An exploration of knowledge articulation in teams within project-based organisations

By

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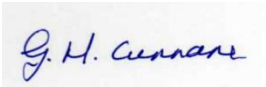
Ethical Declaration

I declare that this thesis is wholly my own work except where I have made explicit reference to the work of others. I have read the DBA guidelines and relevant institutional regulations and hereby declare that this thesis is in line with these requirements. I have discussed, agreed, and complied with whatever confidentiality or anonymity terms of reference were deemed appropriate by those participating in the research and dealt appropriately with any other ethical matters arising. I have uploaded the entire thesis as one file to Turnitin on Moodle, examined my 'Similarity Report' by viewing the detail behind the overall 'Similarity Index', and have addressed any matches that exceed 3%. I have made every effort to minimise my overall 'Similarity Index' score and the number of matches occurring.



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Abstract

Articulation is considered central in the conversion of tacit to explicit knowledge during knowledge sharing. However, existing literature provides limited insights into how knowledge articulation takes place and the types of mechanisms used to help convert tacit into explicit knowledge. This Doctorate of Business Administration (DBA) study explores knowledge sharing and articulation in project teams in a Project-Based Organisation (PBO). It aims to understand the articulation process, focusing on the mechanisms used during the articulation process. This study is exploratory and seeks to understand the research aim through the lens of the externalisation mode of Nonaka's (1994) knowledge creation theory. The research design employed is qualitative: 26 interviewees were conducted with project team members and documentation relevant to the organisational context and knowledge sharing were reviewed.

The study finds that the context surrounding how explicit knowledge is shared is different from how tacit knowledge is shared. Explicit knowledge sharing takes place within formal structures implemented by upper management. Tacit knowledge sharing takes place informally and occurs naturally and frequently, among the team members. There was evidence that knowledge articulation is influenced by the willingness of the team members to articulate their knowledge to other team members. It was also found that team members use articulation mechanisms which are most convenient to them, at that point in time, rather that the most appropriate mechanisms, to articulate their personal tacit knowledge to other team members. Synthesising the findings two frameworks are developed illustrating the context surrounding the sharing of tacit and explicit and more importantly the nuances of the knowledge articulation process in project teams.

Contents

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The completion of this thesis represents the end of the DBA journey, from which there are several people that I wish to acknowledge for their encouragement and support along the way. As rewarding as this DBA journey has been, there have been many periods where it seemed impossible to continue, and it is during these times the support of my family and friends has been invaluable.

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Finally, I would like to thank my family my two boys Francis and Gearóid and my dear husband and best friend, Ed. Thank you for your amazing ongoing support and encouragement. I will be forever grateful to you.

Dedication

I would like to dedicate this thesis to my beloved husband and best friend Ed, and my two boys, Francis, and Gearóid.

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List of Abbreviations

CF – Conceptual Framework

DBA – Doctorate of Business Administration

EPC – Engineering Procurement and Construction

PBO – Project-Based Organisation

PMBOK – Project Management Body of Knowledge

RQ – Research Question

SECI – Socialisation, Externalisation, Combination, and Internalisation (Nonaka, 1994)

SETU – South East Technological University

WIT – Waterford Institute of Technology

SECTION ONE: RESEARCH OVERVIEW AND STUDY CONTEXT

1.0 Introduction

This study investigates the practice of knowledge sharing and articulation, seeking to understand the articulation process within a project-based organisation (PBO). The articulation process is recognised as central to knowledge sharing, particularly during the conversion of tacit to explicit knowledge (Nonaka, 1994; Oppl, 2016; Tell, 2016; Ractham and Srisamran, 2018). However, research pertaining to the actual articulation process is limited (O'Meara and Kelliher, 2020). Furthermore, this study seeks to understand the mechanisms used during the articulation process where tacit knowledge is transformed into an understandable explicit form.

This research seeks to gain greater understanding of how knowledge is shared and articulated in project teams and to unearth what types of mechanisms are used during knowledge articulation. Three research questions (RQs) are addressed in this study:

RQ1 – How is knowledge shared in project teams?
RQ2 – How is knowledge articulated in project teams?
RQ3 – What mechanisms are used to articulate knowledge?

RQ1 examines the sharing of tacit and explicit knowledge between project team members.
RQ2 concentrates on how team members articulate their knowledge and who is involved in the articulation process.
RQ3 focuses on the various mechanisms used by the team members, which help transfer and convert personal tacit knowledge into an understandable, explicit form between the team members.

This study is set in an Irish PBO, within the engineering, procurement, and construction sector (EPC). The structures of PBOs differs from other business structures in that the particular project needs determine the project structure (Hobday, 2000; Miterev *et al*., 2017). Given that each project is unique in nature (Project Management Institute, 2013), change is common and an inevitable part of any PBO business landscape. Changes within projects offer project team members an opportunity to gain new knowledge from the knowledge

shared and articulated (Terzieva, 2014; Navimipour and Charband, 2016). This new knowledge, when shared and articulated among team members, may prevent mistakes from reoccurring and the reinvention of solutions when similar projects are undertaken in the future. In time-sensitive industries such as EPCs, this articulation of knowledge saves time for trouble-shooting project plans and problems, increases efficiency and effectiveness in project execution which is central to this industry where time is critical, and there is no room for errors. Therefore, PBOs are a setting where knowledge sharing, and articulation is important to how PBOs operate. However, this is not always so easily performed in practice (Mueller, 2014).

The research is explored through the lens of interpretivism, following a qualitative research approach. This allows the researcher to understand the phenomena through the lens of individual lived experiences. In sympathy with this philosophical paradigm, a single case study research design is applied. Semi-structured interviews and documentary reviews are used as methods to collect data. Using a number of data collection methods allowed the researcher to gain a deeper understanding of knowledge sharing, articulation, and the mechanisms used by the PBO under scrutiny.

In the next section, the background and motivation for the study are outlined, followed by the research study design. An account of the organisational context for this case study research is presented, and the participants selection technique is detailed. Finally, the overall structure of the thesis is outlined.

1.1 Background and motivation for the study

In specific organisational sectors and business environments, such as the engineering, procurement, and construction (EPC) sector knowledge sharing is a core aspect of the business structure. Companies in the EPC sector encourage knowledge sharing, particularly among team members, because they understand that knowledge sharing practices will ultimately benefit the overall performance of the organisation (Swift and Hwang, 2013; Ganguly *et al.*, 2019) and therefore is essential for the longevity of the organisations (Mueller, 2014). The practice of knowledge sharing, within teams has been well researched

in that knowledge sharing has been recognised to improve team and project performance (Lee *et al*., 2010; Lee *et al*., 2015), employee creativity (Rahmi and Indarti, 2019; Zeb *et al*., 2019), and an individual's commitment to an organisation (Curado and Vieira, 2019). Although knowledge sharing has been acknowledged to add value to an organisation the practice of knowledge sharing has proven to be difficult. This is because knowledge is understood to exist in two forms, explicit knowledge, and tacit knowledge (Polanyi, 1966; Nonaka and Konno, 1998). Explicit knowledge is codified and comes in a form that is more easily shared such as reports and manuals (Maravilhas and Martins, 2019). Tacit knowledge is associated with personal knowledge, such as an individual's skills, insights, and expertise. Personal tacit knowledge is difficult to share. The sharing of tacit knowledge involves converting it into an explicit form that is understood by other. This conversion process is identified as externalisation (Nonaka, 1994; Ganguly *et al.*, 2019).

Researchers acknowledge that central to the externalisation process is articulation and that through articulation tacit knowledge can be rendered explicit and therefore shared with others fluently and organically (Nonaka, 1994; Hakanson, 2007; Oppl, 2016; Tell, 2016; Ractham and Srisamran, 2018). Furthermore, it has been acknowledged that the conversion of tacit knowledge into an understandable form, is reliant on the mechanisms used during the articulation process (Furlan et al., 2019; Weldemariam and Garfield, 2019). The importance of articulation in converting tacit into explicit knowledge is well documented in the literature (Cowan and Foray, 1997; Hakanson, 2007; Balconi et al., 2007). However, it seems that few researchers have probed into how the articulation of knowledge takes place (O'Meara and Kelliher, 2020). Understanding the intricate details of the articulation process can help ensure clear and accurate transfer of personal tacit knowledge. This in turn enhances the overall quality of the articulated knowledge and thereby reduces confusion between the knowledge holder and the knowledge receiver. In practice, managers who acknowledge how articulation take places can foster a culture of open dialogue and active listening. By encouraging employees to articulate their skills and expertise, managers create an environment where diverse perspective are valued, which leads to more creative problem-solving (Furlan *et al*., 2019) and innovation. Additionally, little consideration has been given to the types of mechanisms used to help convert tacit into explicit knowledge (Furlan *et al*.,

2019; Weldemariam and Garfield, 2019). Recognising that individuals possess varied learning styles, managers can adapt the mechanisms to suit the needs of the individual, thereby speeding up the articulation process and enhancing collaboration. Previous research has not extensively explored knowledge sharing from the perspective of externalisation. Additionally, there exists a limited body of literature that delves into the specifics of the articulation process, the mechanisms applied during the articulation process, and the associated challenges. In light of this identified knowledge gap, which is elaborated further in Paper 1, this study aims to explore the articulation process within project teams. Specifically, to examine how knowledge is shared focusing on the mechanisms used during the articulation process.

Knowledge sharing has been viewed through many theoretical lenses and perspectives, including social capital theory (Wu *et al*., 2015), knowledge-based view (Blome *et al*., 2014), and social exchange theory (Wu and Lee, 2017). This study's interests lie in the conversion of tacit to explicit knowledge during the articulation process. Therefore Nonaka's (1994) knowledge creation theory is considered the best fit for this study. Specifically, this study draws on the externalisation mode of Nonaka's four-mode model (i.e., socialisation, externalisation, combination, and internalisation). Externalisation involves individual-to-group knowledge sharing during which tacit knowledge is converted into explicit knowledge, through articulation. Next, an overview of the research study design is presented, followed by a detailed portrayal of the organisational context in which the study was undertaken.

1.2 Research study design

This study seeks to understand knowledge sharing and the articulation process through the lived experiences and perspectives of team members working together on projects within one PBO. The study takes an exploratory approach following a qualitative single case study design.

1.2.1 Case study approach and data collection method

A case study design is considered the most suitable design for this research as it offers the researcher an opportunity to gain deep understanding (Eisenhardt, 1989) of knowledge sharing and articulation in practice. Furthermore, using a case study assumes the context surrounding the phenomena is studied so it is a natural fit, given that knowledge sharing, and articulation are context specific and have no meaning if separated from its context (Klein and Myers, 1999). Therefore in this case, it is important to also understand the context surrounding knowledge sharing and articulation.

Multiple data collection methods were used in this study. In-depth semi-structured interviews and documents relevant to the organisational context (i.e., the case) and to knowledge sharing and articulation were reviewed. Additionally, reflective journaling by the researcher was also used to capture ideas as the research progressed. Semi-structured interviews supported by an interview guide (see Appendix A of Paper 2), was the primary data collection method used. Interviews are widely recognised as the most appropriate method for capturing individuals' experiences in context (Walsham, 2006; Denzin and Lincoln, 2018). Using semi-structured interviews allowed the researcher to probe the participants to obtain greater depth regarding their experiences and perspectives. The interviews revealed many details, nuances and insights on knowledge sharing and the articulation process within project teams, that would not have been possible from other methods (e.g., questionnaires). Reviewing documents relevant to the wider organisational context helped the researcher understand the organisation, its policies and attitude towards knowledge sharing and articulation. Furthermore, documents relevant to knowledge sharing and articulation supported and substantiated the information gathered from semi-structured interviews (Yin, 2009). The researcher used reflective journaling throughout the study to record her reflective thoughts (Ortlipp, 2008). This took two forms: (a) note-taking during the interview process and (b) voice recordings after each interview. The use of multiple data collection methods also allowed the researcher the opportunity to cross-check findings across and within data sets (Bowen, 2009). This process added rigour and enhanced the

credibility of the research (Lincoln and Guba, 1986). The next section discusses in detail the context in which this research study was undertaken.

1.2.2 Context of the study

This study is set in an Irish based multinational PBO operating in the EPC sector. The organisation undertakes projects of various sizes in both residential and non-residential areas. The PBO has a long-standing history in the construction industry in Ireland, and in the past decade, the firm's operations expanded to international countries. It was recognised as one of Ireland's top 60 building contractors in 2022 (Irish Construction News, 2022).

This research study was conducted with four project teams. Each team worked on different project sites throughout Ireland. Each project was assigned a team of people with varied skills and different levels of expertise. Each team was managed and led by a project manager. The number of members per project team required to complete a project varied. This was determined by the size and complexity of the project. Furthermore, within this organisation, it is common practice for members of the project team to change project sites at various stages of the project's lifecycle. Such changes depend on the skills needed to complete a task on the project. Hence, skilled team members may move back and forth between different project sites because their particular skillset is needed there.

The project sites are fast-paced settings because they are driven by the project's schedule. The completion date of a project is very rigid and monitored closely due to the commercial impacts on the company. A penalty is applied if there is a delay in the delivery of the project, (Irish Building Magazine, 2020). Therefore, any interruptions to the project, such as weather issues, lack of resources, or design issues, could impede the planned progress of the project, thereby causing it to fall behind. This, in turn, generates a fast-paced environment as the team members are urged to accomplish their tasks in accordance with the planned schedule in order to complete the project on time and avoid additional costs.

