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Research paper

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Abstract

The aim of this research is to explore how knowledge is shared from a participant's perspective within a collaborative project in university-industry collaborations in Australian IT-related faculties. A case study using the three parts of Nonaka's theory of knowledge creation was carried out. Semi-structured interviews, participant observation, and document analysis were conducted for data collection to study the ways in which researchers and industry representatives within these partnerships share information and knowledge. The findings showed that based on the continuum of tacit and explicit knowledge, there are five knowledge-sharing mechanisms including reactive, articulate, sequential, accumulate, and transfer in this socio-technical collaborative project. Researchers and industry representatives experience a variety of challenges during these mechanisms such as language failure, different work routines, different organisational cultures, and difficulty in tele-communication, mutual understanding, working hours and research aims. Also, further drivers for these mechanisms are identified, such as interest in research, mutual benefit and partner's needs.

Keywords: knowledge-sharing mechanisms, socio-technical collaborative project, knowledge creation theory

1 Introduction

Knowledge-sharing is an important but complex process in university-industry engagement (Alavi and Leidner 2001). It comprises capturing, disseminating, transferring, and applying useful knowledge, and is a strategic issue for universities as it can be a source of funding, and for industrial organisations as a policy tool for economic development (Nemati-Anaraki and Heidari 2014). Commercialisation and academic engagement can result from collaboration and partnerships between university and industry, and so play an important role for knowledge sharing. The range of knowledge sharing activities, including commercialisation or technology transfer and academic engagement, represents the channels or mechanisms through which the knowledge is transferred between the partners. The existing literature focuses on the full range of channels through which university researchers interact with industry and analyses them as mechanisms of knowledge exchange. Most of these studies focus on academic patenting behaviour and publications (D'Este and Patel 2007, Hermans and Castiaux 2007). The review of the literature found that limited studies focused on a single mechanism of knowledge sharing activities, examining knowledge-sharing practices in-depth with academic/industry researchers as the unit of analysis.

From a knowledge creation perspective, knowledge-sharing in university-industry engagement is seen as problematic for three main reasons: characteristics of universities, characteristics of industries, and socio-cultural differences between university and industry (Pineda et al. 2009). Universities have collaborated with industry partners in various forms such as joint research projects, contract research and

technology-related consulting, joint supervision of PhD and Master Theses by university and firm members, the mobility of university researchers into private firms, vocational training for employees, use of intellectual property rights (IPR) by public scientific organisations, spin-offs, and informal contacts and personal networks, patents, or other forms of knowledge exchange (Polt et al. 2001, Khan 2015, Fernández-Esquinas et al. 2015, Schartinger et al. 2001, Perkmann et al. 2013). Since person-to-person interactions are the bedrock for this collaboration, several factors can enable or make barriers for this interaction such as leadership, communication, mutual trust and commitment, culture, and adequate resources (Ankrah and Omar 2015). Knowledge-sharing processes are problematic, and the collaboration level between researchers and industry in Australia is low with "Australia ranking 29th and 30th out of 30 OECD countries in the proportion of large businesses and SMEs collaborating with higher education and public research institutions on innovation" (Department of Education and Training 2014).

Nonaka's theory of knowledge creation is commonly used in inter-organisational and intra-organisational context. The interpretations of this theory have changed considerably based on different contexts. This research explores this theory to show knowledge-sharing mechanisms that consider socio-cultural differences between university and industry. The modified model consists of three components: SECI, Ba, and knowledge assets. These components act dynamically together, but each component shows a different process of knowledge-sharing. The SECI process forms the basis of how knowledge is shared; Ba forms the basis of where and when (space and time) knowledge is shared; and the knowledge assets are the basis of what knowledge is shared (Nonaka 1994, Nonaka and Konno 1998, Nonaka et al. 2000) (see Table 1). Current studies have typically focused on only one part of knowledge creation theory, either SECI (Lilleoere and Hansen 2011, Jin and Yaqi 2011, Hermans and Castiaux 2007) or Ba (Hautala 2011, Brännback 2003, Brännback et al. 2008) as a theoretical framework for exploring knowledge-sharing practices. However, this research considers the whole of Nonaka's theory for exploring knowledge-sharing mechanisms based on individuals' acts and their purpose in knowledge sharing in an Australian context.

