Sourcing knowledge for innovation: knowledge reuse and creation in project teams

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Abstract

Purpose – *The purpose of this paper is to investigate motivations of team members to source knowledge and how the sourced knowledge increases their reuse and creation outcomes.*

Design/methodology/approach – *A model based on knowledge sourcing perspective is proposed and tested to link knowledge sourcing methods in teams to their performance outcomes. The hypotheses are tested on data collected from a survey of 341 project teams.*

Findings – *The findings show the critical role of team members' learning orientation in increasing knowledge sourcing, reuse and creation; group knowledge sourcing and repositories are more appropriate to increase knowledge reuse; the Internet is more effective to increase knowledge creation; and knowledge reuse increases knowledge creation among team members with a strong learning orientation.*

Research limitations/implications – *Further studies can replicate the model presented in this paper and introduce group characteristics to improve its explanatory power. Also, use of self-reported measures in data collection may lead to biases; future research should collate different measures longitudinally or use separate primary and secondary observations.*

Practical implications – *Team leaders should enhance team effectiveness by ensuring diversity of knowledge and skills. Current research emphasizes that team leaders can integrate a crowdsourcing or "users as co-creators" approach to increase knowledge creation by team members. Team members' learning orientation can be increased by promoting a climate that encourages open discussion of problems, mistakes and errors.*

Originality/value – *This research highlights that knowledge sourcing methods produce different performance outcomes regarding knowledge reuse and creation. These insights can be useful to team leaders and researchers to better understand what motivates team members to source knowledge and how it increases their reuse and creation outcomes.*

Keywords *Knowledge, Innovation, Knowledge creation, Project teams, Knowledge management, Action learning*

Paper type *Research paper*

1. Introduction

In a complex business environment, team projects allow companies to earn a major share of their profit (Aubry and Lièvre, 2010; Garel and Lièvre, 2010; Melkonian and Picq, 2010). Team projects allow new innovations to be conceived, developed and implemented within an organization or on the market (Archibald, 2003). The improvement of innovations may require new knowledge and new routines. For instance, the development of information technology within an organization requires the creation of new technical solutions and the reuse of existing ones (Keller, 1992). The ability to facilitate knowledge sourcing, reuse and creation is, therefore, critical to improve innovations (Gray and Meister, 2006; Majchrzak *et al.*, 2004; Markus, 2001).

Knowledge sourcing refers to the ability of team members to actively engage in the process of searching, accessing, transferring and applying knowledge (Khedhaouria and Ribiere, 2013; Staats *et al.*, 2014). Knowledge sourcing allows team members to reflect on the

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sourced knowledge and to adjust their understanding of a given problem. It reflects team members' ability to perform together toward a common goal, which results in collective competence (Melkonian and Picq, 2010). The role of team leaders is critical for defining a common goal and organizing team members to accomplish collective competence (Aubry and Lièvre, 2010; Bass *et al.*, 2007; Edmondson, 2003; Pitrola-Merlo *et al.*, 2002; Strang, 2010; Turner and Müller, 2007; Zaccaro *et al.*, 2001).

Studies argued that knowledge reuse is more likely to enhance innovation because it is easily manageable (Markus, 2001). Although knowledge creation is critical for innovation, it is difficult to manage due to costs in terms of time, resources and efforts required to producing new knowledge (Armbrecht *et al.*, 2001; Majchrzak *et al.*, 2004).

Most studies investigated knowledge reuse and creation with an emphasis on knowledge management systems, driven by the goal to make knowledge available to team members in the required format when they need it (Alavi and Leidner, 2001; Majchrzak *et al.*, 2004, 2013; Markus, 2001; Watson and Hewett, 2006). However, little is known about what motivates team members to source knowledge and how the sourced knowledge increases their reuse and creation outcomes.

Three main points can justify the present research:

- first, research on knowledge sourcing suggests that merely making knowledge available does not guarantee its use by team members but rather understanding what motivates them to source knowledge can encourage its use (Gray and Meister, 2004); and
- second, there is evidence that different knowledge sourcing methods (e.g. group knowledge sourcing, technical support knowledge repositories and the Internet) have varied performance outcomes (Gray and Meister, 2006).

Understanding knowledge sourcing methods that influences knowledge reuse and creation by team members will be useful for the team's collective competence. Finally, it was suggested that knowledge reuse enhances its creation by stimulating creative cognitive processes (Majchrzak *et al.*, 2004). Therefore, understanding how knowledge is reused and created can help to identify ways to facilitate its reuse and creation.

The present research investigates what motivates project team members to source knowledge and how it increases their reuse and creation outcomes. To address this question, we adapted and tested a model based on knowledge sourcing perspective (Gray and Meister, 2004). We included learning orientation as a motivational input that inspires team members to initiate knowledge sourcing processes, which result in various performance outcomes (Gray and Meister, 2006; Khedhaouria and Ribiere, 2013).