Projects involve a series of sequenced tasks to produce a unique product that conforms with the client's requirements. The completion of tasks involves the interaction of different

skilled domains such as engineering, architectural design, and health and safety (Mueller, 2014). Therefore, team members rely on each other to complete a team task (Buvik and Rolfsen, 2015). This suggests that the interdependent nature of project tasks requires team members to communicate and share knowledge with each other to successfully complete the task.

The organisation employs apprentices through an apprenticeship programme, which is designed to develop new practitioners (i.e., an apprentice) in a specialised trade through on-the-job training. On-the-job training gives the apprentice the opportunity to work alongside an experienced, skilled practitioner. This, in turn, allows the apprentice to learn from the experienced practitioner, thereby developing their skills and knowledge (Generation Apprenticeship, n.d.). The sharing and articulation of knowledge between the skilled team members during the completion of tasks, along with the apprenticeship programme, makes this context fitting for researching knowledge sharing and articulation.

1.2.3 Participant selection

A non-probability sampling technique was used to select participants that represent the organisation (i.e., the case). This helped the researcher to subjectively select participants based on a predetermined selection criteria (Patton, 2002) (see Table 2 of Paper 2). Members of four project teams were selected for interviews and a total of 26 interviews were conducted. Each of the teams worked on various projects. Although it was the managing director, of the organisation, who was the researcher's initial access into the organisation, it was decided based on potential gatekeeper bias (Atkinson and Flint, 2001), that someone other than the director should be part of the interviewee selection process. Therefore, the selection process involved a functional manager, within the organisation, along with the researcher guided by the ethical protocols and participant selection criteria which identified the individuals invited to participate in the study.

1.2.4 Interview preparation and data collection

Prior to the interviews each participant was informed that their participation in the study is voluntary, and they can withdraw from the study, at any time, up until the point of data

merge. Participants were provided with an informed consent document, via email, which provided reassurance of personal and organisational confidentiality. This was accompanied with an information document detailing the purpose of the study sent, via email, to each interview participant, prior to the interviews commencing. As fieldwork was conducted during a global pandemic, each interview was conducted online, using Microsoft Teams. The 26 semi-structured interviews were audio recorded and were then transcribed, and analysed for this study (Adler and Adler, 2012). The duration of the interviews ranged from 25 minutes to 65 minutes with the average duration being 39 minutes. An audio-to-text software application was used to transcribe the interviews. The researcher rigorously checked the interview transcriptions as the audio-to-text application was unable to transcribe all of the recording accurately. To ensure the rigour of the transcribed interviews each transcription was emailed to the participants for review. This allowed the participants to make changes to the information they provided.

The transcribed interviews and documentation received were imported into the software application NVivo where the analysis process commenced using Braun and Clarke's (2006) thematic analysis strategy. NVivo was used to manage the analysis of the data. The memo feature in NVivo was used to record the researcher's decisions at various points of the analysis. The next section details the overall structure of the thesis.

1.3 Structure of the thesis

This thesis is comprised of four sections, outlined as follows.

Section 1 provides the background to the research study which includes the justification for the study and the context in which the study is carried out. The subject area of interest is detailed, acknowledging the focus of the study. The research study design and a description of the specific organisational context in which the study is undertaken is provided.

Section 2 consists of four papers produced and examined during the Cumulative Paper Series, during the Doctorate in Business Administration (DBA) programme: Paper 1: Conceptual, Paper 2: Methodology, Paper 3: Design and initial findings, and Paper 4:

Findings and Discussion. Each paper was produced sequentially throughout the journey of the research study.

Paper 1 (Conceptual) presents a review of the literature pertaining to knowledge sharing and articulation and reveals the justification for choosing the selected theory. A preliminary conceptual framework is also presented, which details the assumed articulation process.

Paper 2 (Methodology) specifies the research design. The philosophical perspective of the study is provided, and the justification for the selected research design, data collection and analysis approach are presented. Ethical implications inherent in the research study are addressed, and issues relating to the trustworthiness of the study, such as credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1986), are discussed.

Paper 3 (Design and Initial Findings) presents the outcome of the pilot study and the initial stage of the fieldwork, during which the research design was operationalised and validated. Emerging themes from the analysis of the first round of interviews are presented along with lessons learned therefrom.

Paper 4 (Findings and Discussion) incorporates the data for the 19 interviews conducted, and develops the initial themes detailed in Paper 3. This paper outlines the justification for changes made to the initial themes, reports on the comprehensive analysis process undertaken on the full data set and details the implementation and findings of the full set. Each of the four papers were examined by internal and external examiners in line with the DBA process.

A preface is presented at the beginning of each paper, which provides the reader with a brief overview of the evolution of each paper and any adjustments made following feedback from the examiners. The preface acts as the link between each of the papers, marrying the papers together to form one cohesive overall thesis.

Section 3, the discussion section of the thesis, provides a detailed discussion of the key findings of the thesis. This section also considers the research contributions to practice and literature, an analysis of its limitations, and recommendations for future research.

Section 4, the final section of the thesis, is comprised of extracts of the researcher's reflective log, which the researcher maintained throughout her DBA journey. These logs detail the personal growth of the researcher at various phases of the programme. The logs report the researcher's thoughts, learnings, experiences, challenges, and achievements over the course of the DBA programme. Table 1 illustrates the timeline of the development of the four sections of the thesis.

Table 1: Timeline of the development of the four sections of DBA Thesis

Sections of the Thesis	**Jan 2020 – Feb 2021**	**Feb-June 2021**	**June-Nov 2021**	**Nov 2021– June 2022**	**June 2022- March 2023**
Section 1: Research overview and study context					
Section 2: Paper series					
Conceptual					
Methodology					
Design and Initial Findings					
Findings and Discussion					
Prefaces to research paper series					
Section 3: Discussion, conclusion, and recommendations					
Section 4: Reflective log					

The four distinct sections of the DBA thesis are depicted in Table 1. Section 1 introduces the reader to the research study. Section 2 is compiled of four research paper series and four prefaces to the research paper series. Section 3 concludes the research study and Section 4 presents excerpts from the researcher's reflective log.

References

Adler, P. and Adler, P. (2012) In S. E. Baker and R. Edwards, *How Many Qualitative Interviews are Enough?* National Centre for Research Methods Review Discussion Paper, pp. 8–11.

Atkinson, R. and Flint, J. (2001) 'Accessing Hidden and Hard-to-Reach Populations: Snowball Research Strategies', *Social Research Update,* Vol. 33, No. 1, pp. 1-4.

Balconi, M., Pozzali, A. and Viale, R. (2007) 'The Codification Debate Revisited: A Conceptual Framework to Analyze the Role of Tacit Knowledge in Economics', *Industrial and Corporate Change,* Vol. 16, No. 5, pp. 823–849.

Blome, C., Schoenherr, T. and Eckstein, D. (2014) 'The impact of knowledge transfer and complexity on supply chain flexibility: A knowledge-based view', *International Journal of Production Economics*, Vol. 147, pp. 307–316.

Bowen, G. A. (2009) 'Document analysis as a qualitative research method', *Qualitative Research Journal,* Vol. 9, No. 2, pp. 27–40.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, Vol. 3, No. 2, pp. 77–101.

Buvik, M. P. and Rolfsen, M. (2015) 'Prior ties and trust development in project teams – A case study from the construction industry', *International Journal of Project Management*, Vol. 33, pp. 1484–1494.

Cowan, R. and Foray D. (1997) The economics of codification and the diffusion of knowledge, *Industrial and Corporate Change*, Vol. 6, No. 3, pp. 595–622.

Curado, C. and Vieira, S. (2019) 'Trust, knowledge sharing and organisational commitment in SMEs', *Personnel Review*, Vol. 48, No. 6, pp. 1449-1468.

Denzin, K. N. and Lincoln, S. Y. (2018) *The Sage Handbook of Qualitative Research*, 5th Edn. Los Angeles: Sage.

Eisenhardt, M.K. (1989) 'Building theories from case study research', *The Academy of Management Review,* Vol. 14, No. 4, pp. 532–550.

Furlan, A., Galeazzo, A. and Paggiaro, A. (2019) 'Organizational and perceived learning in the workplace: A multilevel perspective on employees' problem solving', *Organization Science*, Vol. 30, No. 2, pp. 280-297.

Ganguly, A., Talukdar, A. and Chatterjee, D., (2019) 'Evaluating the role of social capital, tacit knowledge sharing, knowledge quality and reciprocity in determining innovation capability of an organization', *Journal of Knowledge Management*, Vol. 23, No. 6, pp. 1105-1135.

Generation Apprenticeship (2023) *A Central Route to Skills Development in Ireland.* [online] Available at: https://www.apprenticeship.ie/ (Accessed 10 January 2023).

Hakanson, L. (2007) 'Creating knowledge: The power and logic of articulation', *Industrial and Corporate Change*, Vol. 16, No. 1, pp. 51–88.

Hobday, M. (2000) 'The project-based organisation: an ideal form for managing complex products and systems?', *Research Policy*, Vol. 29, pp. 871-893.

Irish Building Magazine (2020) *Liquidated Damages – So what's New?* [online] Available at: https://irishbuildingmagazine.ie/2020/03/25/liquidated-damages-so-whats-new/ (Accessed 8th January 2023).

Irish Construction News. (2022) *Ireland's Top 60 Contractors (Total Turnover) 2022.* [online] Available at: https://constructionnews.ie/irelands-top-60-contractors-total-turnover-2022/ (Accessed: 6th January 2023).

Klein, K. H. and Myers, D. M. (1999) 'A set of principles for conducting and evaluating interpretive field studies in information systems', *MIS Quarterly*, Vol. 23, No. 1, pp. 67–93.

Lee, P., Gillespie, N., Mann, L. and Wearing, A. (2010) 'Leadership and trust: Their effect on knowledge sharing and team performance', *Management Learning*, Vol. 41, No. 4, pp. 473–491.

Lee, H., Park, J. and Lee, J. (2015) 'Designed interdependence, growing social capital and knowledge sharing in IS project teams', *Thirty Sixth International Conference on Information Systems*, USA.

Lincoln, Y. S. and Guba, E. G. (1986) 'But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation', *New Directions for Program Evaluation,* Vol. 30, pp. 73–84.

Maravilhas, S. and Martins, J. (2019) 'Strategic knowledge management in a digital environment: Tacit and explicit knowledge in Fab Labs', *Journal of Business Research,* Vol. 94, pp. 353-359.

Miterev, M., Mancini, M. and Turner, R. (2017) 'Towards a design for the project-based organization', *International Journal of Project Management*, Vol. 35, No. 3, pp. 479-491

Mueller, J. (2014) 'A specific knowledge culture: Cultural antecedents for knowledge sharing between project teams', *European Management Journal*, Vol. 32, pp. 190-202.

Navimipour, N.J. and Charband, Y. (2016) 'Knowledge sharing mechanisms and techniques in project teams: Literature review, classification, and current trends', *Computers in Human Behavior*, Vol. 62, pp. 730–742.

Nonaka, I. (1994) 'A dynamic theory of organisational knowledge creation', *Organisational Science*, Vol. 5, No. 1, pp. 14–37.

Nonaka, I., and Konno, N (1998) 'The concept of "Ba": Building a foundation for knowledge creation', *California Management Review,* Vol. 40, No. 3, pp. 40-54.

O'Meara, M. and Kelliher, F (2020) Exploring the process of articulating tacit knowledge in an organisational setting, *Paper presented at the 34th Annual British Academy of Management Conference*, 2-4 Sep, University of Manchester, Manchester.

Oppl, S. (2016) 'Towards scaffolding collaborative articulation and alignment of mental models', *Procedia Computer Science*, Vol. 99, pp. 125-145.

Ortlipp, M. (2008) 'Keeping and using reflective journals in the qualitative research process', *The Qualitative Report,* Vol. 13, No. 4, pp. 695–705.

Patton, Q. P. (2002) *Qualitative Research and Evaluation Methods,* 2nd Edn. Thousand Oaks, CA: Sage Publications.

Polanyi, M. (1966) 'The logic of tacit inference', *The Journal of the Royal Institute of Philosophy,* Vol. 41, No. 155, pp. 1-18

Project Management Institute (2013) *A Guide to the Project Management Body of Knowledge PMBOK Guide*, 5th Edn. Newtown Square, Pennsylvania: Project Management Institute, p. 544.

Ractham, V. V. and Srisamran, P. (2018) 'Effects of knowledge articulation and self-reflection on team performance'. *Knowledge Management & E-Learning: An International Journal*, Vol. 10, No. 2, pp. 177–195.

Rahmi, D. Y. and Indarti, N. (2019) 'Examining the relationships among cognitive diversity, knowledge sharing and team climate in team innovation', *Team Performance Management: An International Journal*, Vol. 25, No. 5/6, pp. 299-317.

Swift, P. and Hwang, A. (2013) 'The impact of affective and cognitive trust on knowledge sharing and organisational learning', *The Learning Organisation*, Vol. 20, No. 1, pp. 20-37.

Tell, F. (2016) 'Knowledge Articulation', in Augier, M and Teece, D.J., (eds) *The Palgrave Encyclopedia of Strategic Management.* London: Palgrave Macmillan, pp. 1-5.

Terzieva, M., (2014) Project Knowledge Management: How Organisations Learn from Experience, *Procedia Technology,* Vol. 16, pp. 1086–1095.

Walsham, G. (2006) 'Doing interpretive research', *European Journal of Information Systems,* Vol. 15, No. 3, pp. 320–330.