The study addresses a high-level need by exploring knowledge-sharing mechanisms in a collaborative research project in an Australian context, and by looking at the ways in which researchers and industry representatives use different tools and techniques within these partnerships to share information and knowledge. Viewing knowledge-sharing mechanisms from an actor's perspective may help university and industry to reflect on their own characteristics of collaboration and create more flexible solutions. It will assist universities and industry to better understand their potential differences. Furthermore, research findings will provide industry and universities with guidelines through which they can discover new opportunities to facilitate knowledge-sharing among actors. That, in turn, could improve collaboration between universities and industry in the information systems (IS) discipline.

This research uses a case-study approach to explore knowledge-sharing mechanisms. It uses a project, PROTIC, that is investigating information system design and socio-technical questions related to the adoption and re-adaptation of new technologies from researchers and industry representative's perspective. It focuses on a collaborative project as one form of university-industry collaboration that emerges as a results of person-to-person interactions by answering the following research questions.

- How is knowledge shared in collaborative project of IT-related faculties in Australia?

- What are the drivers and barriers in the knowledge-sharing mechanisms of this project from participants' perspective in Australia?

2   Research methodology

This research is exploratory research within the interpretive paradigm. Since this study looks at participants' viewpoints and experiences in regards to knowledge-sharing, it is qualitative in nature. Among different ways to conduct qualitative studies, a case study is a suitable research strategy for studying the phenomenon in its context. It also gives more advantages when the theoretical refinement of a concept such as knowledge creation theory is applied as a lens of analysis (Yin, 1994). Given that in

the context of exploratory research, studying one case in-depth can be enough to explore the relation between different elements of the theoretical framework and clarify its applicability, we decided to use a case study method with in-depth analysis.

For the purposes of this study, semi-structured interviews, participant observation and document analysis were adopted as a data collection method. Minutes of the meetings, official reports, and any documents related to the project, which we had permission to access, were resources for document analysis. In order to observe participants, the interviewer's role was as an observer who recorded information and processed it as it occurs in order to explore the relation between what participants say and what they actually do.

Participants were asked about what sort of knowledge they share, how they share knowledge, how they create shared collaborative spaces, which spaces or tools do they prefer for knowledge sharing, limitations/difficulties in sharing knowledge, and what are the drivers to knowledge sharing. Two interviews were conducted over Skype and Zoom and recorded using software recorder, six interviews were conducted at Monash University during normal working hours. The duration of interviews ranged from 35 to 80 minutes. The recorded interviews were transcribed verbatim and then entered into the qualitative data analysis software NVivo 11. In this paper, participants are identified by codes: e.g. M1=Monash Researcher 1; OA= Oxfam Australia; OB= Oxfam Bangladesh.

Thematic Analysis was selected for data analysis. There are two basic approaches to Thematic Analysis including theory-driven (Terry et al. 2017) and data-driven (Terry et al. 2017, Creswell 2013). The data-driven approach was used to see what emerged from the data. The transcriptions were initially coded without considering literature, the Nonaka's conceptual frameworks are presented in Table 1, or the research questions.

Data was coded with exact words used by participants rather than pre-existing codes. After initial coding, the codes were reviewed to modify and remove duplicate codes.

 In understanding the emerging themes, the literature, conceptual frameworks, and the research questions were consulted. Therefore, the codes and themes were determined by a mix of data-driven, based on familiarisation with the data, and theory-driven, based on literature, conceptual framework, and research questions to improve the level of robustness.

In total, 250 open codes were derived from data. In the second phase, after reviewing the codes, the cods were reduced to 150. Finally, it reduced to 130 after consulting with conceptual framework (Table 1) and research questions. For theme identification, 130 codes were grouped together to develop themes according to their content similarity, theoretical links, and their frequency of occurrence. The extracted themes reflect active 'actors perspective and experience of how knowledge is shared. The final analysis revealed five themes (Reactive, Articulate, Sequential, Accumulate, and Transfer) that depict how academics and industry representatives share knowledge in particular and will be explained in section 4-1. These themes were defined and reported as preliminary findings of the research. The complete results will be reported after applying second round of interviews, document and observation analysis.

