, 2007), intranet development (Yakhlef, 2001), product development (Kreiner, 2002), and policy and procedural documentation (Reilly, 2009) among others. Artifacts created in these examined practices included sketches and diagrams (Holford, 2014); lists, prospects, guidelines, documentation, intranet or quality management systems (Hustad, 2007); co-created assessment tools (Kajamaa, 2011); digital earing instruments (Kreiner, 2002); referrals, laboratory reports, and instructions as well as routines and rules, prototypes or practical tests, and standards and documentations (Maaninen-Olsson *et al.*, 2008); software development project patterns (Martin *et al.,* 2012); consolidated knowledge platforms (Padova and Scarso, 2012); and groupware and cognitive artifacts (Singh *et al.*, 2009) among others.

The majority of articles focused at the organizational level of analysis i.e., macro level (n=25, 83%). One article focused at the individual level (3%); three articles focused at the group level i.e., meso level (11%); and only one article focused at the inter-organizational level of analysis (3%).

Those articles that employed theories or theoretical perspectives used, for instances, Nonaka and Konno (1998) and Von Krogh's (1998) notions of 'ba' and care in knowledge creation (e.g., Aarrestad *et al.*, 2015); sensemaking (Gephart, 1993) and boundary objects conceptualizations (Boland and Tenkasi, 1995) (e.g., Nosek, 2004); or strategy-based ontologies (e.g., Saito *et al.*, 2007). To note is that four articles (13%) used an activity theory perspective (i.e., Singh *et al.*, 2009; Kajamaa, 2011; Kim *et al.*, 2002; Shariq, 1998) which seems to represent a widespread accepted way to investigate artifacts in organizational contexts (for key contributions in the activity theory debate see, for instance, Engeström, 1987, 1991; Kaptelinin and Nardi, 2006; Leont'ev, 1978; Nicolini *et al.*, 2012).

Contextual levels, influencing factors, and propositions

Singh *et al.* (2009) proposed the study of artifacts at different contextual levels i.e., micro, meso, and macro levels. Studying how collaborative knowledge building contributes to the co-creation of artifacts at different contextual level helps better identify potential influencing factors as well as mediating effects across levels of analysis. This, in turn, enables a refined understanding of what may contribute to the co-creation of artifacts, and how to intervene to facilitate it, providing important insights for theory as well as managerial practices. Therefore, and following Singh *et al.*'s (2009) recommendations, the authors reviewed the selected articles, and identified and classified factors that could potentially influence the co-creation of artifacts in collaborative knowledge building at different contextual levels of analysis.

Table 2 provides a synthesis of key findings that are discussed in details in the following sections.

Insert Table 2 about here

Micro level. At the micro level, it was found that individual motivation, individual capabilities and reflexivity were likely to influence the co-creation of artifacts in collaborative knowledge building. Individual motivation was addressed in the work of Maaninet-Olsson *et al.* (2008), Mueller (2012), Schwabe and Salim (2002), Brichni *et al.* (2014), and Kreiner (2002). Individual motivation (also referred to as 'intrinsic motivation'; see, for instance, Mueller, 2012) seemed to be a crucial individual factor enabling proper co-creation and subsequent use of artifacts (Brichni *et al.*, 2014), especially in the long-term in conjunction with individual awareness and willingness to contribute to the creation of artifacts (Brichni *et al.*, 2014).

Individual motivation was found to allow organizational members "to understand each other's knowledge and work activities" (Maaninet-Olsson *et al.*, 2008, p. 271), with positive effects on knowledge sharing among members and teams (Mueller, 2012) as well as to achieve desired outcomes (Kreiner, 2002; see also Barney, 1986). Monetary rewards, but also recognition by peers and supervisors, were proposed as valuable motivators, and potential ways to increase individual motivation levels (Schwabe and Salim, 2002), although research has found that, in the absence of incentive systems, a positive experience with knowledge sharing processes may be sufficient to motivate intrinsically (Mueller, 2012) and engage in team project activities, such as artifact co-creation processes.

Along with individual motivation, individual capabilities emerged as an additional potential factor influencing collaborative knowledge building. Individual capabilities were discussed with respect to how existing knowledge, intellectual resources, skills and capabilities (Reilly, 2009) all contributed to the creation of both new knowledge and artifacts in the context of policies and procedures developed in third-sector organizations (Reilly, 2009), or with regards to the development of practices aimed at the invention of new products (Kreiner, 2002). Individual capabilities were also discussed in relation to how previous experience and practical knowledge of 'to-dos' and methods of software development (Martin *et al*., 2012) influenced the creation and management of knowledge objects (i.e., artifacts). At the individual level, capabilities thus seemed to be crucial to effective co-creation practices in the context of collaborative knowledge building aimed at the final production of organizational artifacts. Together with individual knowledge and motivation, individual capabilities seemed to have a positive impact on planned collaborative outcomes, even in the presence of limited amount of knowledge shared, as showed by previous research on product development practices where

coordination and compatibility levels among scientists were achieved even in the absence of a

formal de-centralized plan (Kreiner, 2002).