Weldemariam, S. G. and Garfield, J. M. (2019) 'Framework for Externalisation of Tacit Knowledge in Participatory Agricultural Research in Ethiopia: The Case of Farmers Research Group', *Proceedings of the 52nd Hawaii International Conference on System Sciences*.

Wu, D., Liao, Z. and Dai, J. (2015) 'Knowledge heterogeneity and team knowledge sharing as a moderated by internal social capital', *Social Behaviour and Personality,* Vol. 43, No. 3 pp. 423-436.

Wu, W.-L. and Lee, Y.-C. (2017) 'Empowering group leaders encourages knowledge sharing: Integrating the social exchange theory and positive organizational behavior perspective', *Journal of Knowledge Management*, Vol. 21, No. 2, pp. 474–491.

Yin, R. K. (2009) *Case Study Research: Design and Methods,* 4th Edn. Los Angeles: Sage.

Zeb, A., Abdullah, N. H., Hussain, A. and Safi, A. (2019) 'Authentic leadership, knowledge sharing, and employees' creativity', *Management Research Review*, Vol. 43, No. 6. pp. 669-690.

SECTION TWO: RESEARCH PAPER SERIES

Preface to Paper 1 – Conceptual Paper

Following the DBA workshops, the development of the Conceptual paper commenced in January 2020. Due to the Covid 19 restrictions, this paper was not presented in person at the Doctoral Colloquium at Waterford Institute of Technology (WIT), now South East Technological University (SETU). The paper was examined, by report, by the examination panel Prof. Felicity Kelliher and Prof. Joseph Coughlan, and written feedback was provided. The final version of Paper 1 was submitted in February 2021 and is included in this thesis. This version incorporates improvements made to address examiners' comments. The researcher was cognisant that her academic writing skills needed improving. To aid in this, the researcher undertook writing lessons from a colleague who was skilled in academic writing along with an online academic writing course provided by Coursera. Furthermore, the researcher spent considerable time engaging with the literature, concentrating on the style and structure of the writing. Although these additional aids helped the researcher improve her writing style, it was through the writing of many drafts of the Conceptual paper, along with the guidance of her supervisors' and examiners' feedback, that really sharpened her writing skills.

The Conceptual paper details the aim of the research study and the rationale for the study, which is built on several bases. At the forefront of these bases is the lack of research addressing the articulation process and the challenges encountered during articulation. In addition, Paper 1 presents a review of Nonaka's Knowledge Creation theory, and the conceptual framework for the study is presented, along with the contextual setting for the study.

Consideration of the examiners' commentary

The researcher was clear from the beginning of the DBA that her interests lay in the phenomenon of knowledge sharing. The researcher dedicated an inordinate amount of time to researching and writing about knowledge sharing. This gave her a broad understanding, rather than a deep granular understanding, of the knowledge sharing process. This was highlighted in the examiners' commentary. The examiners suggested that refinement was needed to help determine the boundaries of the research study. This prompted the researcher

to find a niche in the knowledge sharing process, which resulted in further research and rewriting and restructuring the Conceptual paper.

The examiners further addressed the researcher's choice of theories. Initially three theories were selected: 1) Theory of Action (Argyris and Schon, 1996); 2) Systems Thinking (Senge, 2006); and 3) The Knowledge Creation Theory (Nonaka, 1994). The examiners sought further explanation of why particular theories were included or excluded. As the researcher sought to defend her justification for selecting these theories, she became aware that two of the theories, namely the Theory of Action (Argyris and Schon 1996) and Systems Thinking (Senge, 2006), concentrated on the learning organisation. Considering this study's main interest lies in the explication of personal tacit knowledge into an explicit understandable form, and not the learning organisation, both theories where excluded. At this point, the researcher felt Nonaka's theory, which is underpinned by knowledge sharing, was the best fit for this study. Further commentary from the examiners challenged whether the use of Nonaka's framework was the optimum choice and they suggested using Social Exchange Theory (Homans, 1958; Blau, 2017). From further analysis of Social Exchange Theory, it became apparent to the researcher that the theory focused on the importance of a reciprocal exchange process. However, a reciprocal exchange process is not central to this research study. This study focuses on the articulation process and the mechanisms used to explicate personal tacit knowledge, which is converted into an understandable form, and not an exchange process common to Social Exchange Theory. Therefore Nonaka's (1994) knowledge creation theory, specifically the externalisation mode, was considered the most appropriate for this research study.

Feedback from the examiners indicated that it remained unclear which mode, socialisation or externalisation, of Nonaka's (1994) SECI model was the focus of the paper. The researcher intended to use the externalisation mode, given that sharing knowledge in teams was central to the study. However, the paper did not clearly convey this. This led the researcher on a quest to re-examine the literature in light of the concepts of socialisation and externalisation, to ascertain how knowledge sharing differed in each mode. This exercise helped to crystalise the researcher's understanding of each mode. The researcher recognises

socialisation to be the sharing of knowledge through shared experiences, from which new knowledge is created. Externalisation is the sharing of personal knowledge from the individual to team members, to inform or develop the members' comprehension. This reconfirmed the researcher's decision to view knowledge sharing through the lens of externalisation. Furthermore, re-examining the literature highlighted the importance of articulation during the practice of externalisation and the lack of research in this area. This finding sparked the researcher to refine the focus of the study to knowledge articulation and the mechanisms used during the articulation process.

Researcher's personal and professional development

The development of Paper 1 aided in the growth of the researcher's personal and professional development. Paper 1 involved the researcher engaging in extensive and rigorous research that helped the researcher understand the boundaries of the study and thereby stay focused on matters relevant to the study, which in turn gave the researcher a deeper understanding of knowledge sharing and articulation. This exercise also afforded the researcher the opportunity to develop a more comprehensive understanding of the theory used in this study and other theories concerning knowledge sharing and articulation. Through deep, careful thinking and analysis the researcher understood how different theories can be used to address the research objective. Furthermore, the use of language mattered in that words used implied particular theories. This gave the researcher a greater understanding of the existing theoretical landscape relevant to knowledge sharing and articulation. This reassured the researcher in her choice of theory for this study. Furthermore, the researcher has become more confident in defending her choices and decisions based on the thorough and comprehensive analysis of the literature.

References

Argyris, C. and Schon, D. A. (1996) *Organisational Learning II Theory, Method, and Practice,* USA: Addison-Wesley publishing company.

Blau, M. P. (2017) *Exchange and Power in Social Life,* USA: Routledge New York.

Homans, C. G. (1958) 'Social Behaviour as Exchange', *American Journal of Sociology,* Vol. 63, No. 6, pp. 597-606.

Senge, P. (2006) *The Fifth Discipline The Art & Practice of The Learning Organisation,* United Kingdom: Random House Business Books.

Nonaka, I. (1994) 'A Dynamic Theory of Organisational Knowledge Creation', *Organisational Science,* Vol. 5, No. 1, pp. 14-37.

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RESEARCH PAPER SERIES

PAPER 1: CONCEPTUAL PAPER

An exploration of knowledge articulation in teams within project-based organisations.

ABSTRACT

The externalisation mode of Nonaka's theory is a process whereby tacit knowledge is translated into an understandable form of knowledge. This process involves individuals working together in a group, sharing their personal tacit knowledge, and is facilitated by the use of figurative language such as metaphors, analogies, and storytelling, as a means of articulation through continuous meaningful dialogue. The mechanisms employed during the practice of articulation have been identified as central to the externalisation process, as such mechanisms will promote effective means for communicating the personal tacit knowledge in an explicit form. Limited research exists pertaining to how knowledge is shared through the lens of externalisation; specifically, the mechanisms used during the articulation of individual personal tacit knowledge. This is of particular importance to organisations that rely heavily on knowledge sharing, such as project-based organisations in the engineering, procurement and construction sector. This paper offers a review of the literature pertaining to knowledge sharing and the nature of knowledge, recognising knowledge exists on a continuum. The author establishes Nonaka's (1994) theory as the best fit for the area of study, drawing particular attention to the externalisation mode, which is the proposed lens to investigate the mechanisms used to articulate knowledge. The paper concludes with the conceptual framework, and the research aims to be examined in this research study. Finally, the contextual setting of the research study is explained.

Keywords: externalisation, articulation, knowledge sharing, tacit knowledge

1.0 Introduction

In today's business environment, organisations struggle with volatile economies, rapid technological changes, and new and complex environmental obligations. Such an uncertain dynamic backdrop forces organisations to change and adapt in a fast and effective manner (Teece *et al*., 2016). From this perspective, Peter Drucker's (1993) research on knowledge-work production, which characterises knowledge, rather than natural resources, capital, and labour, as the primary productive resource of an organisation, has increased recognition of the value of knowledge. Organisations that constantly increase their knowledge are better equipped to contend with challenges from the organisational environment (Almeida and Soares, 2014). This is particularly relevant in project-based organisations (PBOs), the context of this study, that depend on knowledge sharing between interdisciplinary teams and individuals to attain project goals.

Whilst some scholars argue that knowledge resides with the individual (Nonaka and Takeuchi, 1995; Grant, 1996; Argyris and Schon, 1996; Davenport and Prusak, 2005; Senge, 2006; Castaneda *et al*, 2018), new emphasis has foregrounded the sharing of knowledge by individuals within a team. This sharing of knowledge enhances the value of knowledge (Yesil and Hatunoğlu, 2019), thereby forming greater knowledge (i.e., collective knowledge) than would otherwise be possible (Kogut and Zander, 1992; Argote and Ingram, 2000; Senge, 2006). Subsequently, the practice of knowledge sharing has become a key focus within organisations as well as academic research (Nonaka, 1994; Asrar-ul-Haq and Anwar, 2016; Anwar *et al*., 2019; Navimipour and Charband, 2016).

1.1 Defining knowledge sharing

Many different accounts of knowledge sharing exist in the literature. Knowledge sharing is referred to as the act of making knowledge available to others (Ipe, 2003) through the exchange of information, skills, or expertise (Caruso, 2017). Knowledge sharing has been characterised as a process controlled by the individual (Swart *et al*., 2014), which requires the individual's willingness to collaborate (Zboralski, 2009) and communicate (Ma *et al*., 2008) with others. It is claimed knowledge sharing enriches (Davenport and Prusak, 2005) and influences the receiver of the knowledge. Ultimately, knowledge sharing contributes to

the development of individual skills, ideas, and expertise (Argote and Ingram, 2000). Researchers also imply that knowledge sharing is reliant on the methods of articulation (Ambrosini and Bowman 2001; Chennamaneni and Teng, 2011; Furlan *et al*., 2019). Srivastava *et al*. (2006) depicts the practice of knowledge sharing as team members sharing task-related ideas, information, and suggestions with each other. Additionally, knowledge sharing has been described as a mutual process of exchange (Renzl, 2006) or as an activity of transferring or disseminating knowledge from one person, group, unit, or organisation to another (Argote and Ingram, 2000; Joshi *et al*., 2006). This is referred to in the literature as a process of externalisation (Heredia *et al*., 2013), which is further discussed in Section 4.0 below. Informed by a review of this literature the author purposes the following definition of knowledge sharing for this study:

> The wilful act of an individual externalising their personal tacit knowledge – skills, insights, and expertise – into forms that are understood by others, through articulation[1].

Organisations strive to encourage individuals within to share their knowledge because knowledge sharing plays a fundamental role in adding value to, and the success of, organisations. Knowledge sharing contributes to team improvement, project performance (Lee *et al*., 2010; Lee *et al*., 2015), improved employee creativity (Zeb *et al*., 2019) and team innovation (Rahmi and Indarti, 2019). Furthermore, the effective practice of knowledge sharing has been recognised to aid in the advancement of team decision making (Lee *et al.*, 2010), team performance and productivity (Navimipour and Charband, 2016). Knowledge sharing improves organisational commitment and learning (Curado and Vieira, 2019; Swift and Hwang, 2013), while also engendering effective changes within the organisation (Park and Kim, 2015). Knowledge sharing leverages organisational knowledge (Mishra and Bhaskar, 2011), which is positively associated with greater organisational performance (Mueller, 2014). Hence organisations should put conscious effort into the practice of knowledge sharing as it is essential for organisational success.

[1] This definition includes concepts which are elaborated on later in the paper. Externalisation is explained in Section 4.0, tacit knowledge is discussed in Section 2.1, and articulation is considered in Section 4.1.

Scholars have shown much interest in studying knowledge sharing; this is no doubt partially driven by the evidence of its potential benefits. From the literature a range of factors have been identified which influence the practice of knowledge sharing. Trust has been recognised as a significant factor that influences knowledge sharing and is also a component of other factors that impact knowledge sharing (Asrar-ul-Haq and Anwar, 2016; Anwar *et al*., 2019). Jugdev and Wishart (2014) argue that mutual caring through sharing can help prevent knowledge habituation and thereby promote knowledge sharing. Leaderships styles have been recognised as having an influence on knowledge sharing among team members (Boies *et al.*, 2015; Park and Kim, 2018). Wu *et al.'s* (2015) research indicates knowledge heterogeneity—namely, differences in levels of experience, professional training, and thinking styles—affects knowledge sharing. Research by Swift and Hwang (2013) and Wei and Miraglia (2017) suggests that a strong connection between the knowledge provider and the recipient of the knowledge enhances the knowledge provider's willingness to share knowledge. Furthermore, national culture has been recognised to play a major role in knowledge sharing (Kivrak *et al*., 2014). The studies outlined in the literature highlight the factors which influence the practice of knowledge sharing. Apart from some recent exceptions (O'Meara and Kelliher, 2017) few studies have investigated knowledge articulation and the mechanisms used to articulate knowledge. Accordingly, this study aims to understand the articulation process within project teams. Specifically, to examine how knowledge is shared focusing on the mechanisms used during the articulation process.