Element	Dimension	Example
SECI	Socialization	Mentoring and apprenticeships
	Externalization	People be helped to form impressions of what they know "based on imagination and intuitive learning through symbols" "metaphors create networks of related concepts as prototypes to facilitate the ability to understand abstract, imaginary concepts"
	Combination	It may occur in planning strategies and operations, assembling internal and external data by using published literature, computer simulation and forecasting
	Internalization	This is an active process of learning in which people learn "through interaction and a process of trial-and-error"
Ba	Originating	Face-to-face
	Interacting/ Dialoguing	Peer-to-peer
	Cyber/ systemising	Group-to-group
	Exercising	On-the-site
Knowledge assets	Experiential knowledge	• Skills and know-how of individuals • Care, love, trust, and security • Energy, passion, and tension
	Conceptual knowledge	Explicit knowledge articulated through images, symbols, and language • Products concepts • Design • Brand equity
	Routine Knowledge	Tacit knowledge routinized and embedded in actions and practices • Know-how in daily operations • Organisational routines • Organisational culture
	Systemic Knowledge	Systemised and packaged explicit knowledge • Documents, specifications, manuals • Database • Patents and license

Table 1. Elements of Nonaka's theory of knowledge creation (conceptual framework) ((Nonaka and Konno 1998, Nonaka et al. 2000, Nonaka and Toyama 2003)

3 The Case Study: PROTIC

PROTIC (Participatory Research and Ownership with Technology, Information, and Change) is a 5-year collaborative project between Monash University, Oxfam Australia, and Oxfam in Bangladesh (Sarrica et al. 2017). It was launched on June 7, 2015. This project is investigating information system design and socio-technical questions related to the adoption and adaptation of new technologies. PROTIC is a Participatory Action Research (PAR) project, and the outcomes are expected to include recommendations on managing PAR projects and documentation on developing information management systems for resilient farming in Bangladesh. One hundred smartphones and phone credit have been given to women farmers in each of two villages in Bangladesh. Access to a phone provides benefits for women farmers in numbers of ways. Trained women are able to interact with agricultural information via smartphones concerned with crop, rice cultivation, fisheries, livestock, poultry, and general horticulture. This information is provided by commercial telecommunications companies. Women have access to SMS services and a call centre if they need more information.

The PROTIC research team is split between Australia and Bangladesh. Monash University, located in Melbourne Australia, is responsible for the governance of the project and designing and undertaking research. Three academics are involved with the project, as well as two part-time post-doctoral researchers and five doctoral students. A research associate from the Faculty of Communications Science, Sapienza University of Rome is also engaged in the project. The researchers do not speak Bengali, however, four of the PhD students are Bangladeshi. Oxfam Australia is responsible for administrative aspects of the project, including contract management. There are two staff involved. Oxfam Bangladesh is responsible for field implementation. They manage and give direction to the implementation of the project in Bangladesh. In particular, they work with a number of partners, including three local non-government organisations, a commercial telecommunications company, and a number of Bangladeshi Universities.

The seniors' managers of Oxfam and all academics were interviewed. In total 8 participants were interviewed. Five from Monash, one from Oxfam Australia and two from Oxfam Bangladesh.

4 Preliminary findings

Interview transcriptions was analysed to determine what kinds of information and knowledge project members share during this project. In order to do this, the tacit and explicit classification of knowledge (Polanyi 1967, Nonaka 1994) was used as a guide to analyse and interpret the findings of the study. Tacit knowledge is difficult to express and therefore it is difficult to share. It includes "insights", "intuitions", and "hunches" (Becerra-Fernandez and Sabherwal 2014). In contrast, explicit knowledge can be expressed in a variety of forms such as data, manuals, patents, and computer programs. Therefore it can be shared easily. The thematic analysis of the participants' responses to the interview questions indicated that academics and industry representatives shared various types of both explicit and tacit knowledge during a collaboration. They shared content through the proposal, research agenda, formal minutes, questionnaire, memos, comments, report, writing a paper, and presenting in a conference. These could be considered as an explicit knowledge. Examples of tacit knowledge in this project could be social and cultural knowledge of Bangladesh that can be reached through discussions and interviews with women on the ground and industry representatives in Bangladesh; knowledge about how they do survey and how they conduct a project such as organising things, visas, travel, setting up meetings and sorts of thing; experiences of academics about methodology, consultation meeting, personal experiences and theoretical insights.

In summary, the finding showed that academics and industry representatives share a continuum of tacit and explicit knowledge during collaboration through various types of knowledge.