Finally, it was found that reflexivity represented a third important factor enabling the co-

creation of artifacts in collaborative knowledge building. In particular, individual reflexivity was

proposed to resolve contradictions, articulate knowledge, and develop shared understanding

(Singh *et al.*, 2009; see also Stahl, 2000, 2006); additionally, individual reflexivity was suggested

to represent an essential process for making a boundary object (i.e., artifact) works properly

since, together with interest and motivation, 'time for reflection' seemed to affect collective

knowledge, understanding, and coordination of activities, especially in practice-based contexts

(Maaninet-Olsson *et al.*, 2008).

Therefore, the authors propose the following:

Proposition 1. *Individual motivation, capabilities and reflexivity are likely to*

influence the co-creation of artifacts in collaborative knowledge building at the micro

level of analysis

Meso level. At the meso level of analysis, it was found that teamwork and shared

understanding were likely to influence the co-creation of artifacts in collaborative knowledge

building. In particular, teamwork was addressed as one of the key influencing factors in software

development projects (Martin *et al.*, 2012) together with the identification of the most needed

information as well as the media to share information and knowledge among members to reach

the desired co-creation outcomes. It was also found that specific factors contributed to effective

teamwork, such as: (1) workplace dialogue and culture in the construction/reconstruction of

teamwork activities (Holford, 2014) and planned collaborative outcomes (Kreiner, 2002); (2)

effective coordination (Tiwari, 2015), communication and cooperation skills (Mueller, 2012), as

well as meta-knowledge (Przemyslaw, 2014); and (3) intensified collaboration determined by interaction and emotional intensity, caring questioning to enable help-seeking and help-giving to prevent deviation from planned practice (Aarastad *et al.*, 2015) and define structured content to help achieve teamwork outcomes (Brichni *et al.*, 2014).

Along with teamwork, shared understanding was also found to potentially contribute to co-creation outcomes in collaborative knowledge building. Shared understanding was pointed out in the work of Maaninet-Olsson *et al.* (2008) and Singh *et al.* (2009) and was proposed to be a direct outcome of knowledge articulation and reflexive practices in collaborative organizational settings.

Therefore, the authors propose the following:

Proposition 2. *Teamwork and shared understanding are likely to influence the co-creation of artifacts in collaborative knowledge building at the meso level of analysis*

Macro level. At the macro level, it was found that structural, behavioral and cognitive factors were likely to influence the co-creation of artifacts in collaborative knowledge building.

Structural factors included organizational rules (Shariq, 1998; Schwabe and Salim, 2002; Kim *et al.*, 2002) and workplace setting (Aarastad *et al.*, 2015; Padova and Scarso, 2012; Jiang *et al.*, 2010; Lamproulis, 2007). Organizational rules were discussed with regards to the organizational system as a whole where the tools (i.e., artifacts), the rules of the community, and the division of labor all affected the practice and corresponding final outcomes (Shariq, 1998). Organizational rules were also addressed as crucial factors to enhance clarity of project outcomes, such as a knowledge portal (Schwabe and Salim, 2002), but also an impediment to knowledge implementation and corresponding outcomes, such as an enterprise information portal, if rules were not sufficiently and explicitly developed (Kim *et al.*, 2002). Along with

organizational rules, workplace setting was also addressed as a potential structural factor influencing the co-creation of artifacts in collaborative knowledge building. In particular, physical space (Lamproulis, 2007), collaborative space (Aarastad *et al.*, 2015), organizational arrangements (Padova and Scarso, 2012), and a good fit between artifacts type and organizational context (Jiang *et al.*, 2010) all seemed to directly influence the co-creation process and the corresponding artifact production since a proper collaborative space was found to enlarge "the sensory-motor connectivity in knowledge creation" (Aarastad *et al.*, 2015, p. 88) and contribute to shared meanings of actions and behaviors (Lamproulis, 2007).