The remainder of the paper is structured as follows: It commences with a discussion of the nature of knowledge relevant to knowledge sharing and details the perspective that knowledge exists on a continuum. Next, and most appropriate to the context of this research, theories of knowledge sharing are reviewed. A rationale is provided for the selection of Nonaka's theory of knowledge creation, specifically the externalisation mode, as the most appropriate and relevant theory to inform this study. This is followed by an explanation of externalisation which directs the focus to articulation and the mechanisms employed during articulation. Based on this analysis the conceptual framework is presented supported by the research aims and concludes with an outline of the contextual setting of this study.

2.0 The nature of knowledge in knowledge sharing

Knowledge sharing requires an understanding of the structure of knowledge. Often the terms knowledge and information are equated and are treated as having the same meaning. Hence, they are used interchangeably (Huber, 1991). However, there are important differences between these terms. Information can be defined as a flow of messages that may take several forms, such as written documents or verbal communications, without any critical evaluation of the messages involved. By contrast, knowledge is information transformed into meaningful and relevant content through analytic modes that are used by individuals as well as groups or teams (Davenport and Prusak, 2005).

Knowledge exists in two forms: explicit and tacit (Polanyi, 1966). Explicit knowledge, referring to the concept of information, is formal and systematic. It is shared through data, regulations, and policies (Nonaka, 1994) as well as in manuals, patents, blueprints, reports, and other types of accessible sources (Maravilhas and Martins, 2019). Through these means, explicit knowledge is easily communicated (Grant, 1996) and shared. By contrast, tacit knowledge is intangible (Jugdev and Wishart, 2014), complex, and difficult to share (Maravilhas and Martins, 2019). Its properties are highly personal and range from routines and opaque habits (Adloff *et al*., 2015) to intuitions and hunches (Maravilhas and Martins, 2019). Additionally, tacit knowledge is embedded in individual beliefs and values (Nonaka, 1994; Desouza, 2003) as well as technical skills and experience (Gubbins *et al*., 2012; Chugh, 2015), thereby making it subjective in nature (Maravilhas and Martins, 2019). From this perspective, tacit knowledge is elusive, making it difficult to communicate and share. Individuals who try to express their tacit knowledge are often unable rather than unwilling to describe what they know (Argyris and Schon, 1996). Moreover, tacit knowledge is context specific regarding who participates and how they participate (von Krogh *et al*., 2000). Hence, it is dependent upon time and space specificity (Nonaka, 1994). Tacit knowledge is also dynamic in structure because it changes and grows while interconnecting with experiences, insights, and other relevant information, developing idiosyncratic elements over time. Therefore, it could be said that tacit knowledge evolves into a life form as it interacts with its environment (Davenport and Prusak, 2005). Drawing from a broad base of literature table

1 below summaries the characteristics of, and the process for, sharing each form of knowledge (i.e., explicit, and tacit knowledge).

Table 1: Characteristics and processes for sharing knowledge.

Forms of knowledge	Properties/characteristics	Process for sharing
Explicit	Is tangible and is conveyed in a systematic form such as polices, and patents.	Shared through printed documents and electronic methods.
Tacit	Context specific and is primarily accumulated though direct experience and training. Often referred to as know-how (skill) and also has a cognitive dimension such as values and beliefs.	Articulation through dialogue, using storytelling, analogy and metaphors.

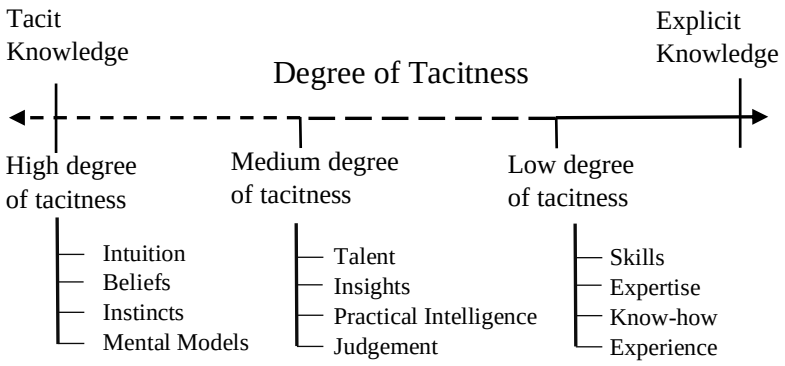
Whilst the literature outlines the tacit and explicit nature of knowledge it further distinguishes how tacit knowledge can vary in its form and consequently how it relates to becoming explicit during the knowledge sharing process.

2.1 Knowledge existing on a continuum

Tacit knowledge may be classified into degrees of tacitness gauged by the extent to which the knowledge can be articulated. These degrees of tacitness have been viewed to exist on a continuum ranging from tacit to explicit (Ambrosini and Bowman 2001; Chennamaneni and Teng, 2011). A high degree of tacitness is knowledge of a highly personal, embodied nature which is intuitive and connected to the senses (Nonaka and von Krogh, 2009), such as mental models and instinct. This type of knowledge is developed through experience over time. It is ineffable, and therefore cannot be articulated and shared, hence it usually stays with the individual (McIver *et al*., 2012). Explicit being primarily information, is structured, thereby making it easy to communicate, and share. Positioned between tacit and explicit are medium and low degrees of tacitness. A medium degree of tacitness represents knowledge that is considered intangible in character however, its application results in a more tangible form,

such as the production of work, an example is practical intelligence (Mc Adam *et al*., 2007; Weldemariam and Garfield, 2019). A low degree of tacitness denotes knowledge that is easily observed and taught, involving skills and experience. Knowledge with medium or low degrees of tacitness can be articulated and shared with others, through dialogue using various mechanisms such as metaphors, analogies, and storytelling (Ambrosini and Bowman 2001; Nonaka and von Krogh, 2009; Nonaka *et al*., 2014). Figure 1 illustrates a tacit-explicit continuum along which the three degrees of tacitness are positioned (Ambrosini and Bowman, 2001).

Figure 1: Tacit-explicit continuum along with the degrees of tacitness



Source: Adapted from Ambrosini and Bowman (2001) and Weldemariam and Garfield (2019).

Thus, the literature indicates that the degrees of knowledge tacitness are related ultimately to the extent to which tacit knowledge can be converted into explicit knowledge. This conversion of tacit to explicit knowledge is embedded in wider theoretical foundations which are discussed next.

3.0 Knowledge sharing theories

The study examines how knowledge is shared, concentrating on the mechanisms used by project team members to articulate tacit knowledge into explicit knowledge. Therefore, it is appropriate that the theoretical lens for this research study is pertinent to knowledge sharing, the different forms of knowledge, and is relevant to group or team level knowledge sharing.

In this section two highly regarded theories, social exchange theory (Homans, 1958), and knowledge creation theory (Nonaka, 1994) are considered. Having considered both theories, a justification for selecting Nonaka's knowledge creation theory is provided.

3.1 Social exchange theory

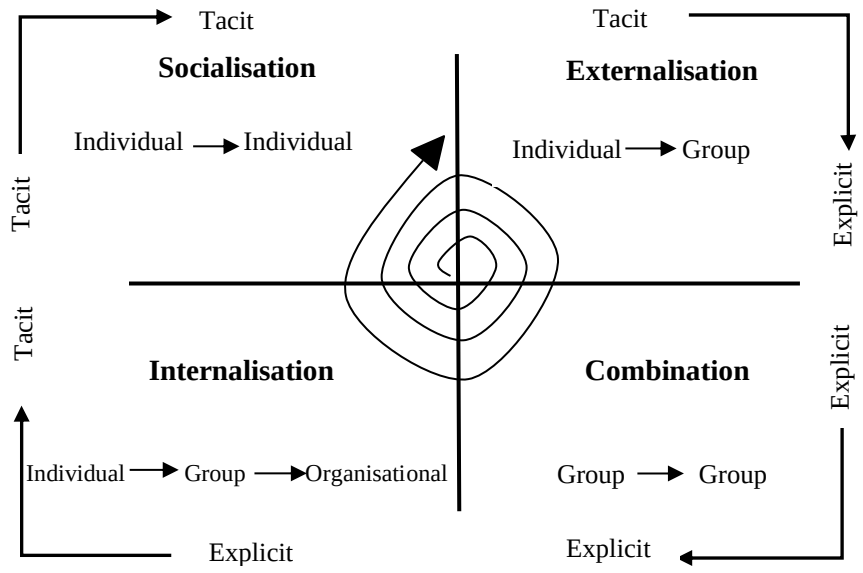
Social exchange theory is concerned with social interaction and social structure. The theory suggests that individuals participate in exchange of information (Lambe *et al.,* 2008) and knowledge (Liu *et al.,* 2011) out of self-interest. An exchange is considered a social process governing the relationships between individuals, groups, and organisations. This exchange is dependent on trust (Blau, 2017). On the one hand, the act of exchange is built on the quality of the ideas, assistances, and information (resource) sharing an individual gives. On the other, it is constructed on the value (rewards) of what an individual gets in return (Homans, 1958; Liu *et al.,* 2011). Failure to receive a reward halts the exchange process (Blau, 2017). Therefore, social exchange theory requires mutual dependence because one party's action relies on another party's behaviour (Cook and Rice, 2003). Blau's (2017) view of social exchange theory analyses the reciprocity of the exchange process, centring on extrinsic rewards (Cook and Rice, 2003). Social exchange theory recognises the importance of the reciprocal exchange process guided by the social structure during knowledge sharing. However, a reciprocal process is not central to this research study. This study focuses on articulation mechanisms used to explicate personal tacit knowledge, which is converted into an understandable form, not an exchange process common to social exchange theory.

3.2 Knowledge creation theory

Ikujiro Nonaka's (1994) knowledge creation theory builds on Polanyi's (1966) concepts of tacit and explicit knowledge. Nonaka's theory involves four sequential, interactive, and complementary modes of generating and elaborating tacit and explicit knowledge (Dyck *et al*., 2005). These four modes consist of socialisation, externalisation, combination, and internalisation (SECI). Collectively, they facilitate the sharing of knowledge within organisations. Socialisation (S) is the process of acquiring new tacit knowledge (Kogut and Zander, 1992). Here, individuals share experiences and skills through joint activities such as mentoring and apprenticeship (Nonaka, 1994; Nonaka and Toyama, 2003). Externalisation

(E) is the sharing of knowledge by converting tacit knowledge into explicit knowledge. Such conversion is enabled by continuous dialogue and collective reflection by the use of metaphors, models and questioning to explain experiences to others in a group setting (Nonaka, 1994; Nonaka and Takeuchi, 1995). Combination (C), meanwhile, reconfigures explicit knowledge. For example, the use of technology may assist in reconfiguring existing knowledge by adding acquired explicit knowledge (Kogut and Zander, 1992), thereby making existing knowledge more structured and systematic (Lopez-Nicolas and Soto-Acosta, 2010). Internalisation (I) converts explicit knowledge into organisational tacit knowledge through application and practice such as learning-by-doing (Nonaka and Konno, 1998; Nonaka *et al.*, 2000; Nonaka and Toyama, 2003). The four modes, depicted in Figure 2 below, are not dependent on each other. However, their interaction produces a spiral-like pattern, as the scope of the knowledge and the number of participants involved increase in scale while moving through the various organisational levels (Nonaka, 1994; Nonaka and Takeuchi, 1995; Nonaka and Toyama, 2003).

Figure 2: SECI modes of knowledge creation



Source: Nonaka (1994)

3.3 Critique of Nonaka's theory

Nonaka's theory, whilst highly regarded and continues to be the basis of much research is not without its criticism (Glisby and Holden, 2003; Li and Gao, 2003). For example, researchers have pointed to limitations arising from the specific Japanese cultural context that underpins Nonaka's model (Glisby and Holden, 2003; Hong, 2012; Hong *et al*., 2014). Hong (2012) argued that the adaptation of the SECI model to settings external to Japan would be extremely difficult because each mode of the SECI model is embedded in Japanese cultural values. This view is empirically supported by Hong *et al.,* (2014). However, examining theories in different settings is, in many regards, the essence of research. For example, Whetten (1989) advocated for applying models and theories to new contextual settings, which would allow theorists to learn something new about the model and/or theory, thus helping to improve rather than merely confirm the usage of the model and/or theory.

Gourlay's (2006) critical review of Nonaka's theory highlighted two issues: First, Nonaka's interpretation of Polanyi's tacit and explicit knowledge. Second, the lack of verification substantiating the externalisation mode of the SECI model. Nonaka and von Krogh (2009) attempted to address these issues in their subsequent paper. Nonaka's interpretation of tacit and explicit knowledge is attributed to the original work of Michael Polanyi. Gourlay (2006) argued that Nonaka (1994), in his original paper, misrepresented Polanyi's idea of tacit and explicit knowledge. Gourlay (2006) maintained that Nonaka (1994) neglected to acknowledge that, during the conversion process, there is a degree of tacit knowledge that cannot be converted into explicit knowledge due to its inherent complex, intangible nature. Nonaka and von Krogh (2009), in their subsequent paper, modified their original thinking about tacit knowledge to reflect the embodied nature of tacit knowledge. Acknowledging that embodied tacit knowledge (i.e., intuition) cannot be converted to explicit knowledge, Nonaka and von Krogh (2009) asserted that tacit and explicit knowledge exist on a continuum. Therefore, the extent to which knowledge can be externalised depends on its position along that continuum, or as described by Ambrosini and Bowman (2001), depends on its degree of tacitness. Although Nonaka and von Krogh (2009) have addressed and adjust their perspective towards tacit knowledge, it is evident in the current literature that theorists have not yet accepted such changes (Wang, 2020).