4.1 Application of the knowledge creation model to the knowledge-sharing mechanisms identified

This section considers the first research question and reveals participant perspectives as to how they derive knowledge from the project and from each other. Based on the thematic analysis of interview data and through the lens of Nonaka's model, I have identified five context-specific knowledge-sharing mechanisms: Reactive, Articulate, Sequential, Accumulate, and Transfer. The continuum of tacit and explicit knowledge was the underlying resource for each mechanism. These represented in the diagram in Figure 1, I will explain more in depth following (see Figure1).

Knowledge sharing through Reactive mechanism: Academics and industry representatives learn from each other and react through the exchange of experience. It can happen between academics themselves when they start to talk about their theoretical knowledge, or when they try to talk and implement this knowledge in the field, or it can happen when they share their personal knowledge about organisational, cultural and social knowledge about Bangladesh. Project members gain tacit knowledge of the characteristics and requirements of the project, field, and theoretical background through socialisation. Face-to face interactions are underlying components for this mechanism. Although the structure of the project is complex, and it is difficult for them having face to face meeting, they prefer to socialise in physical places at the first stage. Sharing information and knowledge mostly happens in the design stage of the project like designing a new survey instrument or new set of questions. Knowledge sharing is relatively straight forward in Monash University between academics. They are trying to have regular meeting with an individual researcher in Italy and industry representative in Bangladesh. There are two pre-established meeting that everyone must attend. One is the steering committee meeting that is run about once a month. It can be done through Skype and the other is the Governance committee that is run every six months and everybody must attend it is knowledge about the high level of project management.

As two participants stated:

> Okay in terms of designing projects, I think you have to add links always and different tools would have various structures and weaknesses but I think face to face meeting are always important (M1).

> With the Bangladesh the best time is when we sit together meetings, face to face, it is a best effective way. And with [researcher in Italy] face to face most effective way. I went to Italy. And we worked in June and we worked for two weeks. I am going to back again and we sit to write article (M2).

Care, trust and commitment are outputs of this mechanisms emotional knowledge. As one of the participant observed,

> When the situation arise we have to be careful and go through the documents, go lots of drafts; make sure everybody is getting what they need (M1).

> And also large part of it is creating documents like some survey questions, some interview questions, and going to drafts to sure everybody is happy (M1)

The academics and industry representatives trust each other's knowledge in this mechanism. They trust each other because they rely on their partner's knowledge. One interviewee strongly supported the idea of trusting their partner's knowledge.

Project members talk more about "we". It shows their commitment to each other and the project. Academic and individual researcher are socially close to each other, which indicates their mutual understanding of the phenomena under research.

> We work on it together. We sit down here and say what information we want from them we want because Oxfam has some information that he wants. We have some information that we want. So there is base line survey we both contributed to that. So we talk people in Oxfam Bangladesh to get social, cultural knowledge from them (M1).

>   We are very collaborative I think we got a good friendship circle it is been developed over many years (M2).

In addition to care, trust and commitment, being open and respectful can appear in this mechanism. Project members mentioned that being open to accept new ideas is another characteristic in sharing and creating knowledge within the project.

>   of course every day you have to get be open it is challenging it is maturing it is coming more mature except criticisms reviews you suffer from, yes of cures so like [researcher] being involved he knows all stuff we are judging knowledge about it is wonderful but I have got him with other stuff that is what academics have to be is open there is a no one exact way so in the research method book sometimes a little bit too like this we suggest ideals , ideal types , there is always new data like you know a story of Black swan (M2).