Behavioral factors embraced organizational culture, as discussed in the work of Lamproulis (2007), Padova and Scarso (2012), Kim *et al.* (2002), and Pandey and Dutta (2013). Organizational culture was proposed to influence the use of information technology artifacts and related knowledge production within an organization (Lamproulis, 2007; see also Schein, 1992) since it defined the context of behavior and corresponding relationships, especially when different subcultures influenced certain knowledge management project outcomes (Padova and Scarso, 2012). Organizational culture was also addressed as a problematic key driver of organizational change (Padova and Scarso, 2012; Kim *et al.*, 2002) that required strong and continuous efforts when organizational members did not show satisfying commitment levels to collaborative knowledge building processes since "an organization's culture is one of the most significant components of effective KM practice, and also one of the most difficult hurdles to overcome" (Pandey and Dutta, 2013, p. 446).

Finally, a certain number of articles referred to cognitive factors such as organizational learning and memory. These articles focused on circuits of learning (Fosstenløkken, 2015) that influenced an object (i.e., artifact) co-creation and transformation; group sensemaking as a basis

for knowledge creation and sharing (Nosek, 2004); the interplay between individual and collective knowledge for learning and knowledge building (Kimmerle *et al.*, 2010); and corporate and organizational memory impacts on research activities and artifacts (Jaime *et al.*, 2005). Although these articles focused on different aspects of the co-creation process, they provided valuable insights to incorporate cognitive factors into a refined conceptual framework for the analysis of collaborative knowledge building. Therefore, these factors are worth exploring in future studies.

Therefore, the authors propose the following:

Proposition 3. *Structural (organizational rules and workplace setting), behavioral (organizational culture), and cognitive (learning and memory) factors are likely to influence the co-creation of artifacts in collaborative knowledge building at the macro level of analysis*

Inter-organizational levels. From the analysis of selected articles, it was found that potential inter-levels factors ranging from managerial agency to characteristics of artifacts, to the influence of knowledge brokers and boundary spanners in organizational and inter-organizational contexts could potentially influence the co-creation of artifacts in collaborative knowledge building.

Managerial agency was addressed as a key factor at all contextual levels (Schwabe and Salim, 2002) in the development of knowledge management projects and related artifacts. Strong leadership and commitment levels by top managers was found to determine the success or failure of projects involving large amount of objects i.e., artifacts (Padova and Scarso, 2012). Managerial trust was proposed to have a direct influence on employees' outcomes and sharing

performance when boundary objects are involved (Mueller, 2012); and managerial support was addressed as a key driver in the use and sustainment of jointly created artifacts (Kajamaa, 2011).

Along with managerial agency, characteristics of artifacts (Shariq, 1998) were also extensively addressed in the current literature with reference to co-creation processes and collaborative knowledge building. Eppler and Pfister (2014) discussed how the characteristics of visuals influenced knowledge management practices in a leading regional police force. Visuals were also studied in the work of Eppler and Burkhard (2007) who elaborated a taxonomy to help corporate knowledge management go beyond the simple creation and use of documents or knowledge maps as the most widespread adopted organizational artifacts. Martin *et al.* (2012) proposed that in the creation and management of knowledge objects (i.e., artifacts), degree of formality of product-flow as well as workflow definitions represented critical factors for correct modelling of knowledge objects. Similarly, Bosua and Venkitachalam (2015) pointed out the key role of codification practices in the construction of boundary objects for shift handover between shifts, highlighting the importance of correct artifact structures. Similarly, Jeyes and Dolphin (2005) and Brichni *et al.* (2014) investigated a repository structure to understand its contribution to collaborative knowledge building and sustainable developments, where structured content (Brichni *et al.*, 2014) and accessibility issues (Jeyes and Dolphin, 2005) seemed to be the most contributing factors to successful co-creation outcomes. Lastly, Jiang *et al.* (2010) proposed that an analysis of temporal and dynamic nature of design could contribute to successful creation and implementation of designed artifacts.

Finally, it was found that knowledge brokers and boundary spanners reduced the disruptive effects of structural diversity i.e., geographical dispersion, business functions and business divisions and, together with boundary objects (i.e., artifacts), contributed to successful

performance in a multinational company that operated in the marine industry (Hustad, 2007).

Boundary spanners were also addressed as crucial drives in knowledge transfer during shifts and handovers that made use of specific co-created boundary objects i.e., artifacts (Bosua and Venkitachalam, 2015) and were key in knowledge integration processes in practice-based contexts (Maaninet-Olsson *et al.*, 2008).

Therefore, the authors propose the following:

Proposition 4. Managerial agency, characteristics of artifacts, and knowledge brokers and boundary spanners are likely to influence the co-creation of artifacts in collaborative knowledge building at the inter-organizational level of analysis

Summary of findings and remarks

This section summarizes emerged findings and answers the research question posed at the beginning of the paper i.e., what factors and contextual levels are involved in collaborative knowledge building aimed at the co-creation of artifacts?