Gourlay's (2006) also claimed that Nonaka *et al.'*s. (1994) main research findings regarding the externalisation mode lacked evidence to support the use of metaphors and analogies. In response to this criticism, Nonaka, and von Krogh (2009) presented studies (Becerra-Fernandez and Sabherwal, 2001; Chou and He, 2004), which empirically support the implementation of the SECI model. This study seeks to extend research by further examining the externalisation mode through the practice of articulation.

Notwithstanding these critiques, Nonaka's (1994) theory which is underpinned by knowledge sharing is considered as a fitting theory for this study. Specifically, this study draws on, the externalisation mode, involving individual to group knowledge sharing, encompassing both tacit and explicit knowledge, and the utilisation of articulation. Nonaka conceptualises the process of knowledge sharing through articulation, and the literature indicates factors that may influence the practice of articulation. In the next section externalisation is discussed, followed by a review of articulation, as a core component of this concept.

4.0 Externalisation

As discussed, externalisation is a process whereby tacit knowledge is converted into an understandable form (Maravilhas and Martins, 2019). Externalisation follows the prevailing view that knowledge exists on a continuum with tacit and explicit knowledge at either end (Nonaka and von Krogh, 2009). Externalisation is a fragile and complex process which is triggered through the mismatch of thought and action; accordingly, it is the process of shifting from an individual's subjective tacit knowledge towards a collective objective form that is comprehensible and easily sharable. During the process of externalisation, the tacit knowledge being shared—skills, insight, and expertise—moves along the continuum towards explicit knowledge. This movement is evoked by dialogue, using mechanisms such as metaphors, analogies (Nonaka, 1994; Nonaka and Takeuchi, 1995), and storytelling (Ambrosini and Bowman 2001) which are used to help express or articulate the tacit knowledge. As tacit knowledge moves along the continuum, it gains clarity, and by this means loses some of its tacitness while gradually becoming enhanced (Nonaka and von

Krogh, 2009). In essence, knowledge accrues as it is transformed from a tacit to an explicit state.

In Nonaka's SECI model, the conversion of tacit to explicit knowledge is collective in nature and involves the participation of all group members. The fluidity of the transfer of tacit to explicit knowledge is dependent on both the knowledge holder and the knowledge recipient having previous subject knowledge and contextual experience (O' Meara, and Kelliher, 2020). As knowledge is shared, individuals recognise differences in their perspectives, causing them to question existing premises, subsequently examining, revising, and validating their existing perspectives through critical inquiry and self-reflection (Argyris and Schon, 1996; Grant, 1996; Nonaka *et al*., 2000; Ractham and Srisamran, 2018). This is an iterative process which ceases when a common level of understanding and meaning is engendered (Ahn and Hong, 2019) within the group, and new explicit concepts are built that expand the knowledge boundaries beyond what a single individual might know (Nonaka, 1994; Nonaka and von Krogh, 2009). Essentially, externalisation is the practice of sensemaking where individuals blend current concepts being pursued with past experiences, thus modifying their understanding of the concept (Nonaka and Takeuchi, 1995; Addis, 2016; Ahn and Hong, 2019). Additionally, the new concept may be further codified for storing, retrieval, and sharing with others outside the group (von Krogh *et al*., 2000; Hakanson, 2007), which may yield a change in the design of organisational practices (Argyris and Schon, 1996). Externalisation stimulates the mutual development of ideas within a team (El-Den and Sriratanaviriyakul, 2019). This may facilitate the increase in prompt responses to context-specific problems and provide new solutions (Nonaka and von Krogh, 2009) which, in turn, may improve organisational processes and products as well as supporting organisations contending with the uncertain dynamics of the external environment.

Researchers have identified that articulation is central to the externalisation process (Hakanson, 2007; Ractham and Srisamran, 2018). As explained, articulation involves the utilisation of meaningful dialogue (Nonaka 1994; Tsoukas, 2009), using various mechanisms such as metaphors, analogies (Nonaka 1994; Nonaka and Takeuchi, 1995) and

storytelling (Ambrosini and Bowman 2001) which determines the quality of the knowledge being shared. Therefore, the effectiveness of the externalisation process is dependent on the mechanisms used during the practice of articulation (Weldemariam and Garfield, 2019). On account of this, it is necessary to understand the mechanisms used during the practice of articulation and the challenges encountered. Whilst scholarly interest in knowledge articulation is increasing (O'Meara and Kelliher, 2020), prior studies have failed to probe into the nature of articulation (Dyck *et al*., 2005; Al Attar and Shaalan, 2016; Farnese *et al*., 2019). As a result, the practice of articulation is vulnerable to varied interpretations. Accordingly, a lack of research exists pertaining to the practice of articulation, the mechanisms used during articulation, as well as challenges encountered. Therefore, further research is needed.

4.1 Articulation and codification

Within the literature articulation and codification are often regarded as having the same meaning and are equated with the conversion of tacit knowledge to explicit knowledge (Cowan and Foray, 1997; Hakanson, 2007; Balconi *et al*., 2007). Some researchers argue codification takes place after articulation (Zollo and Winter, 2002), whilst other scholars believe codification takes place before articulation (Gubbins *et el*., 2012). The fundamental objective of externalisation is the collective understanding of a concept developed from the explication of shared tacit knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995), therefore irrespective of which precedes the other, the objective remains the same. That said, this study follows Zollo and Winter's (2002) perspective whereby the process of knowledge articulation precedes the process of knowledge codification. This study assumes that the practice of knowledge articulation acts as a means of transfer, using various mechanisms for sharing personal tacit knowledge, to others in a comprehensible (explicit) form. Subsequently a new formed knowledge (concept) will be developed based on the combined subjective understanding of the shared personal tacit knowledge.

4.1.1 Articulation definitions, merits, and challenges

Articulation is a process which brings cognitive awareness to subliminal actions (Tell, 2016). Kelloway and Barling (2000) describe articulation as making the unknown known, while

Janhonen and Johanson (2011), refer to knowledge articulation as the transfer of the invisible into the visible. Oppl (2016) suggests articulation is a process which converts an individual's thoughts and perspectives into a tangible form for further sharing. Furthermore, Tell (2016) defines knowledge articulation as the conversion or extraction of individual tacit knowledge into a standard form. Consistent with Tell (2016) the author defines articulation as a process which brings cognitive awareness to subliminal actions.

The practice of articulation facilitates the enhancement of individual experience and understanding by joining elements during a creative process (Rotenberg, 1983) through which the most essential aspects of an experience are conveyed (Hakanson, 2007). Hakanson (2007) specified three cyclical elements deemed fundamental to the practice of articulation: theory, codes, and tools. Theory is an individual's existing cognitive frame, such as beliefs and mental models. Codes are the methods used to express meaning, and are comparable with the mechanisms (metaphors, analogy, and storytelling) used to articulate tacit knowledge during externalisation. Tools represent a broad range of context dependent physical artefacts, such as technology and blueprints. The relationship between these three elements is influential in determining the amount and quality of explicit knowledge developed from tacit knowledge.

The importance of articulation is documented in the literature. For example, Hakanson, (2007) refers to the supporting role articulation plays in the enhancement of product growth, while Lazaric *et al*. (2003) acknowledges the significance of articulation during the development of best practices. Research conducted by Ractham and Sirsamran (2018) investigated the link between articulation and team performance and their findings suggest that tacit knowledge converted to explicit knowledge through articulation is positively associated with team performance. Gubbin *et al's*. (2012) research supports the proposition that the conversion of tacit to explicit knowledge yields a financial return. Lazaric *et al*. (2003) suggested that the articulation process is predominantly language dependent whereby personal tacit knowledge is explicated and converted into a generic state, thereby allowing it to be shared with others. Zollo and Winter's (2002) conceptual piece denoted articulation as a learning mechanism essential to the development of organisational operating routines.

This view is shared by Furlan *et al*. (2019) but with emphasis on knowledge articulation associated with improving problem-solving skills. Table 2 below summarises some of the noted benefits of knowledge articulation in the literature.

Table 2: The benefits of knowledge articulation.

Benefits of knowledge articulation	Author/year
Improves product growth	Hakanson, (2007)
Enhances the development of best practices	Lazaric *et al.* (2003)
Improved team performance	Ractham and Srisamran (2018)
Increase return on investment	Gubbins *et a*l. (2012)
Development of organisational routines	Zollo and Winter (2002)
Improved problem-solving skills	Furlan *et al.* (2019)

Although articulation has been linked to improving the overall performance of organisations, the practice of articulation can also be costly to implement (Hakanson, 2007). This indicates why organisations may decide not to partake in the act of articulation. However, research indicates the conversion of tacit knowledge to explicit knowledge increases an organisation's return on investment (Gubbins *et al*., 2012). The subsequent section probes deeper into the mechanisms by which tacit knowledge could be explicated during the articulation process.

4.1.2 Mechanisms of articulation

As discussed, it is evident from the literature that articulation has a role to play in the conversion of tacit knowledge into an explicit form. Therefore, the mechanisms employed during articulation and the challenges encountered using such mechanisms merit further investigation. Through dialogue various mechanisms are utilised to articulate tacit knowledge such as metaphors, analogies (Nonaka, 1994; Nonaka and Takeuchi, 1995), and storytelling (Ambrosini and Bowman 2001). Prior studies have aligned the mechanisms of articulation with the varied degrees of tacitness (Chennamaneni and Teng, 2011), whilst other studies indicate one mechanism of articulation can be applied to several degrees of tacit knowledge (Weldemariam and Garfield 2019). Several researchers have discussed the significance of meaningful dialogue—a joint activity where participants engage in verbal

exchanges of reasoning intended to remove ambiguity—as an essential mechanism for articulating tacit knowledge (Nonaka and Takeuchi, 1995; Tsoukas, 2009). The manner and attitude conveyed by the individuals involved in such acts are influential factors determining the wealth of tacit knowledge depersonalised (Tsoukas, 2009). Some claim that a simulation that closely reflects an expert's environment, coupled with rare impromptu challenges, should trigger an expert to apply their tacit knowledge by this means of acting as a mechanism for explicating tacit knowledge (Abidi *et al*., 2005). Kristiansen *et al*. (2009) suggest the utilisation of LEGO building bricks in this case, as a mechanism for tapping into unconscious knowledge paired with narrative to ensure richness as well as exposing nuances in articulation.

Hemmecke and Stary (2004) employed repertory grid interviews as a mechanism used for articulating tacit knowledge. The utilisation of the repertory grids helped draw out the individual's personal perception of their work activities into an explicit form, which in turn allowed for differences in work perspectives to be discussed giving way to a reduction in conflict. Acknowledging the cultural context of their research, Whyte and Classen (2012) aligned the mechanism used for articulation with the culture's norms. Accordingly, storytelling was used to extract personal tacit knowledge from retiring experts and acted as a rich source for sharing complex details. However, the utilisation of storytelling as a mechanism for articulation engendered a number of challenges during the process, such as time, and poor storytelling ability.

Weldemariam and Garfield's (2019) research intention was to understand what types of tacit knowledge were being externalised, based on the degree of tacitness, and the most appropriate mechanisms used. Employing several data collection techniques such as semi-structured interviews, observation and focus group, their research findings indicated one mechanism metaphorical expressions, could be used to externalise both medium (judgement, insights, and indigenous knowledge) and low degrees (experience and practical skills) of personal tacit knowledge. Subsequently, local terminology, language variation, and knowledge capabilities were identified as challenges which inhibited the articulation process.

Sharing knowledge was the emphasis of Gubbins *et al.'s* (2012) research. An instructional document (created by a subject matter expert) was the mechanism employed to share personal skilled knowledge pertinent to a specialised task. To validate the instructional document, it was trialled on experts with similar skill sets as the subject matter expert. However, the experts used to trial the instructional document were inexperienced in performing the specific task. The research findings showed some tacit knowledge had become subconscious and automatic to the subject matter expert, as relevant information had been omitted from the instructional document, which resulted in errors. Additionally, utilisation of the instructional document highlighted two challenges which inhibited the completion of the specialised task: (i) the inexperienced experts misinterpreted the meaning of several key words within the text and (ii) utilised images over text regardless of the sequence of instructions. Table 3 below summaries the studies that provide empirical evidence on the mechanisms used to convert tacit knowledge into an explicit form during the practice of articulation.