Our hypotheses are tested on data collected from a survey of 341 French project teams from 53 companies across France. Our findings show that group knowledge sourcing and repositories are more appropriate to increase knowledge reuse, while the Internet is effective to increase knowledge creation. Interestingly and somewhat contrary to prior research, group knowledge sourcing has no effect on knowledge creation. The results highlight the role of team members' learning orientation in increasing knowledge sourcing, reuse and creation in teams. Knowledge reuse increases knowledge creation. The findings have many theoretical and practical implications on how knowledge should be managed to increase knowledge reuse and creation among the team members.

In the following section, we present the theoretical development of individual and team-level concepts, knowledge sourcing, reuse and creation concepts. In the method section, we present our sample and variables. Afterward, we elaborate on the results and conclude.

2. Theoretical development

2.1 Team members and collective competence

Project-based working, widely used in firms of all sizes and in different sectors, is particularly useful for knowledge sourcing, reuse and creation in teams (Garel and Lièvre, 2010; Melkonian and Picq, 2010; Turner and Müller, 2007). Nevertheless, the integration of the sourced knowledge within a team is conditioned by the involvement and commitment of its members to the common goal (Turner and Müller, 2007). The ability to build a team-level collective competence poses a challenge for team leaders (Zaccaro *et al.*, 2001). To federate interdisciplinary team members toward a common goal, team leaders are often entrusted in a unique position to understand how different skills fit together in the project and to help members to share knowledge (Melkonian and Picq, 2010). For example, innovation to be developed may require new knowledge and new routines (Keller, 1992). It is therefore a learning process that involves collective discussion and experimentation, sharing both technical knowledge and social knowledge about who knows what (Edmondson, 2003). The challenge of the team leaders lies in meshing together variety of individual skills and channeling them toward a collective team competence that leads to successful innovation (Melkonian and Picq, 2010; Pitrola-Merlo *et al.*, 2002; Strang, 2010; Turner and Müller, 2007; Zaccaro *et al.*, 2001).

2.2 Knowledge sourcing in teams

Most studies have investigated knowledge management (KM) on supply-side issues, such as sharing, learning and transferring knowledge (Alavi and Leidner, 2001; Cohen and Levinthal, 1990). These studies are motivated by the goal of making knowledge available and accessible to individuals who need it, when they need it and in the format they need it. Nevertheless, it will not be correct to assume that knowledge availability guarantees its use by individuals. Gray and Meister (2004) adopted a knowledge sourcing perspective to address this theoretical gap in KM research by helping to articulate the missing segment in the causal chain connecting knowledge availability to its individual learning outcomes. In the present research, we adapt the knowledge sourcing perspective to connect knowledge availability to its performance outcomes in the project teams.

Knowledge can be obtained from various sources (Huggins *et al.*, 2010); team knowledge sourcing can mean using group members' experience and expertise to facilitate innovation (e.g. direct contact, conversations and exchanges among team members). It may involve learning about problems encountered inside the organization from technical support knowledge repositories (e.g. published documents posted on the company's intranet and access to knowledge-based systems). Or, it may involve drawing on new knowledge using expert advice and technical or business development expertise that is not available within the organization but accessible through the Internet (e.g. access to community network sites and virtual communities).

Knowledge sourcing allows the team members to reflect on the sourced knowledge and to reuse it to adjust their understanding of a given problem. They can then create new knowledge that integrates the sourced knowledge with their new understanding of the problem (Staats *et al.*, 2014). Learning orientation, that is team members' intrinsic motivation and dedication to learn in the project, is found to be the major driver influencing the team members' willingness to source the required knowledge for problem-solving (Shalley *et al.*, 2009). Team members vary in the extent to which they seek to acquire new knowledge or skills and, thus, to improve a collective competence (Dweck and Elliott, 1989). Those with a strong learning orientation believe that their own skills can be improved through effort and experience and have a desire to do so. As such, they "persist, escalate effort, engage in solution-oriented self-instruction, and report enjoying the challenge" (Brett and Van de Walle, 1999, p. 864). They are more likely to source knowledge to improve their skills (Gray and Durcikova, 2005). Team members' disposition to directing increased attentional resources toward learning orientation is, therefore, an important predictor of

their knowledge sourcing activities. In projects, the team members face challenging problems regularly for which they have no systematic solution available to be recalled from their own memories (Sethi *et al.*, 2001). In such situations, the members may consult their groups (i.e. peers), repositories and the Internet to explore and exploit potential solutions (Aubry and Lièvre, 2010). Consistent with knowledge sourcing perspective, when the team members are not able to solve problems using their own skills and expertise, those with strong learning orientation are more likely to source knowledge from peers, repositories and the Internet. We hypothesize the following:

H1a. Team members with strong learning orientation will source knowledge from their peers.

H1b. Team members with strong learning orientation will source knowledge from technical support knowledge repositories.

H1c. Team members with strong learning orientation will source knowledge from the Internet.

2.3 Performance outcomes

Knowledge sourcing perspective distinguishes two main activities that can be used by the team members to solve problems:

1. *Replication and adaptation*: Team members reuse existing knowledge to replicate and adapt it to new situations, for example use shared "*best management practices*" to find generic solutions used in previous similar problems (Bogan and English, 1994).
2. *Innovation*: Team members take risks to explore and create entirely new knowledge, for example experiment new knowledge by trial and error to develop new outcomes (Albers and Henzinger, 2000).