Reactive mechanism happens through socialisation process in originating Ba of the Nonaka's Knowledge creation model (see Table 1). In Nonaka's model, socialisation typically occurs in a traditional apprenticeship and mentorship in organisation while PROTIC's member socialised through observation and discussion in physical or virtual collaborative spaces (Figure 1). Face-to face interactions are underlying components for them. However, they socialise mostly virtually because of the scatter nature of the project. Mutual trust is created during socialisation process based on Nonaka's model, while in PROTIC, building a trust is not main challenge for project members. They relied on partner's abilities and knowledge.
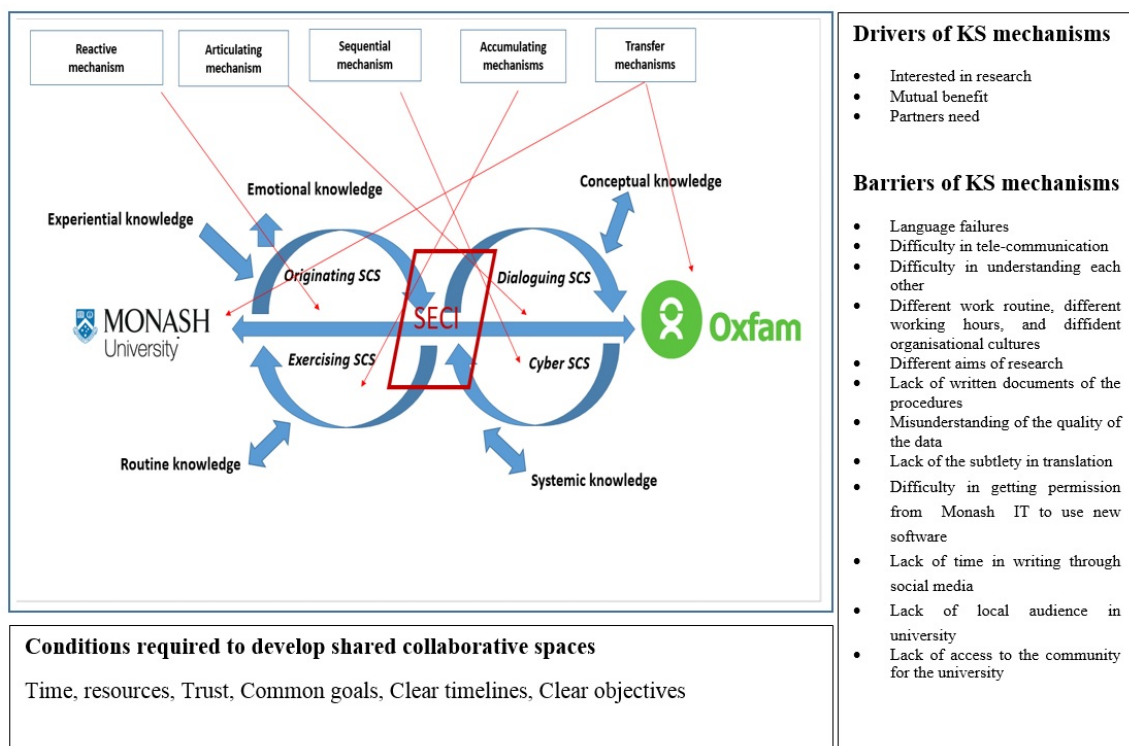

Figure 1: Application of the knowledge creation model to the knowledge-sharing mechanisms

Knowledge sharing through articulate mechanism: In this mechanism tacit knowledge is crystallised and articulated into explicit forms. Members of the project are able to externalise new explicit knowledge through activities such as writing papers. For example projects members after talking about theoretical, social and cultural knowledge and based on their conversation and exchange of knowledge in the socialisation mode started to write journal articles or articulate the process of the implementation in the field. This leads to documenting project objectives, designing interview questions, and capturing community requirements and characteristics. As one participant described it,

> We also write the report and we write the report and generally speaking because we are interested in the theory and they are interested in practical outcomes. They write the reports they evaluated the practical side of the project. What is happened? How information system been used? Things like that and we write journals articles to explore the theories. And then we share them. We had been involved in everybody has been involved in one or another those things but it is Monash does much more in theory and Oxfam does more in practical. Um and Oxfam Bangladesh also had commission have a report like that and evaluation report and they have shared with us and jointly we decide what data needs to be collected, surveys or interviews in the fields and whatever (M1).

This mechanism corresponds to Externalisation process of Nonaka's model which takes place in Dialoguing Ba (see Table 1). Tacit knowledge articulated into explicit knowledge through symbols in externalisation. In Nonaka's Model, metaphor, analogy, and model are used to impress tacit knowledge of people (Nonaka et al. 2000). While in PROTIC, writing a journal article, documenting project objectives, designing interview questions are means for converting individuals' skill. Like Nonaka's model, peer-to-peer interaction is bedrock for crystallising knowledge into common terms that mostly happens in dialoguing shared collaborative spaces (see Figure 1).