Table 3: Mechanisms employed during the practice of articulation

Mechanisms employed	Challenges encountered	Author
Repertory grid interviews (selected by the researcher)	None stated	Hemmecke and Stary (2004)
Storytelling (selected by the researcher)	Time, and poor storytelling ability.	Whyte and Classen (2012)
Metaphors, observations, dialogue, and reflection on behaviour and experimentation and evaluation (evolved from the research)	Local terminology, language variation, and knowledge capabilities	Weldemariam and Garfield's (2019)
Instructional document (developed by the knowledge holder)	Linguistic semantics and information processing preference.	Gubbins *et al.* (2012)

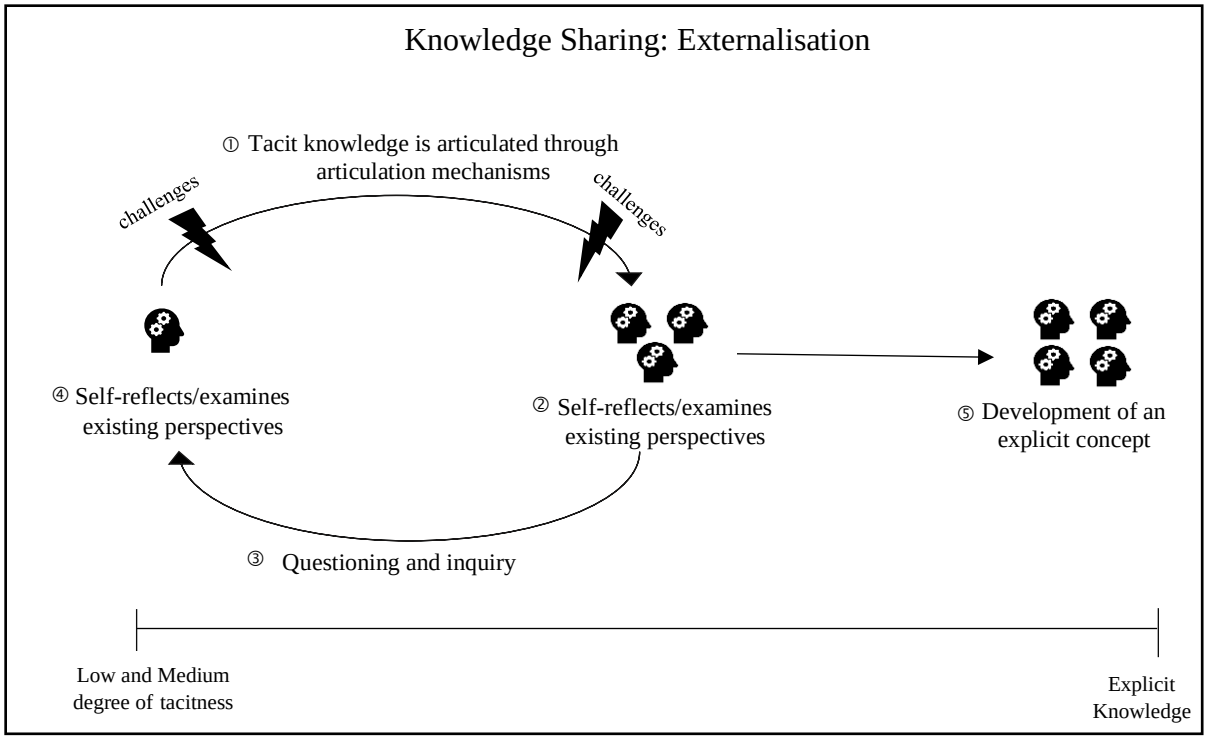
The eclectic mechanisms employed during articulation are apparent from the literature as are the challenges encountered utilising such mechanisms. The literature acknowledges there is theoretical and empirical interest in knowledge articulation. However, there is a scarcity of research applicable to the mechanisms used to explicate personal tacit knowledge, and the challenges encountered during the practice of articulation. Accordingly, this research study centres on the phenomenon of articulation, specifically the mechanisms used during

articulation and the challenges encountered. The subsequent section illustrates the major themes of knowledge sharing and externalisation, the underpinning theoretical perspective, and specifically the practices of articulation as part of the process of explicating tacit knowledge into an explicit form of knowledge.

5.0 Conceptual framework

Figure 3 below depicts the conceptual framework emerging from the literature review and draws from Nonaka's (1994) externalisation mode of the SECI model as the lens through which the knowledge sharing process will be viewed. Acknowledging the significance of articulation in the externalisation process of knowledge sharing the mechanisms employed during articulation and the acknowledgement that challenges maybe encountered are also illustrated.

Figure 3: Conceptual framework



① Personal tacit knowledge is shared with team members through various articulation mechanisms (e.g., metaphors, analogies, storytelling)
② Team members self-reflect and recognise differences in perspectives.
③ Team members develop an understanding through questioning the individual.
④ Individual/s self-reflect understanding their perception through the perspectives of the other team members.
① ② ③ ④ An iterative process which continues until a collective explicit understanding is developed.
⑤ A preliminary model of the explicit concept is created.

During the externalisation process Nonaka (1994) contends personal tacit knowledge is converted into an explicit form or concept. This conversion process involves individuals working together within a group, and is facilitated by the use of abductive reasoning, utilising figurative language such as metaphors and analogies, as a means of articulation, through continuous meaningful dialogue (Nonaka and Takeuchi, 1995). Often the mechanisms employed are ineffective, and inadequate, in conveying the shared tacit knowledge. This in turn, creates misinterpretation, and inconsistencies which, stimulates self-reflection, from which individuals examine and investigate their existing perspectives and premises of the shared tacit knowledge (Nonaka and Takeuchi, 1995). The practice of self-reflection may generate questions and inquiry which challenges each team members' viewpoint (Argyris and Schon, 1996) as more clarity is needed to help understand the meaning of the conveyed tacit knowledge. This process continues until the shared tacit knowledge is collectively understood by all team members and no inconsistencies exist (Nonaka *et al*., 2006). The collective understanding is further developed into an explicit concept (Nonaka and Takeuchi, 1995).

As explained in Section 2.1 knowledge can be classified into degrees of tacitness gauged by the extent to which the knowledge can be articulated. As such, it exists on a continuum ranging from tacit knowledge with high degree of tacitness to explicit knowledge (Ambrosini and Bowman, 2001; Chennamaneni and Teng, 2011; Weldemariam and Garfield, 2019). Nonaka and von Krogh's (2009) depiction of externalisation suggests that the externalisation process may commence at the medium degree of tacitness on the continuum. As the process of externalisation materialise tacit knowledge moves along the continuum towards explicit knowledge, this movement is provoked through the act of reflection, inquiry and questioning (dialogue) and is an iterative process which ceases when a collective understanding is developed by all team members (as illustrated in Figure 3).

As discussed in Section 4.1 and 4.1.1 the literature recognises the practice of articulation as a critical component to the externalisation process. Additionally, the mechanisms used as well as challenges encountered have been identified. The literature suggests that it is the type of mechanisms used during the articulation process determines the quality and richness of

the knowledge shared. Therefore, it is imperative that the most appropriate articulation mechanisms are used for the efficient and effective sharing of knowledge.

To the best of the author's knowledge, prior published research has not examined knowledge sharing through the lens of externalisation. Furthermore, there is a scarcity of literature which concentrates on the practice of articulation, the mechanisms used during articulation and the challenges encountered. Informed by the literature, the proposed research aim is to understand the articulation process within project teams. Specifically, the study will examine how knowledge is shared focusing on the mechanisms used during the articulation process.

Having presented the literature culminating in the presentation of the conceptual framework, the next section sets out the proposed empirical context to which the conceptualisation of knowledge sharing is to be related to.

6.0 Contextual settings

This section outlines the particular intended empirical domain for this study. This study is concerned with Irish-based and project-based organisations (PBOs), in the engineering, procurement and construction (EPC) sector. Practitioners in these sectors, known to the researcher, have explained their concerns about knowledge sharing during the lifespan of projects. These practitioners have observed over time a decrease in knowledge sharing within project teams. Thus, due to poor knowledge sharing practices critical project knowledge is not easily shared with others and thereby lost when projects are completed, and the project team members disperse. This results in repeated mistakes and reinvention of solutions when similar projects commenced. The practitioners viewed this as a critical cost problem, potentially jeopardising their opportunity to gain future projects.

In project-based organisations (PBOs) knowledge sharing in project teams is important because it offers insights for future projects (Schindler and Epplier, 2003). In general, each project is unique in character (Project Management Body of Knowledge, 2017) therefore, PBOs must deal with change on a regular basis. In turn, these changes provide a platform for gaining new knowledge through sharing (Terzieva, 2014). Despite the importance of

sharing knowledge within projects, in many project-based organisations, knowledge gained from prior projects is not easily shared (Mueller, 2014). This may be due to the temporary nature of project team members within the PBO environment.

The PBO structure differs from other business structures in that projects are the central unit of production, and the particular project needs determine the PBO's structure (Hobday, 2000). PBOs frequently use unstructured methods of communication within their operations, rather than relying solely on formal channels (Keegan and Turner, 2002). Project scheduling, budgetary controls and health and safety policies play a significant role in shaping the operational dynamics of PBOs (Keegan and Turner, 2002). The project schedule is often used as a measurement to determine the success of the project (Bakker *et al*., 2012). By maintaining a secure and compliant work environment, PBOs safeguard the well-being of employees while also minimising potential disruptions due to accidents (Badri *et al*., 2012). PBOs strategically assemble teams, typically comprised of diversely skilled experts, to complete non-routine tasks in a project (DeFillippi and Arthur 1998; Keegan and Turner, 2002). Often a discipline or skill external to the PBO is needed to complete the project. To source such skillsets, PBOs may liaise with external sources such as recruitment agencies. Once an external source is identified, the PBO may employ that source on a contractual basis for the project's duration. During that time, that contractor becomes a temporary part of the project team. Whilst some team members may have had previous experience working with the contractor, others may not (Buvik and Rolfsen, 2015). In any case, once the project is complete, the team members disperse (Argyris, 1999; Ajmal and Koskinen, 2008; Bakker *et al*., 2012); Kitimbo and Dalkir, 2013), and the contract team members leave the PBO. When the team disbands, external team members who have contributed critical inputs to the project leave; thus, knowledge that may be beneficial to future projects cannot be shared (Schindler and Eppler, 2003) by those the remaining team members in the future. Moreover, the temporal and changing nature of project team members in a PBO environment may inhibit the use of mechanisms needed to articulate knowledge. This in turn, may restrict the type and quality of the knowledge being shared, which is highly problematic.

Thus, this study's intention is to understand the practice of knowledge sharing through articulation within temporary teams (i.e., project teams), and to understand the mechanisms used during the articulation process. Additionally, as the cultural context of this research study is Irish PBOs and practitioners this study could further explore Hong's (2012) argument discussed in Section 3.3. Hong (2012) maintains that the adaption of Nonaka's theory to environments outside of Japan would be extremely difficult because of the Japanese cultural values which underpin the theory. This study intends to provide outcomes that offers guidance to project managers within PBOs, particularly in the EPC sector, and, thus, contribute to the practice and theory of knowledge sharing in that context.

7.0 Conclusion

This paper presents a review of literature on knowledge sharing. It examines the knowledge sharing process through the lens of the externalisation mode of the SECI model (Nonaka, 1994), concentrating on the practice of articulation and the mechanisms used. Although a wealth of research exists on knowledge sharing in teams, limited research attention has been given to knowledge sharing in project teams of a temporary nature. Additionally, there is much literature regarding externalisation however, to date there is a scarcity of research directly addressing knowledge sharing through externalisation in project teams within PBOs. This study develops and presents a conceptual framework that is informed by of the literature on knowledge sharing, the externalisation process and the practice of articulation. The research aims are identified that will be examined by this study. This study intends to contribute to our understanding of knowledge sharing in seeking to understand the articulation process within project teams. Specifically, the study will examine how knowledge is shared focusing on the mechanisms used during the articulation process. This study hopes to provide useful inputs for practitioners by raising awareness of the most effective mechanisms essential for transferring valuable shared knowledge in a rich format, that is easily understandable thereby adding to the theory of knowledge sharing.

References

Abidi, S. S. R., Cheah, Y. and Curran, J. (2005) 'A Knowledge Creation Info-Structure to Acquire and Crystallize the Tacit Knowledge of Health-Care Experts', *IEEE Transactions on Information Technology in Biomedicine,* Vol. 9, No. 2, pp. 193-204.

Addis, M. (2016), 'Tacit and explicit knowledge in construction management', *Construction Management and Economics*, Vol. 3, No. 7-8, pp. 439-445.

Adloff, F., Gerund, K. and Kaldewey, D. (2015**)** *Revealing tacit knowledge: Embodiment and explication,* Germany: Deutsche Nationalbibliothek.

Ahn, J. and Hong J. A. (2019) 'Transforming I into we in organizational knowledge creation: A case study', *Human Resource Development Quarterly,* Vol. 30, pp. 565–582.

Ajmal, M. K. and Koskinen, U. K. (2008) 'Knowledge transfer in project-based organisations: An organisational culture perspective', *Project Management Journal,* Vol. 39, No. 1, pp. 7-15.

Al Attar, F. and Shaalan, K. (2016) 'Enablers and barriers of knowledge spiral: A case study,' *Proceedings of the 11th International Knowledge Management Organisation Conference Changing Face Knowledge Management Impacting Society*.

Almeida, V. M. and Soares, L. A. (2014) 'Knowledge sharing in project-based organizations: Overcoming the informational limbo', *International Journal of Information Management,* Vol. 34, No. 6, pp. 770-779.

Ambrosini and Bowman's (2001) 'Tacit Knowledge: Some Suggestions for Organisations', *Journal of Management Studies,* Vol. 38, No. 6, pp. 811-829.

Anwar, R., Rehman, M., Wang, S. K. and Hashmani, M. A. (2019) 'Systematic Literature Review of Knowledge Sharing Barriers and Facilitators in Global Software Development Organisations Using Concept Maps', *IEEE Access,* Vol. 7, pp. 24231–24247.

Argote, L. and Ingram, P. (2000) 'Knowledge Transfer: A Basis for Competitive Advantage in Firms', *Organisational Behaviour and Human Decision Processes,* Vol. 82, No. 1, pp. 150–169.

Argyris, C. and Schon, D. A. (1996) *Organisational Learning II Theory, Method, and Practice,* USA: Addison-Wesley publishing company

Argyris, C. (1999) *On Organisational Learning 2nd Edition,* USA, UK, and Australia: Blackwell Publishing.