2.3.1 Replication and adaptation: knowledge reuse. Knowledge reuse is defined as the replication and adaptation activities used to solve common problems (Markus, 2001). This constitutes an exploitation of resources that ge*n*erates value through the efficiencies that result from not recreating knowledge that already exists (Kostopoulos and Bozionelos, 2011; March, 1991). Capturing and documenting knowledge that can be reused for replication and adaptation occur in two major ways. First, replication occurs within a structure providing explicit and published knowledge. Hansen *et al.* (1999) suggested that published knowledge is considered to be a superior mechanism for transferring best practices. Transferring knowledge through published documents is more likely to be superior to direct contact because it saves time and efforts when the required knowledge is to be replicated (Gray and Meister, 2006). Transferring knowledge through published documents may also be superior because it is more objective and clear compared to knowledge provided through conversation, which is often irrelevant and hard to be interpreted (Daft and Lengel, 1986). Technical support knowledge repositories also provide useful knowledge that can be easily replicated, as it is properly indexed and easily searchable (Davenport and Klahr, 1998). Indeed, knowledge-based systems facilitate organizational memory by providing the required knowledge to be replicated (Haseman *et al.*, 2005). In contrast, sourcing knowledge from the Internet is less likely to be replicated effectively, given the fact that knowledge that has not been previously appraised by experts may be perceived as inaccurate, inappropriate or incomplete and cannot be trusted (Constant *et al.*, 1996).

Second, adaptation occurs within a structure providing support for communication and interactivity among the team members. Daft and Weick (1984) suggested that understanding the relevance of the needed knowledge to be adapted often requires interactive cycles of discussions and interpretations. Discussions are important for individuals to understand the applicability of the knowledge and then to adjust it to a given situation (March and Olsen, 1987). High level of interactivity is important to acquire feedback, so that individuals can adjust what they perceive useful and correct any

misunderstandings (Hinds and Kiesler, 1995). The dialogue helps groups to understand the implications of a particular knowledge (Gray and Meister, 2006). Group knowledge sourcing favors a richer dialogue between members. It enhances knowledge adaptation because it increases trust between the team members and favors collaboration. Therefore, knowledge reuse resulting from replication and adaptation activities will occur within a structure providing support for group knowledge sourcing and repositories. We hypothesize the following:

H2a. Sourcing knowledge from groups will increase knowledge reuse by team members.

H2b. Sourcing knowledge from repositories will increase knowledge reuse by team members.

H2c. Sourcing knowledge from the Internet will not increase knowledge reuse by team members.

Finally, as explained above, learning orientation has been found to influence knowledge reuse. When the team members face common problems, those with a strong learning orientation are more likely to activate their cognitive structures for searching systematic solutions available in their own memories to adapt them to new situations (Farr *et al.*, 2003). We hypothesize the following:

H2d. Team members with strong learning orientation will show an increase in knowledge reuse.

2.3.2 Innovation: knowledge creation. Knowledge creation is defined as the extent to which the team members adopt creative approach to solve problems (Von Krogh *et al.*, 2000). This constitutes an exploration of new possibilities to find out new knowledge (Kostopoulos and Bozionelos, 2011). Team members can assimilate their understanding of the problem and invent new solution favoring a radical innovation with greater modification representing greater novelty (Farr *et al.*, 2003). Radical innovation is differentiated from incremental innovation by involving discontinuous development where unprecedented improvements or performance features are achieved (Leifer *et al.*, 2000). Team members are more likely to produce creative solutions when they perceive a situation from a new perspective (Amabile, 1996). Because knowledge sourcing in group setting suitably taps a wider range of perspectives than does repositories, it is most likely to enhance innovation.

In an appropriate team work context, team members' diversity encourages divergent thinking and trigger creative cognitive processes (West, 2002). Cognitive diversity has been suggested as predictive of idea generation and creativity (Farr *et al.*, 2003). Team members with potentially diverse backgrounds increase the number of minority viewpoints, which lead members to develop more novel solutions. Gray and Meister (2006) argued that group discussions provide a valuable exposure to comparative experiences, which consequently leads to more creative outcomes. Group knowledge sourcing would be more effective to the extent that members engage in learning behavior, such as seeking feedback, enjoying challenges, sharing information, asking for help, talking about errors and experimenting (Edmondson, 1999).

Online communities also provide powerful tools for sharing, accessing useful knowledge and enhancing innovation (Füller *et al.*, 2009). Online community question answering sites provide a place where the team members can ask their questions and they will be answered by other online participants and experts. The answers are validated by a "start-based" system where the team members give feedback whether the answer was helpful or not. Some of the well-known community questions answering systems are "yahoo!" for answering general questions, "Stack Overflow" for answering questions on programming, "Server Fault" for server administrators and IT professionals and many others answering systems. Further, virtual communities enable consumers to actively engage in co-creation activities and participate in innovation process (Dahan and Hauser,

2002). Consumers are invited to actively participate by generating and evaluating new ideas, discussing and improving optional solution details.