In summary, findings revealed that the four proposed contextual levels (Singh *et al.*, 2009) i.e., micro, meso, macro and inter-organizational levels all potentially contributed to the co-creation of artifacts in collaborative knowledge building, and that several identified factors influenced the related co-creation outcomes.

At the micro level, individual motivation (Maaninet-Olsson *et al.*, 2008; Mueller, 2012; Schwabe and Salim, 2002; Brichni *et al.*, 2014; Kreiner, 2002), individual capabilities (Kreiner, 2002; Martin *et al.*, 2012; Reilly, 2009) and reflexivity (Maaninet-Olsson *et al.*, 2008; Singh *et al.*, 2009) seemed to play a central role in collaborative knowledge building aiming at the co-creation of artifacts. At the meso level, teamwork (Martin *et al.*, 2012; Holford, 2014; Przemyslaw, 2014; Aarastad *et al.*, 2015; Tiwari, 2015; Kreiner, 2002; Mueller, 2012; Brichni *et*

al., 2014) and shared understanding (Maaninet-Olsson *et al.*, 2008; Singh *et al.*, 2009) were identified as the two key major influencing factors. At the macro level structural, behavioral and cognitive factors were identified and discussed. These factors included: (1) structural factors, such as organizational rules (Shariq, 1998; Schwabe and Salim, 2002; Kim *et al.*, 2002) and workplace setting (Aarastad *et al.*, 2015; Padova and Scarso, 2012; Jiang *et al.*, 2010; Lamproulis, 2007); (2) behavioral factors, such as organizational culture (Lamproulis, 2007; Padova and Scarso, 2012; Kim *et al.*, 2002; Pandey and Dutta, 2013); and (3) cognitive factors, such as learning and memory (Fosstenløkken, 2015; Jaime *et al.*, 2005; Nosek, 2004). Managerial agency (Padova and Scarso, 2012; Mueller, 2012; Kajamaa, 2011; Schwabe and Salim, 2002), characteristics of artifacts (Eppler and Pfister, 2014; Martin *et al.*, 2012; Bosua and Venkitachalam, 2015; Jeyes and Dolphin, 2005; Brichni *et al.*, 2014; Jiang *et al.*, 2010; Eppler and Burkhard, 2007; Shariq, 1998), as well as knowledge brokers and boundary spanners (Hustad, 2007; Bosua and Venkitachalam, 2015; Maaninet-Olsson *et al.*, 2008) seemed to have an influence at the inter-organizational levels of analysis, potentially contributing to all three proposed contextual levels.

These emerged findings helped the elaboration of several propositions for future testing in the context of collaborative knowledge building and co-creation of artifacts.

Figure 2 provides a visual representation of findings and propositions. To note is that, although some links between factors at different contextual levels have been identified (for instances the link between reflexivity and shared understanding highlighted with a dotted-point arrow in Figure 2), the authors decided to leave these relationships out of the discussion and made the deliberate choice of not developing potential related propositions. This decision was made due to the overall aim and focus of contribution, clarity of exposition, and the relatively

small number of references that could sufficiently justify the development of research propositions related to the links marked with dotted-point arrows in Figure 2. However, it is recognized that this could represent a fruitful area for future conceptual contributions, which seem to be worth exploring. This aspect is discussed in details in the future research directions section that follows below.

Insert Figure 2 about here

Conclusions, implications for theory and practice, limitations, and future research directions

This paper assessed the role of collaborative knowledge building in the co-creation of artifacts in the knowledge management field, and contributed to theory as well as practice.

From a theoretical perspective, this paper developed research propositions and provided directions to scholars interested in the study of collaborative knowledge building and artifacts in the knowledge management field. To accomplish these aims, this paper reviewed fifty-eight articles published in six knowledge management-related journals in the past 17 years (1998-2015), and showed factors that could potentially contribute to the co-creation of artifacts in collaborative knowledge building at the micro, meso, macro and inter-organizational levels of analysis.

For practitioners, this paper provided insights on the intricacies involved in collaborative knowledge building. In particular, it helped shed some lights on the role of collaborations at the micro, meso, and macro levels to produce co-created artifacts. The insights would help knowledge managers strategize collaboration practices that could potentially contribute to co-

creation of artifacts. This paper could help knowledge managers identify, assess, and evaluate important elements that contributed to the establishment of knowledge artifacts. These elements referred to individuals, teams and the organization as a whole, and thus could inform knowledge managers to better develop effective and efficient knowledge management practices, projects, and services involving the use of artifacts.