Asrar-ul-Haq, M. and Anwar, S. (2016) 'A systematic review of knowledge management and knowledge sharing: Trends, issues, and challenges', *Cogent Business & Management,* pp. 1-17.

Badri, A., Gbodossou, A. and Nadeau, S. (2012) 'Occupational health and safety risks: Towards the integration into project management', *Safety science,* Vol. 50, No. 2, pp.190-198.

Bakker, R. M., Boroş, S., Kenis, P., and Oerlemans, L. A. (2012) 'It's only temporary: Time frame and the dynamics of creative project teams', *British Journal of Management*, Vol. 24, No. 3, pp. 383–397.

Balconi, M., Pozzali, A. and Viale, R. (2007) 'The Codification Debate Revisited: A Conceptual Framework to Analyze the Role of Tacit Knowledge in Economics', *Industrial and Corporate Change,* Vol. 16, No. 5, pp. 823–849.

Becerra-Fernandez, I. and Sabherwal, R. (2001) 'Organisational knowledge management: A contingency perspective', *Journal of Management Information Systems,* Vol.18, No. 1, pp. 23-55.

Blau, M. P. (2017) *Exchange and Power in Social Life*, USA: Routledge New York.

Boies, K., Fiset, J. and Gill, H. (2015) 'Communication and trust are key: Unlocking the relationship between leadership and team performance and creativity', *The Leadership Quarterly,* Vol. 26, pp. 1080-1094.

Buvik, M., P. and Rolfsen, M. (2015) 'Prior ties and trust development in project teams – A case study from the construction industry', *International Journal of Project Management*, Vol. 33, pp. 1484–1494.

Caruso, S. J. (2017) 'A foundation for understanding knowledge sharing: organisational culture, informal workplace learning, performance support, and knowledge management', *Contemporary Issues in Education Research,* Vol. 10, No. 1, pp. 45-52.

Castaneda, D. I., Manrique, L. F. and Cuellar, S. (2018) 'Is organizational learning being absorbed by knowledge management? A systematic review', *Journal of Knowledge Management,* Vol. 22, No. 2, pp. 299-325.

Chennamaneni, A. and Teng, T. C. J. (2011) 'An Integrated Framework for Effective Tacit Knowledge Transfer', *Proceedings of the Seventeenth Americas Conference on Information Systems, Detroit, Michigan August 4th-7th*.

Chou, S. and He, M. (2004) 'Knowledge management: The distinctive roles of knowledge assets in facilitating knowledge creation', *Journal of information science,* Vol. 30, No. 2, pp. 146-164.

Chugh, R. (2015) 'Do Australian Universities Encourage Tacit Knowledge Transfer?' *In proceedings of the 7th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (Portugal)* pp. 128-135, [ISBN: 978-989-758-158-8].

Cook, S. K. and Rice, (2003) 'Social exchange theory', *Handbook of Social Psychology,* New York: Publishers, Kluwer Academic/Plenum pp. 53–76.

Cowan, R. and Foray D. (1997) The Economics of Codification and the Diffusion of Knowledge, *Industrial and Corporate Change*, Vol. 6, No. 3, pp. 595–622.

Curado, C. and Vieira, S. (2019) 'Trust, knowledge sharing and organisational commitment in SMEs', *Personnel Review*, Vol. 48, No. 6, pp. 1449-1468.

Davenport, T. H. and Prusak, L. (2005) 'Working knowledge: How organisations manage what they know', Association of computing machinery, pp. 1-15.

DeFillippi, R. J., and Arthur, M. B. (1998) 'Paradox in project-based enterprise: The case of film making', *California Management Review,* Vol. 40, No. 2, pp. 125–139.

Desouza, K. (2003) 'Facilitating Tacit Knowledge Exchange', *Communications of the ACM,* Vol. 46, No. 6, pp. 85-88.

Drucker, P. (1993) *Post-Capital Society,* British Publishing Company: Butterworth-Heinemann.

Dyck, B., Starke, A. F., Mischke A. G, and Mauws, M. (2005) 'Learning to Build a Car: An Empirical Investigation of Organisational Learning', *Journal of Management Studies,* Vol. 42, No. 2, pp. 387-416.

El-Den, J. and Sriratanaviriyakul, N. (2019) 'The Role of Opinions and Ideas as Types of Tacit Knowledge', *The Fifth Information Systems International Conference (Indonesia)* pp. 23–31.

Farnese, M. L., Barbieri, B., Chirumbolo, A. and Patriotta, G. (2019)' Managing Knowledge in Organizations: A Nonaka's SECI Model Operationalization', *Frontiers in Psychology*, Vol. 10, pp. 1-15.

Furlan, A., Galeazzo, A. and Paggiaro, A. (2019) 'Organizational and Perceived Learning in the Workplace: A Multilevel Perspective on Employees' Problem Solving', *Organization Science* Vol. 30, No. 2, pp. 280-297.

Glisby, M. and Holden, N. (2003) 'Contextual Constraints in Knowledge Management Theory: The Cultural Embeddedness of Nonaka's Knowledge-creating Company', *Knowledge and Process Management,* Vol. 10, No. 1, pp. 29-36

Gourlay, S. (2006) 'Conceptualising knowledge creation: A critique of Nonaka's theory', *Journal of Management Studies*, Vol. 43, pp. 1415-1436.

Grant, R. M. (1996) 'Toward a knowledge-based theory of the firm', *Strategic Management Journal,* Vol. 17, pp. 109-122.

Gubbins, C., Corrigan, S., Garavan, N. T., O'Connor, C., Leahy, D., Long, D. and Murphy, E. (2012) 'Evaluating a tacit knowledge sharing initiative: a case study', *European Journal of Training and Development*, Vol. 36, No. 8, pp. 827–47.

Hakanson, L. (2007) 'Creating knowledge: the power and logic of articulation', *Industrial and Corporate Change*, Vol. 16, No. 1, pp. 51–88.

Hemmecke, J. and Stary C, (2004) 'A Framework for the Externalization of Tacit Knowledge Embedding Repertory Grids'. *Proceedings 5th European Conference on 'Organizational Knowledge, Learning and Capabilities*, April, Innsbruck

Heredia, A., Guzman, G. J., de Amescua, A. and Sanchez-Segura, M. (2013) 'Interactive Knowledge Asset Management: Acquiring and Disseminating Tacit Knowledge', *Journal of Information Science and Engineering,* Vol. 29, pp. 133-147.

Hobday, M. (2000) 'The project-based organisation: an ideal form for managing complex products and systems?', *Research Policy,* Vol. 29, pp. 871-893.

Homans, C. G. (1958) 'Social Behaviour as Exchange', *American Journal of Sociology,* Vol. 63, No. 6, pp. 597-606.

Hong, F. L. J. (2012) 'Glocalising Nonaka's knowledge creation model: issues and challenges', *Management Learning,* Vol. 43, No. 2, pp. 199-215.

Hong, F. L. J., Snell, S. R. and Mak, C. (2014) 'Contextualizing Nonaka's theory of knowledge in China: When Samurai meets Bruce Lee', in *Handbook of Research on Knowledge Management,* edited by A. Örtenbald, pp. 343–365. Cheltenham: Edward Elgar

Huber, G. P. (1991) 'Organisational Learning: The Contributing Processes and the Literatures', *Organisational Science,* Vol. 2, No. 1, pp.88-115

Ipe, M. (2003) 'Knowledge Sharing in Organisations: A Conceptual Framework', *Human Resource Development Review*; Vol. 2, No. 4, pp. 337-359.

Janhonen, M. and Johanson, J. (2011) 'Role of knowledge conversion and social networks in team performance', *International Journal of Information Management,* Vol. 31, pp. 217–225.

Joshi, K. D., Sarker, S. and Sarker S. (2007) 'Knowledge transfer within information systems development teams: Examining the role of knowledge source attributes', *Decision Support Systems,* Vol. 43, pp. 322-335.

Jugdev, K. and Wishart, P. (2014) 'Mutual caring-resolving habituation through awareness: supporting meaningful learning from projects, *Project management Journal* Vol. 45, No. 2. pp. 66-82.

Keegan, A., and Turner, J. R. (2002) 'The management of innovation in project-based firms', *Long Range Planning,* Vol. 35, Np. 4, pp. 367–388.

Kelloway, W. K. and Barling, J. (2000) 'Knowledge work as organizational behaviour', *International Journal of Management Reviews,* Vol. 2, pp. 287-304.

Kitimbo, I. and Dalkir, K. (2013) 'Characterisation of Knowledge Sharing Practices in a Project Based Organisation', *International Conference on Intellectual Capital and Knowledge Management and Organisational Learning*; Kidmore End**:** 561-XIV. Kidmore End: Academic Conferences International Limited.

Kivrak, S., Arslan, G., Tuncan, M. and Birgonul, M.T. (2014), "Impact of national culture on knowledge sharing in international construction projects", *Canadian Journal of Civil Engineering,* Vol. 41, No. 7, pp. 642-649.

Kogut, B. and Zander, U. (1992) 'Knowledge of the firm, combinative capabilities, and the replication of technology', *Organisation Science,* Vol. 3, No. 3, pp. 383-397.

Kristiansen, P., Hansen, P. K. and Moller Nielsen, L. (2009) 'Articulation of tacit and complex knowledge', in P. Schönsleben, M. Vodicka, R. Smeds, and J.O. Riis (eds.) *13th International Workshop of the IFIP*, pp. 77–89.

Lambe, C. J., Wittmann, C. M. and Spekman, E. R. (2008) 'Social exchange theory and research on Business-to-Business relational exchange', *Journal of Business-to-Business Marketing,* Vol. 8, No. 3, pp. 1-36.

Lazaric, N., Mangolte, P. and Massuéc, M. (2003) 'Articulation and codification of collective know-how in the steel industry: evidence from blast furnace control in France', *Research Policy*, Vol. 32, pp. 1829-1847.

Lee, P., Gillespie, N., Mann, L. and Wearing, A. (2010) 'Leadership and trust: Their effect on knowledge sharing and team performance', *Management Learning,* Vol. 41, No. 4, pp. 473–491.

Lee, H., Park, J. and Lee, J. (2015) 'Designed Interdependence, Growing Social Capital and Knowledge Sharing in IS Project Teams', *Thirty Sixth International Conference on Information Systems,* USA.

Li, M. and Gao, F. (2003) 'Why Nonaka highlights tacit knowledge: a critical review', *Journal of knowledge management*, Vol. 7, No. 4, pp 6-14.

Liu, C. C., Liang, T.P., Rajagopalan, B., Sambamurthy, V. and Wu, C. J. (2011), 'Knowledge sharing as social exchange: evidence from a meta-analysis', *Pacific Asia Journal of the Association for Information Systems*, Vol. 3, No. 4, pp. 21-47.

Lopez-Nicolas, C. and Soto-Acosta, P. (2010) 'Analysing ICT adoption and use effects on knowledge creation: An empirical investigation in SMEs', *International Journal of Information Management,* Vol. 30, pp. 521-528.

Ma, Z., Qi, L. and Wang, K. (2008) 'Knowledge sharing in Chinese construction project teams and its affecting factors', *Chinese Management Studies*, Vol. 2, No. 2, pp. 97-108.

Maravilhas, S. and Martins, J. (2019) 'Strategic knowledge management in a digital environment: Tacit and explicit knowledge in Fab Labs', *Journal of Business Research,* Vol. 94, pp. 353-359.

McAdam, R., Mason, B. and McCrory, J. (2007) 'Exploring the dichotomies within the tacit knowledge literature: towards a process of tacit knowing in organisations', *Journal of Knowledge Management,* Vol. 11, No. 2, pp. 43-59.

McIver, D., Lengnick-Hall, A. C., Lengnick-Hall, L. M., and Ramachandran I. (2012) 'Integrating knowledge and knowing: A framework for understanding knowledge-in-practice', *Human Resource Management Review,* Vol. 22, No. 2, pp. 86-99.

Mishra, B. and, Bhaskar, U. A. (2011) 'Knowledge management process in two learning organisations', *Journal of Knowledge Management*, Vol. 15, No. 2, pp. 344-359.

Mueller, J. (2014) 'A specific knowledge culture: Cultural antecedents for knowledge sharing between project teams', *European Management Journal,* Vol. 32, pp. 190-202.

Navimipour, N. J. and Yeganeh Charband, Y. (2016) 'Knowledge sharing mechanisms and techniques in project teams: Literature review, classification, and current trends', *Computers in Human Behavior,* Vol. 62, pp. 730-742.

Nonaka, I. (1994) 'A Dynamic Theory of Organisational Knowledge Creation', *Organisational Science,* Vol. 5, No. 1, pp. 14-37.

Nonaka, I., B. Philippe, Borucki, C. C., and Konno, N. (1994) 'Organisational Knowledge Creation Theory: A First Comprehensive Test', *International Business Review,* Vol. 3, No. 4, pp. 337-351.

Nonaka, I. and Takeuchi, H. (1995) *The knowledge creating company,* New York: Oxford University Press

Nonaka, I., and Konno, N (1998) 'The concept of "Ba": Building a Foundation for Knowledge Creation', *California Management Review,* Vol. 40, No. 3, pp. 40-54.

Nonaka, I., Toyama, R., and Konno, N. (2000) 'SECI, Ba and Leadership: A Unified Model of Dynamic Knowledge Creation', *Long Range Planning,* Vol. 33, pp. 5-34.

Nonaka, I and Toyama, R. (2003) 'The knowledge-creating theory revisited: knowledge creation as a synthesising process', *Knowledge Management Research & Practice,* Vol. 1, pp. 2-10.