Knowledge sharing through Sequential mechanism: In this mechanism, explicit form of knowledge are created sequentially. This can be done through breaking down concepts or combining the separate explicit knowledge. During the collaboration, different versions of survey questions, interview questions, drafts of the journal papers are created based on the first draft which emerged in the articulated mechanisms. In this mechanism, common terms and concepts are negotiated and renegotiated in project management via physical meetings and communications technologies, such as Skype, email, and phone. Virtual collaborative share space plays an important role. Because of the scatter structure of the project and distance, project members prefer to use skype for a regular meeting and email for sharing documents and files. They supposed to use Zoom, but because of the bandwidth problem, they prefer to use Skype because they got a bit better results in using skype.

Examples of interview content are:

> we are also learning from here, but he, I mean, whole, academia is also learning that, it's, it's a, I mean, development is not only the theory, development also is the [crosstalk 00:44:13] Practice (OB2).

> I mean, somehow, we need to negotiate. like when you see any of the report, if it is not very much on the table for the practitioner, uh, then uh, they know uh, meaning of having benefit or there is no benefit. So, from your side, you have to negotiate, you have to also change your narratives and also you have to change your thinking and also language and presentation (OB1).

Sequential mechanism matches Combination process which happens in systemising Ba of Nonaka's Model (see Table 1). This mechanism happens in cyber collaborative spaces (Figure 1) where different version of explicit knowledge such as survey questions, interview questions, and journal based on discussion and revision can emerge sequentially by each of the project's member and disseminate between them. However, in Nonaka's model, after emerging a new explicit knowledge by managers, they disseminated to groups of people in the organisations.

Knowledge sharing through Accumulate mechanism: In this mechanism, the explicit knowledge is accumulated in individual mind after discussion and feedback. Explicit knowledge such as survey questions, interview questions, journal paper and theoretical frameworks are discussed among projects members. Based on the discussion, they decided to act in the field. In other words, action and practice are results of this discussion. Learning and training are fundamental in this process. It can happen through shared space like in workshop or it can happen through reading and discussing on journal paper. Discussion and reflection lead to internalising the explicit knowledge in the individuals mind and creates a basis for new steps in the project. Holding workshops are another example of internalisation in this Project. Local organisations are trained in PAR and how they can apply in the project; how to

do the survey; how to do the interviews. When this knowledge is embodied as individual tacit knowledge, it creates a basis for the project because accumulated tacit knowledge in the individual mind is the new start of a knowledge creation spiral. As explained by two participants,

> That is a project continue we realised that everybody was new to this area. The local people, the local NGO, they are not doing very well. So that point we said okay obviously everybody needs more training what we can do so we found the other person who works for research institutes Bangladesh and who is specialised in PAR and they gave we got them to have workshops to everybody in Bangladesh in PAR methods (M1).

> And then internally, we or, organize seminars. Uh, so through the seminar, uh, app, we actually uh, place this knowledge uh and learning and other team also, I ask other team that how do we actually going to use this knowledge? Because this is making some kind of benefit. This is also contributing this way to being changed. So, I mean, these plan, from your perspective, how are we actually going to use the knowledge? Or how do you, going, you are going to use the uh, practice (OB1).

Accumulate mechanism represent Internalisation process of Nonaka's model which occurs in exercising Ba (see Table 1). In internalisation, individuals absorb explicit knowledge via virtual media such as written manuals, teleconferences, or simulation and then convert it to tacit knowledge. At first, transcendence and explicit knowledge are synthesised, and then, they internalised in individuals as tacit knowledge through action (Nonaka et al. 2000). However, in PROTIC, the explicit knowledge is accumulated in individual mind after discussion and feedback in exercising shared collaborative spaces. Same as Nonaka's model, action and practice are fundamental for this mechanism.

Knowledge sharing through Transfer mechanism: This mechanism occurs when knowledge was transferred from the project to the organisation (Oxfam and Monash). Also Monash is producing some research in response to Oxfam particular problems. The outcome of these kind of research needs to transfer to Oxfam. For example, there are number of research questions that PhD students need to explore.

> I think that there will be a lot that come out from the PhDs, and hopefully from before - you know, as we discussed before, hopefully more of these new ideas and nights could be shared before the completion of the PhDs, but maybe on an annual basis (OA)

The knowledge produced in this project can be considered as a base for other similar projects under the ICT umbrella. Holding seminars and workshops are mentioned as a means of knowledge transfer from the project to partners.