In contrast, transferring knowledge through repositories is found to be inappropriate for triggering creative outcomes (Gray and Meister, 2006). Internal published documents and knowledge-based systems are more likely to encourage the syndrome of "cognitive inertia" by preventing individuals to view the problem from different perspectives (McFadzean, 2001). We hypothesize the following:

H3a. Sourcing knowledge from groups will increase knowledge creation by team members.

H3b. Sourcing knowledge from repositories will not increase knowledge creation by team members.

H3c. Sourcing knowledge from the Internet will increase knowledge creation by team members.

Furthermore, learning orientation has been found to influence knowledge creation. When the team members perceive a problem from a new perspective, those with a strong learning orientation are more likely to develop new cognitive structures, which trigger their creative processes (Tierney and Farmer, 2002). We hypothesize the following:

H3d. Team members with strong learning orientation will show an increase in knowledge creation.

Finally, knowledge reuse can enhance knowledge creation by stimulating creative processes mainly in two ways (Majchrzak *et al.*, 2004). First, by replication, although replicated knowledge is just relatively novel, it can be used creatively in new contexts to resolve problems with a notably better quality or more economically than the original solution (Sternberg *et al.*, 2003). Second, by adaptation, sourced knowledge provides an alternative lens through which prior knowledge and existing problems can be viewed, so that the team members can revisit and adapt the knowledge to generate entirely new solutions and solve existing problems (Majchrzak *et al.*, 2004). Knowledge reuse is the exploitation of existing diverse ideas previously unknown to the team members when creating new products or services (Armbrecht *et al.*, 2001). If the team members limit their search for solutions to their current personal knowledge base or existing network of sources, then the extent to which radical solution is achieved will be limited (Leifer *et al.*, 2000). When the team members reuse peers' knowledge, previously unknown to them, the creativity envelope will be expanded (Armbrecht *et al.*, 2001). A knowledge management system expands the creativity envelope, improves the research and development process through quicker access and movement of new knowledge. This leads to our final hypothesis:

H3e. Knowledge reuse by team members will increase their knowledge creation.

2.4 Research model

All our hypotheses are depicted in Figure 1.

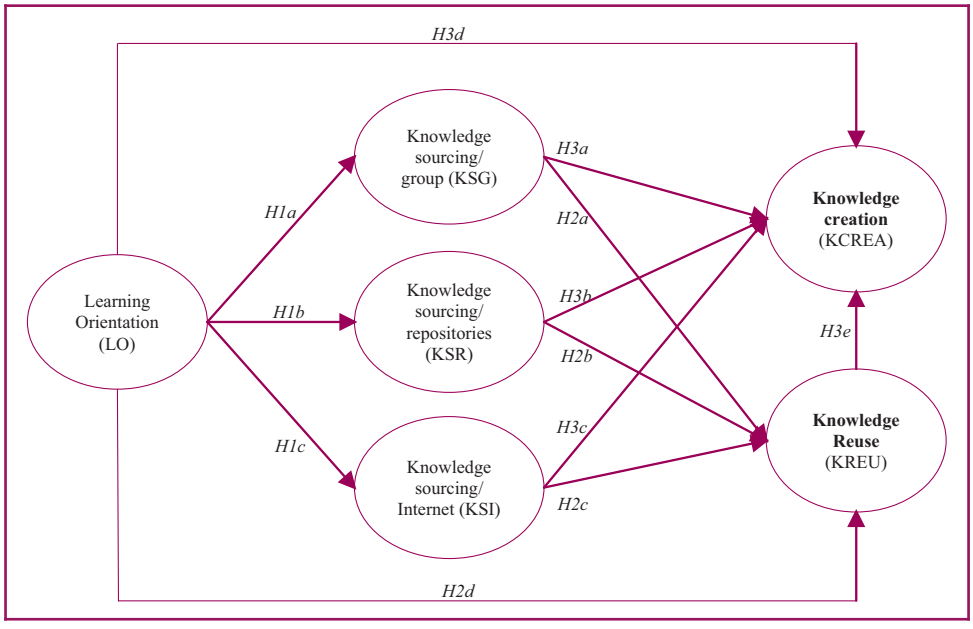
3. Methodology

3.1 Data collection

In the present research, we used a quantitative approach to test our hypotheses. Quantitative approach allows replication and adaptation of a model to understand a set of relationships in new contexts (Black, 2005). Indeed, a model based on knowledge sourcing perspective was adapted and used to explain how the team members source knowledge and how it enhances their reuse and creation outcomes.

Data were collected using key informants approach (Bharadwaj and Menon, 2000; Duggan, 2013; Egan, 2005). Key informants are highly knowledgeable about team events and practices (Sethi *et al.*, 2001). They often are highly experienced and well-informed

Figure 1 Research model



team leaders who are knowledgeable about the team members and projects that they coordinated (Egan, 2005). Consequently, their perceptions and experiences are instrumental in understanding how the members of a team source knowledge in projects (Egan, 2005).