Limitations of this study regarded covered time span (17 years), restrictions in journal subscriptions, and boundary conditions related to the scope and overall aim of the review that focused only on knowledge management studies and, therefore, did not include other streams of research such as innovation, marketing, dynamic capabilities or absorptive capacity.

Future research could test the suggested propositions as well as investigate some of the identified potential relationships highlighted with dotted-point arrows in Figure 2 and which refer to the micro, meso and macro levels. A research agenda is proposed as follows.

Micro level: Individual motivation, capabilities and reflexivity. It was found that individual motivation allowed organizational members to better understand collective knowledge (Maaninet-Olsson *et al.,* 2008, p. 271) with positive implications for knowledge sharing, team work (Mueller, 2012) and planned outcomes (Kreiner, 2002; see also Barney, 1986); it was also found that positive knowledge sharing experiences could be potentially sufficient to motivate intrinsically organizational members (Mueller, 2012). In the context of co-creation processes, it would be, thus, interesting to further investigate these proposed relationships. For instance: Does individual motivation contribute to teamwork and shared understanding in collaborative knowledge building? Similarly, if was found that individual capabilities had a positive impact on planned collaborative outcomes, even in the presence of limited amount of knowledge shared (Kreiner, 2002), and that reflexivity could potentially resolve contradictions, articulate

knowledge, and develop shared understanding (Singh *et al.*, 2009; see also Stahl, 2000, 2006) for making a boundary object (i.e., artifact) work properly since reflection time was proposed to affect collective knowledge, understanding, and coordination of activities, especially in practice-based contexts (Maaninet-Olsson *et al.*, 2008). In the context of co-creation processes it would, thus, be worth exploring some of these proposed relationships, for instance: Do individual capabilities influence teamwork, and does reflexivity have an impact on shared understanding in collaborative knowledge building?

Meso level: Teamwork and shared understanding. It was found that role of workplace dialogue and culture in the construction/reconstruction of teamwork activities (Holford, 2014) and planned collaborative outcomes (Kreiner, 2002), as well as effective coordination (Tiwari, 2015), communication and cooperation skills (Mueller, 2012), meta-knowledge (Przemyslaw, 2014), intensified collaborations (Aarastad *et al.*, 2015), and defined structured content (Brichni *et al.*, 2014) all contributed to effective teamwork. It was also proposed that shared understanding represented a direct outcome of knowledge articulation and reflexive practices in collaborative organizational settings. In the context of co-creation processes it would, thus, be worth exploring some of these relationships, for instance: Do teamwork and shared understanding influence organizational culture, and does organizational culture influence teamwork in collaborative knowledge building?

Macro level: Structural, behavioral and cognitive factors. At the macro level several factors were discussed, including organizational rules (Shariq, 1998; Schwabe and Salim, 2002; Kim *et al.*, 2002) as crucial factors to enhance clarity of project outcomes (Schwabe and Salim, 2002); workplace setting (Aarastad *et al.*, 2015; Padova and Scarso, 2012; Jiang *et al.*, 2010; Lamproulis, 2007) as a collaborative space to enhance connectivity in knowledge creation

(Aarastad *et al.*, 2015, p. 88) and contribute to shared meanings of actions and behaviors (Lamproulis, 2007); organizational culture (Lamproulis, 2007; Padova and Scarso, 2012; Kim *et al.*, 2002; Pandey and Dutta, 2013) as a means to define context of behavior and corresponding relationships (Padova and Scarso, 2012) although a potential problematic key driver of organizational change (Padova and Scarso, 2012; Kim *et al.*, 2002); and organizational learning and memory (e.g., Fosstenløkken, 2015; Nosek, 2004; Kimmerle *et al.*, 2010; Jaime *et al.*, 2005) that were proposed to have a crucial impact on research activities and artifacts. From a structural perspective, it would be, thus, interesting investigate some of these proposed relationships, for instance: Do organizational rules and workplace setting influence teamwork activities in collaborative knowledge building? These questions seem to represent fruitful areas for future studies, and seem to be worth exploring. Finally, an additional research area that was out of scope for the present contribution but that could be investigated in future studies regards the emerging stream of literature (e.g., Kazadi *et al.*, 2016; Pera *et al.*, 2016) that considers knowledge co-creation in the context of networked relationships of stakeholders, or eco-systems, that could also be worth exploring from a knowledge management perspective.

This paper was a first attempt to systematically assess the role of collaborative knowledge building in the co-creation of artifacts in the knowledge management field. It represents a primary reference for scholars interested to investigate the relationships between knowledge management-related processes and artifacts, and it also constitutes a useful roadmap for managers and managerial practice interested in the potential impact of artifacts in organizational contexts.

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