> In [……..] project we have been developing based on the ICT and PROTIC knowledge. So it's like, it's helping other, interventions to shaping up from the ICT perspective. So it's happening through seminar, discussion, bilateral dialogue, something like that (OB1).

> I mean, sharing with the Monash, actually, in a governance community meeting, we actually, sharing our, expert ... Like, started I shared some of the experience, and case study. So this is the only way. And then also we are sharing like today, we did some kind of seminars, so this is one of the way we are sharing. And, in this kind of discussion, I had, this is a hard time area (OB2).

Transfer Mechanism can happen concurrently in originating, dialoguing, cyber, and exercising shared collaborative spaces that SECI is base for them. It is not exactly match with Nonaka's model. It is worth noting that this finding is preliminary and more details will be provided in a complete paper after analysis is finalised.

5   Discussion

Five context-specific knowledge-sharing mechanisms based on our preliminary analysis were identified. They were labelled: Reactive, Articulate, Sequential, Accumulate, and Transfer. All of these mechanisms lead to knowledge creation in this project. In the Reactive mechanism, knowledge is shared by exchanging experiential knowledge of the active actors. Face-to face interactions were the underlying component for this mechanism. A study by Lilleoere and Hansen (2011) show that face-to-face interactions which took place at formal, scheduled meetings, such as brainstorming meetings, was an important element in reactive practices in pharmaceutical research. In similar vein, there were different ways for know-how transfer mechanisms in franchise networks, such as initial training sessions, discovery sessions, ongoing training, regional meeting, committees, informal personal contacts, and on-field consultants where the face-to-face interaction was a base for them (Perrigot et al. 2017). Building trust was a barrier to overcome for sharing Know-how in the franchise network (Cumberland and Githens 2012). However, in this project, it is not a big challenge because academics and industry representatives rely on each other's knowledge. In the Articulate mechanism, project members externalise new explicit knowledge based on the conversation they had in the reactive mechanism stage, such as writing papers, but in the franchise network, the franchisor's tacit knowledge turns into explicit knowledge via documents such as operation manuals (Perrigot et al. 2017).

In the study by Amin and Cohendet (2004) sharing goals, passions and routines was mentioned as a basic unit for knowledge creation. In this research, six basic conditions including time, resources, trust, common goals, clear timelines, and clear objectives were found to create shared space through which knowledge can be shared effectively and easily. The preliminary finding revealed that active actors (researchers and industry representatives) experience some challenges when they shared knowledge. The major challenges included: Language failures, difficulty in tele-communication, difficulty in understanding each other, different work routine, different working hours, different organisational cultures, different aims of research, lack of written documents of the procedures, misunderstanding of the quality of the data, lack of the subtlety in translation, difficulty in getting permission from Monash IT to use new software, lack of time in writing through social media, lack of local audience in the university, and lack of access to the community for the university. Active actors also mentioned that interest in research, mutual benefit, and partner's needs are drivers and this needs to be reflected in the Knowledge-sharing mechanisms.

6   Conclusion

The purpose of this paper was to identify different mechanisms of knowledge-sharing in socio-technical collaborative project in Australia where the current collaboration level between university and industry is weak. Nonaka's framework was adapted to describe the communication and interaction within the project to depict knowledge-sharing mechanisms and present attributes affecting its components in PROTIC context. In answering the first research question, the preliminary findings of study by using Nonaka's theory of knowledge creation showed that five mechanisms (Reactive, Articulate, Sequential, Accumulate, and Transfer) for knowledge-sharing can emerge within this interaction based on participants who have different experiences, ideas, skills, passions, and tensions and cultural conditions of the partners. In response to the second research question, there were a variety of challenges during these mechanisms such as language failure, different work routines, diffident organisational cultures, and difficulty in tele-communication, mutual understanding, working hours and research aims. However, on the positive side, drivers such as interest in research, mutual benefit and partner's needs, were also identified. Having identified these five mechanisms, now I am in the position to do the next stage of the research which is to back again to Nonaka's model to examine these five mechanisms in align of its dimensions. It will enable me to suggest effective ways of communications in the specific context of the collaborative project. I, also, acknowledge that the findings presented are preliminary and based on interview data. My future work includes further data analysis and data collec-

tion from document analysis and observation in order to expand the responses to research questions and to validate the findings.

7   Acknowledgement

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