Using a French Business School's database, an email invitation was sent to former graduates who were selected as key informants based on two main criteria:

1. they should have acted the role of team leaders in at least one innovation project in the past two years; and
2. they should be able to report the shared perceptions of their team members regarding team projects they coordinated.

Team projects included problem-solving activities and resulted in successful innovations (Aubry and Lièvre, 2010), such as projects to improve organizational processes, innovation projects to address specific management needs and innovation projects to solve specific organizational problems.

First, a pilot study was conducted with ten business graduates that we selected because of their frequent involvement in managing project teams in their organizations. They answered the initial questionnaire and provided pertinent comments during a 30 minute telephone conversation. According to their feedback, the questionnaire was restructured and reworded to improve its clarity and the logical succession of questions. Finally, the improved questionnaire was then posted on a Web site and the invitation to participate in the survey was sent to all business graduates. Those interested in participating as key informants were able to click on a link embedded in the email invitation to be automatically directed to the survey Web site.

A total of 417 responses were received from 53 large- and medium-sized French companies working in various economic sectors (industry, commerce and services). Only 341 responses were from team leaders out of which 207 occupied middle management positions and 134 occupied senior management positions in their organizations. Their key roles in projects consisted of defining team goals and organizing team members. They were between the ages of 24 and 66 (average 34.87) years and 45.45 per cent were men and 54.54 per cent women. The majority hold a graduate degree (87.39 per cent). Their

work experience varies from less than 1 year to more than 25 years (average 10.02). The projects that they coordinated are classified in six major categories:

1. *Organizational change projects*: To improve management processes, organizational restructuring and legal proceedings.
2. *Communication systems projects*: To improve network communication systems and to switch to wireless communications.
3. *Software implementation projects*: To improve customer relations and to increase organizational integration.
4. *Facilities projects*: To improve manufacturing processes for new products.
5. *Product and service development projects*: To develop new products and services.
6. *Research and development projects*: To improve consumer services.

3.2 Measures

The model presented in Figure 1 includes five constructs measured by adapting valid and reliable scales from the knowledge management literature (Table I).

The respondents indicated their agreement with a set of statements using a seven-point Likert-type scale ranging from (1) "strongly disagree" to (7) "strongly agree". Cronbach's alpha is used to estimate the reliability of questions. As shown below, all measures display an acceptable level of reliability because α exceeds the threshold of 0.7 (Cronbach, 1951):

- knowledge reuse (KREU) explains the replication and adaptation of existing knowledge. In the present study, knowledge reuse construct is measured using three items ($\alpha = 0.759$) covering replication and adaptation activities adapted from Gray and Meister (2006);
- knowledge creation construct (KCREA) is measured using three items ($\alpha = 0.866$) related to creative problem-solving. Items are adapted from the original works of Denison *et al.* (1996; Tiwana and McLean, 2005);
- knowledge sourcing construct is measured using ten items related to groups, repositories and the Internet adapted from Gray and Meister's studies (2004 and 2006) as follows: group sourcing construct (KSG) is measured using three items ($\alpha = 0.811$); repositories construct (KSR) is measured using six items ($\alpha = 0.881$); and the Internet construct (KSI) is measured using two items ($\alpha = 0.733$); and
- learning orientation construct (LO) is measured using three items ($\alpha = 0.827$) adapted from Gray and Meister (2004).

3.3 Data analysis and results

Data were analyzed using partial least squares path modeling (PLSPM Version 2013), following the general procedures suggested by Chin (1998). PLS is suggested to be an alternative to structural equation modeling (SEM) because it places minimum requirements on measurement levels and is more suitable for large samples as well as small samples (Chin, 1998). PLS also qualifies to be appropriate for models with complex relationships (Fornell and Bookstein, 1982).

3.3.1 Testing the model. We first assessed the psychometric properties of the measurement scales in terms of convergent validity, discriminant validity and reliability using confirmatory factor analysis (CFA).

Measurement scales have good convergent validity if the factor loadings of the items exceed 0.60 on their corresponding constructs or the average variance extracted (AVE) of the construct exceeds 0.5 (Hair *et al.*, 2010). All items exceed the 0.60 threshold, indicating adequate convergent validity (Table I).

Table I Items and PLS factor loadings

Items	*Mean*	*KREU*	*KCREA*	*KSG*	*KSR*	*KSI*	*LB*
Knowledge reuse behaviors (KREU)							
My project group frequently experiments with proven solutions to resolve problems	5.150	**0.740**	0.079	0.145	0.157	0.029	0.146
My project group efficiently exploits existing ideas to resolve new problems	5.625	**0.912**	0.264	0.278	0.225	0.086	0.247
My project group frequently adapts existing solutions for resolving new problems	5.326	**0.763**	0.074	0.062	0.115	0.053	0.131
Knowledge creation behaviors (KCREA)							
My project group frequently experiments with new alternatives	4.933	0.199	**0.880**	0.195	0.161	0.217	0.270
My project group is highly imaginative in thinking about new or better solutions to resolve problems	5.317	0.200	**0.905**	0.262	0.195	0.196	0.328
My group project often invents new ideas to resolve non-routine situations	4.900	0.159	**0.879**	0.222	0.145	0.191	0.336
Knowledge Sourcing from the group (KSG)							
In my project group, we frequently discuss difficulties when we need to improve knowledge on issues related to the project	5.757	0.277	0.303	**0.886**	0.322	0.145	0.364
We frequently consult with my project group to improve knowledge on a topic or issue	5.657	0.181	0.186	**0.825**	0.297	0.140	0.304
We rarely use conversations in my project group to acquire required knowledge (r)	5.930	0.133	0.148	**0.842**	0.388	0.139	0.371
Knowledge Sourcing from repositories (KSR)							
In my project group, we often refer to available documents to learn more about a problem	4.619	0.147	0.109	0.240	**0.725**	0.297	0.188
In my project group, we often consult documents posted on the company's intranet	4.282	0.166	0.200	0.292	**0.779**	0.353	0.275
In my project group, we rarely consult available documents (r)	4.968	0.021	0.051	0.356	**0.699**	0.291	0.241
In my project group, we often consult knowledge-based systems to improve our knowledge on a topic or issue	4.716	0.263	0.217	0.340	**0.881**	0.317	0.336
In my project group, we often consult knowledge-based systems to find solutions for similar encountered problems	4.757	0.294	0.154	0.313	**0.866**	0.338	0.344
In my project group, we rarely consult knowledge-based systems (r)	4.915	0.083	0.130	0.341	**0.790**	0.324	0.258
Knowledge Sourcing from Internet (KSI)							
In my project group, we often consult documents available on the Internet	4.692	0.074	0.201	0.190	0.426	**0.916**	0.210
In my project group, we often consult community network sites on the Internet to find useful knowledge on a topic or issue	3.845	0.061	0.202	0.094	0.272	**0.857**	0.229
Learning behaviors (LB)							
In my project group, we prefer tasks that really challenge as so we can learn new things	5.147	0.260	0.311	0.342	0.275	0.157	**0.842**
In my project group, we often look for opportunities to develop new skills and knowledge	5.097	0.139	0.250	0.328	0.319	0.238	**0.841**
In my project group, we enjoy challenging work where we will learn new knowledge	5.097	0.206	0.343	0.382	0.318	0.240	**0.902**

Notes: KREU = Knowledge reuse behaviors; KCREA = Knowledge creation behaviors; KSG = Knowledge sourcing from the group; KSR = Knowledge sourcing from repositories; KSI = Knowledge sourcing from Internet; LB = Learning behaviors; (r) = Reverse-coded item

Discriminant validity is ensured when the square root of the AVE for every construct is greater than the inter-correlation estimates (Chin, 1998). The correlation matrix in Table II shows a good evidence of the discriminant validity.

The composite reliability scores for measurement scales range from 0.849 to 0.918 (Table II), exceeding the recommended 0.70 threshold, which indicates a good level of reliability (Hair *et al.*, 2010).

Finally, to address the common method variance (CMV) problem, we used Harman's (1976) one-factor test in an attempt to isolate the covariance due to artifactual reasons (Podsakoff and Organ, 1986). The rule of thumb is that a single unrotated principal component should not explain more than the threshold level of 50 per cent of the variance for all the indicators measured with the same method. Our results show an explained variance of 29.59 per cent indicating no concern with CMV.

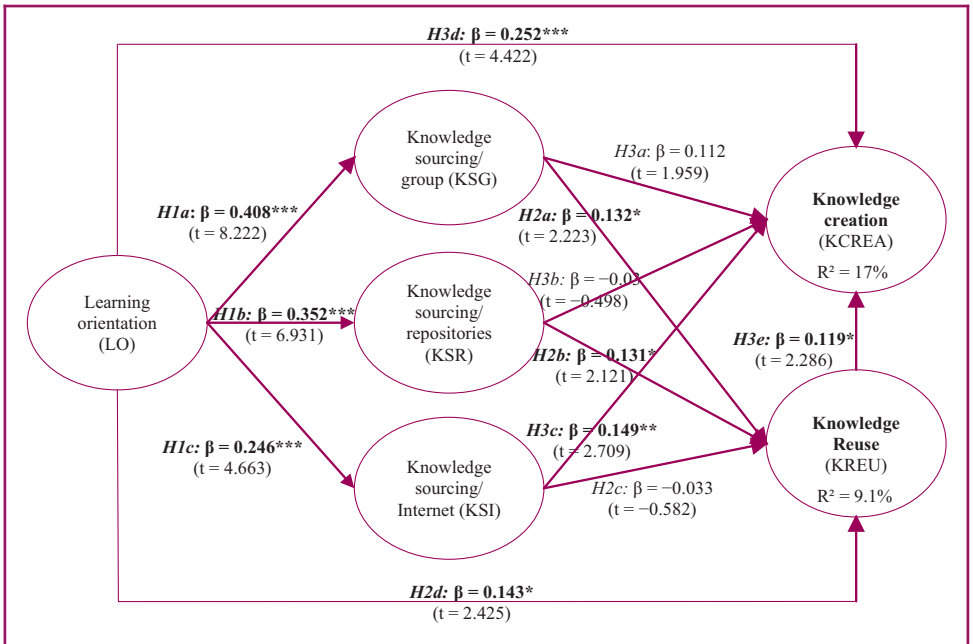
3.3.2 Results. As shown in Figure 2, the model accounts for 9.1 per cent of the variance of KREU and 17 per cent of the variance of KCREA. The goodness of fit value of the model

Table II Discriminant validity

Variables	*Composite reliability*	*Correlation of constructs*[a]					
		LB	*KSI*	*KSR*	*KSG*	*KCREA*	*KREU*
LB	0.897	**0.862**					
KSI	0.881	0.245	**0.887**				
KSR	0.910	0.352	0.403	**0.793**			
KSG	0.888	0.408	0.166	0.393	**0.851**		
KCREA	0.918	0.352	0.226	0.189	0.256	**0.888**	
KREU	0.849	0.235	0.077	0.220	0.237	0.210	**0.808**

Notes: [a]Diagonal elements are the square root of the AVE; KREU = Knowledge reuse behaviors; KCREA = Knowledge creation behaviors; KSG = Knowledge sourcing from the group; KSR = Knowledge sourcing from repositories; KSI = Knowledge sourcing from Internet; LB = Learning behaviors

Figure 2 PLS results



Notes: β represents standardized path coefficients; ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

(GoF) is 0.295, which exceeds the cut-off value of 0.250 for medium effect sizes of R^2 suggested by Tenenhaus *et al.* (2005), indicating satisfactory overall fit of our model.

The satisfactory overall fit of our model provides confidence in our results. Figure 2 supports the importance of the team members' learning orientation in increasing their knowledge sourcing from groups (*H1a*), repositories (*H1b*) and the Internet (*H1c*). Furthermore, sourcing knowledge from groups (*H2a*) and repositories (*H2b*) has increased knowledge reuse compared to the Internet (*H2c*). Conversely, sourcing knowledge from the Internet has increased knowledge creation (*H3c*) than sourcing knowledge from groups (*H3a*) and repositories (*H3b*). Learning orientation has a strong effect on knowledge creation (*H3d*) than on knowledge reuse (*H2d*). These results support the hypothesis that knowledge reuse has increased knowledge creation (*H3e*) among the team members with a strong learning orientation.

4. Discussion and implications

The present research examines the following question: what motivates project team members to source knowledge and how it increases their reuse and creation outcomes?

To address this question, we adapted a model based on knowledge sourcing perspective by considering learning orientation as a motivational input that inspires the team members to initiate knowledge sourcing process, which results in various performance outcomes (Khedhaouria and Ribiere, 2013).

The first finding highlights that knowledge reuse and creation outcomes result from various knowledge sourcing methods. Group knowledge sourcing and repositories are more appropriate to increase knowledge reuse, while the Internet is more effective to increase knowledge creation (Gray and Meister, 2006). Interestingly and somewhat contrary to prior research, group knowledge sourcing has no effect on knowledge creation (Farr *et al.*, 2003; West, 2002). Farr *et al.* (2003) argued that an "optimal" level of knowledge diversity exists for a given task that will encourage creativity through enhanced task performance capabilities, varieties of perspectives and approaches to problems and constructive conflict. Too little diversity among the team members leads to conformity and common approaches to solve problems. However, too much diversity (or insufficient overlap in knowledge and skills) among the team members may result in disparate mental models and poor levels of coordination and communication that, in turn, slow down creative outcomes. Thus, diversity is likely to have a curvilinear relationship with group processes that mediate its link with creative outcomes. Furthermore, it is suggested that the role of the team leaders is critical to manage diversity and to facilitate creativity among the team members (Aubry and Lièvre, 2010; Egan, 2005; Pitrola-Merlo *et al.*, 2002; Strang, 2010; Turner and Müller, 2007). These arguments indicate that further research is needed to clarify the influence of team diversity and leadership on knowledge creation.

The second finding reveals that learning orientation is the main driver for knowledge sourcing, reuse and creation within the project teams (Edmondson, 1999). Learning orientation encouraged the team members to access knowledge from various sources, such as groups, repositories and the Internet. Learning orientation has a high effect on knowledge creation outcomes ($\beta = 0.252$, $p < 0.001$). This emphasizes the role of learning orientation in motivating the team members to source knowledge from the Internet to learn about problems and to create new solutions. Team members with high motivation activated their cognitive structures to explore and create entirely new solutions (Amabile, 1993). Nevertheless, learning orientation has less effect on knowledge reuse ($\beta = 0.143$, $p < 0.05$). This emphasizes that the team members with low motivation activated their cognitive structures to replicate and adapt existing solutions to their problems (Farr *et al.*, 2003).

The third finding highlights that replication and adaptation of existing knowledge can increase knowledge creation. This finding reinforces our argument about the importance of learning orientation. Team members with a strong learning orientation will activate their

cognitive structures to replicate and adapt existing knowledge in new contexts, which results in creative outcomes (Majchrzak *et al.*, 2004). Furthermore, the accumulation of knowledge stored in team members' memories expanded their creative cognitive structures (Moreland and Myaskovsky, 2000).

Our findings have interesting implications for both theory and practice.

4.1 Theoretical implications

From a theoretical perspective, the articulation between knowledge sourcing, reuse and creation has received little attention in the KM literature. Most studies have investigated KM on supply-side to make knowledge available to the team members when they need it. However, making knowledge available does not guarantee its use but rather understanding what motivates the team members to source knowledge can enhance its reuse and creation.

First, our study clarifies the importance of knowledge sourcing in increasing knowledge reuse and creation outcomes. This is an important contribution because it highlights the fact that knowledge reuse and creation can be managed through different sources of knowledge: group knowledge sourcing and repositories increase knowledge reuse, while the Internet increases knowledge creation. This result can be helpful to answer the question on how knowledge can be reused and created (Majchrzak *et al.*, 2004; Markus, 2001). Second, our study emphasizes the critical role of learning orientation in increasing knowledge sourcing, reuse and creation outcomes. It has been observed that many team projects fail to develop successful innovations (Khedhaouria *et al.*, 2014; Sarker and Lee, 1999), suggesting that this may be due to a lack of motivation among the team members. Team members are more likely, and willing, to source the required knowledge when they are motivated to learn within the team project. Finally, our study demonstrates the importance of knowledge reuse in stimulating creation outcomes. Knowledge creation has been often examined in KM literature as distinct from knowledge reuse and it needs exploration capabilities that are different from exploitation capabilities (Markus, 2001). Our study demonstrates that knowledge reuse can increase knowledge creation when the team members are motivated to learn within the project. This finding is particularly interesting for team projects because it emphasizes the importance of learning orientation in stimulating creative cognitive structures through either the exploration or the exploitation of knowledge (Aubry and Lièvre, 2010; Kostopoulos and Bozionelos, 2011).

4.2 Practical implications

From a practical perspective, our findings can be helpful for the team leaders to manage existing knowledge. Understanding how knowledge is sourced, reused and created might help identifying ways to enhance knowledge reuse and creation outcomes. First, our study highlights the importance of group knowledge sourcing and repositories in increasing knowledge reuse. Thus, the team leaders should guarantee the work team effectiveness by ensuring diversity of knowledge and skills among the team members, clarifying and ensuring commitment to team objectives, managing conflict effectively, developing intra-team safety, reflexivity and developing team members' integration skills (West *et al.*, 1998). As technical support knowledge repositories provide useful knowledge that can be reused, the team leaders should ensure that knowledge is properly indexed and easily searchable (Davenport and Klahr, 1998). Second, our study emphasizes the critical role of the Internet, such as online communities, in enhancing teams' knowledge creation behaviors. For the team leaders integrating a crowdsourcing approach into their innovation process may contribute to enhance creative contributions (Brabham, 2008). Another approach is to integrate users as co-creators in the innovation process (Füller *et al.*, 2009). Inviting users to participate in the creation of new products is considered as a suitable means in generating and evaluating new product ideas. Finally, our study emphasizes the critical role of learning orientation in increasing knowledge sourcing, reuse and creation.

For team leaders supporting a climate that encourages open discussion of problems, mistakes and errors is a necessary condition for ensuring learning to occur in teams (Edmondson, 1996). Team leaders should ensure that some team members possess a strong learning orientation (i.e. assessed through learning style tests or by previous observations); it is likely that these members will explore new avenues of bringing new knowledge to the team (Farr *et al.*, 2003).

4.3 Limitations and conclusion

The present study has a number of limitations that needs to be addressed in future research.

First, although a substantial amount of variance of KREU and KCREA can be explained in the model, the explanatory power could be improved. Many antecedents of knowledge sourcing are not included in the present study. For instance, group characteristics, such as the intellectual demands and project complexity (Gray and Meister, 2004), and risk aversion (Gray and Durcikova, 2005) have been shown to influence knowledge sourcing, reuse and creation behaviors. Further studies are needed to replicate our model and introduce other group characteristics to improve the explanatory power of KREU and KCREA.

Second, although our measurement strategy is unlikely to suffer from common method biases, more research is warranted (Podsakoff *et al.*, 2003). In particular, the data collection instrument makes use of self-reported measures. Self-reported measures based on perceptions may lead to biases, especially when data are collected at the same point in time. To overcome this issue, future research should collate different measures spread over time or use separate primary and secondary observations.

Third, our conceptual model does not take into account the specificity, the complexity and the characteristics of the team projects (Garel and Lièvre, 2010; Aubry and Lièvre, 2010). To overcome this limitation, further research is required for in-depth explorations.

Despite these limitations, our findings reveal some interesting patterns that merit replication to better understand what motivates teams to source the required knowledge and how it increases their reuse and creative outcomes. Understanding how knowledge is reused and created within teams may help identifying ways to facilitate knowledge reuse and creation, which contributes to enhance innovations. Our research has offered evidence that knowledge sourcing methods (i.e. group knowledge sourcing, repositories and the Internet) produce different performance outcomes (i.e. knowledge reuse and knowledge creation). Our research provides insights on how the team leaders should manage existing knowledge to increase its reuse and creation.

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