Nonaka, I., von Krogh, g. and Voelpel, S. (2006) 'Organizational Knowledge Creation Theory: Evolutionary Paths and Future Advances' *Organization Studies,* Vol. 27, No.8, pp. 1179–1208.

Nonaka, I. and von Krogh, G. (2009) 'Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organisational Knowledge Creation Theory', *Organisation Science,* Vol. 20, No. 3, pp. 635-652.

Nonaka, I., Kodama M., Hirose, A. and Kohlbacher, F. (2014) 'Dynamic fractal organisations for promoting knowledge-based transformation – A new paradigm for organisational theory', *European Management Journal,* Vol. 32, No. 1, pp.137-146.

O'Meara, M. and Kelliher, F. (2017) 'Framing the Externalisation Phase of Knowledge Creation in an Organisational Setting', *European Conference on Knowledge Management,* Kidmore End.

O' Meara, M. and Kelliher, F. (2020) 'Exploring the process of articulating tacit knowledge in an organisational setting', Paper presented at the 34th *Annual British Academy of Management Conference,* 2-4 Sep, University of Manchester, Manchester.

Oppl, S. (2016) 'Towards scaffolding collaborative articulation and alignment of mental models', *Procedia Computer Science,* Vol. 99, pp. 125-145.

Park, S. and Kim, E. (2015) 'Revisiting knowledge sharing from the organisational change perspective', *European Journal of Training and Development,* Vol. 39, No. 9, pp. 769-797.

Polanyi, M. (1966) ‘The logic of tacit inference’, *The Journal of the Royal Institute of Philosophy,* Vol. 41, No. 155, pp. 1-18.

Project Management Institute (2017) *A guide to the project management body of knowledge (PMBOK guide),* Newtown Square, Pa, Project Management Institute.

Ractham, V. V. and Srisamran, P. (2018) ‘Effects of knowledge articulation and self-reflection on team performance’, *Knowledge Management & E-Learning,* Vol. 10, No. 2. pp. 177–195

Rahmi, D. Y. and Indarti, N. (2019) 'Examining the relationships among cognitive diversity, knowledge sharing and team climate in team innovation', *Team Performance Management: An International Journal,* Vol. 25, No. 5/6, pp. 299-317.

Renzl, B. (2006) ‘Trust in management and knowledge sharing: The mediating effects of fear and knowledge documentation’, *The International Journal of Management Science’,* Vol. 36, No. 2, pp. 206 – 220.

Rotenberg, A. (1983) ‘Creativity, Articulation, and Psychotherapy’, *Journal of American Academy of Psychoanalysis,* Vol. 11, pp. 55-85

Schindler, M. and Eppler, J. M. (2003) ‘Harvesting project knowledge: a review of project learning methods and success factors’, *International Journal of Project Management’,* Vol. 21, pp. 219-228.

Senge, P. (2006) *The Fifth Discipline The Art & Practice of The Learning Organisation,* United Kingdom: Random House Business Books.

Srivastava, A., Bartol M. K. and Locke A. E. (2006) ‘Empowering Leadership in management teams: effects on knowledge sharing, efficiency and performance’, *Academy of Management Journal,* Vol. 49, No. 6, pp. 1239-1251.

Swart, J., Kinnie, N., van Rossenberg, Y., and Yalabik, Y. Z. (2014) ‘Why should I share my knowledge? A multiple foci of commitment perspective’, *´Human Resource Management Journal’,* Vol. 24, No. 3, pp. 269–289.

Swift, P. and Hwang, A. (2013) ‘The impact of affective and cognitive trust on knowledge sharing and organisational learning’, *The Learning Organisation,* Vol. 20, No. 1, pp. 20-37.

Teece, D., Peteraf, M., and Leih, S. (2016) ‘Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy’, *California Management Review,* Vol. 58, No. 4, pp. 13-35.

Tell F, (2016) ‘Knowledge Articulation’, in Augier, M and Teece, D.J., (eds) *The Palgrave Encyclopedia of Strategic Management*. London: Palgrave Macmillan, pp. 1-5.

Terzieva, M., (2014) Project Knowledge Management: How Organisations Learn from Experience. *Procedia Technology,* Vol. 16, pp. 1086–1095.

Tsoukas, H. (2009) ‘A Dialogical Approach to the Creation of New Knowledge in Organizations’, *Organisational Science,* Vol. 20, No. 6, pp. 941–957

von Krogh, G., Ichijo, K. and Nonaka, I. (2000) *Enabling knowledge creation,* Oxford University Press: Published New York.

Wang, S. and Chin, T. (2020) 'A stratified system of knowledge and knowledge icebergs in cross-cultural business models: Synthesising ontological and epistemological views', *Journal of International Management,* Vol. 26, pp. 1-13.

Wei, Y. and Miraglia, S. (2017) 'Organisational culture and knowledge transfer in project-based organisations: theoretical insights from a Chinese construction firm', *International Journal of Project Management*, Vol. 35, No. 4, pp. 571-585.

Weldemariam, S. G. and Garfield, J. M. (2019) 'Framework for Externalisation of Tacit Knowledge in Participatory Agricultural Research in Ethiopia: The Case of Farmers Research Group', *Proceedings of the 52nd Hawaii International Conference on System Sciences.*

Whetten, A. D. (1989) 'What Constitutes a Theoretical Contribution?', *The Academy of Management Review*, Vol. 14, No. 4, pp. 490-495.

Whyte, G. and Classen, S. (2012) 'Using storytelling to elicit tacit knowledge from SMEs', *Journal of Knowledge Management,* Vol. 16, No. 6, pp. 950-962.

Wu, D., Liao, Z. and Dai, J. (2015) 'Knowledge Heterogeneity and Team Knowledge Sharing as a Moderated by Internal Social Capital', *Social Behaviour and Personality,* Vol. 43, No. 3 pp. 423-436.

Yesil, S. and Hatunoğlu, M. (2019) 'Knowledge Sharing Attitude: An Exploratory Study among University Students', *Journal of International Cooperation and Development* Vol. 2, No. 2, pp. 36-50.

Zboralski, K. (2009) 'Antecedents of knowledge sharing in communities of practice', *Journal of Knowledge Management,* Vol. 13, No. 3, pp. 90-101.

Zeb, A., Abdullah, N. H., Hussain, A. and Safi, A. (2019) 'Authentic leadership, knowledge sharing, and employees' creativity', *Management Research Review*, Vol. 43, No. 6. pp. 669-690.

Zollo, M. and. Winter, G. S. (2002) 'Deliberate Learning and the Evolution of Dynamic Capabilities', *Organization Science*, Vol. 13, No. 3, pp. 339-351.

Preface to Paper 2 – Methodology

In April 2021, Paper 2 was presented online to the examination panel consisting of Prof Joseph Coughlan (external examiner) and Prof Felicity Kelliher (internal examiner). The final version of the paper was submitted in June 2021 and is included in this thesis. During this time, the researcher sought and received ethical approval from WIT Business School.

Consideration of the examiners' commentary

The examiners suggested that the researcher guide the reader more clearly through the paper, particularly in the introduction section. They recommended extending the discussion around the research objective and the context of the study. Furthermore, the examiners also noted that the researcher had a tendency to use the words 'to examine' and 'to explore' interchangeably throughout the paper. The examiners recommended using the words 'to explore' only, considering the study is exploratory; this change was consequently applied to the entire paper.

The examiners recommended extending the justification for adopting an interpretive case study approach. Paper 1 indicated that an exploratory approach was the most suitable for the research. The study sought to explore in-depth a deeply embedded organisational process – knowledge sharing – drawing from the perspectives of individuals working in a knowledge sharing context. Using a case study would allow the researcher gain a deeper understanding of knowledge sharing and reveal the intricate details of the phenomenon (Eisenhardt, 1989). Additionally, the researcher was cognisant that knowledge is context specific (Klein and Myers, 1999). Therefore, understanding the context surrounding knowledge sharing is significant to gaining insights into the knowledge sharing process (Ridder, 2017). The researcher felt confident the single case approach was the best fit for this study and would provide the opportunity to contribute new knowledge on knowledge sharing and articulation, while being mindful that the aim of this research was not to generalise the findings to other populations but to explore an under-explored phenomenon in depth.

The examiners recommended including a tentative timeline depicting the data collection and analysis process. In developing the timeline, the researcher became acutely aware of what

lay ahead. The researcher recognised that time and document management practices would need to be in place and adhered to before data collection commenced. The researcher set up a spreadsheet to keep track of the varied documents reviewed. At this point, the researcher also understood the benefits of maintaining a reflective journal. This journal would act as an audit trail when synthesising the findings as well as supporting the dependability and credibility of the research study. Therefore, it was imperative that the reflective log was maintained and managed correctly. To ensure all important matters were captured and considered, reflective journals were maintained in the form of audio recordings and hard copy written records. The refinements to Paper 2, based on the examiners' commentary, resulted in a more unified, structured paper.

Researcher's personal and professional development

During the development of Paper 2, the researcher produced a table, Table 4, which aligned the preliminary interview guide themes with the research questions and the conceptual framework. This table received positive feedback from the examiners. This indicated to the researcher the value of clarity in terms of deeper, careful thinking, which was gained from the experience with writing Paper 1. During the process that led to the production of Paper 2, the researcher adopted a new passion for philosophy. Understanding different worldviews encouraged the researcher to think critically and challenge her own beliefs and assumptions. This then gave her a richer awareness about herself while also making her aware of her unconscious biases. Furthermore, recognising that her philosophical position influenced her research design represented a significant insight as it helped her identify the most suitable approach for the research while also recognising the ethical considerations that needed to be taken into account.

References

Eisenhardt, M. K. (1989) ‘Building theories from case study research’, *The Academy of Management Review,* Vol. 14, No. 4, pp. 532-550.

Klein, K. H. and Myers, D. M. (1999) ‘A set of principles for conducting and evaluating interpretive field studies in information systems’, *Management Information System Quarterly,* Vol. 23, No. 1, pp. 67-93.

Ridder, H. (2017) ‘The theory contribution of case study research designs’, *Business Research,* Vol. 10, pp. 281-305.

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Date: 23rd June 2021

RESEARCH PAPER SERIES

PAPER 2: METHODOLOGY

An exploration of knowledge articulation in teams within project-based organisations

ABSTRACT

This paper outlines the research methodology to investigate how knowledge is shared within project teams concentrating on the mechanisms used during the articulation process. This study is positioned within the interpretivist paradigm, and thereby pursues an understanding of the tenets of the social world at the level of subjective experience. The interpretivist philosophy assumes that reality is self-created and constructed through the meaning and understanding derived from social interaction and lived experience, particularly sharing experiences with others. The research design will follow a qualitative case study approach, utilising in-depth semi-structured interviews with project team members in one project-based organisation, and supplementary organisational documentations and observation as a means of data collection. Thematic analysis will be employed for recognising, analysing, and reporting themes within the collected data. A purposive sampling scheme will be used as a method to select relevant participants for the study. It is anticipated that the case study approach can be used to contribute insights into how knowledge is shared and articulated.

Key words: Interpretivist, research design, qualitative, semi-structure interviews, knowledge sharing

1.0 Introduction

This paper, Paper 2 Methodology, is subsequent to Paper 1, the Conceptual paper, in an accumulating series of papers. Paper 2 details the research design and provides strategies regarding the implementation of the research questions. The paper commences with an overview of Paper 1, detailing the research aim. This study intends to explore the process of knowledge sharing, through the lens of the externalisation mode of Nonaka's knowledge creation theory (Nonaka, 1994). Most important to this research is knowledge articulation and the mechanisms employed to explicate tacit knowledge into an explicit form. The philosophical perspective of the study is provided, acknowledging it favours the interpretive paradigm. Given that central to this study is an individual's perspective or interpretation of a lived experience a qualitative approach is regarded as the most appropriate. This approach allows the researcher to explore knowledge sharing at a deeper level. Justification for adopting the case study framework for data collection and analysis is provided. Ethical considerations inherent in the research study are addressed, along with issues relating to the credibility, transferability, dependability, and confirmability, pertaining to the trustworthiness of the study (Lincoln and Guba, 1986).

1.1 Research aim

Knowledge sharing within project-based organisation (PBO) teams is essential to attain project goals. Yet, despite the importance of knowledge sharing in project teams, knowledge is not easily shared (Mueller, 2014). On account of this, the purpose of this research study is to explore how knowledge is shared in project teams within PBOs.

The practice of knowledge sharing is difficult to achieve due to the forms of knowledge and their intricate nature. It has been suggested that knowledge exists in two forms: explicit and tacit (Polanyi, 1966). Explicit knowledge is tangible and is easily shared and articulated. In contrast, tacit knowledge is subjective and elusive; it is thereby intangible (Jugdev and Wishart, 2014), rendering it difficult to share and articulate. The sharing of tacit knowledge plays a fundamental role in adding value to organisations (Lee *et al*., 2010) and has been recognised as essential to the success of project teams (Navimipour and Charband, 2016), to that end, this research study focuses on the sharing of tacit knowledge within project teams.

Nonaka (1994) contends that, through the externalisation mode of his knowledge creation theory, tacit knowledge can be shared through the conversion process. This process transforms tacit knowledge into an explicit, sharable form through articulation. Therefore, central to externalisation is the role of articulation (Hakanson, 2007; Ractham and Srisamran, 2018). Articulation is the process of transferring personal tacit knowledge, using various mechanisms such as metaphors, analogies (Nonaka, 1994; Nonaka and Takeuchi, 1995) and storytelling (Ambrosini and Bowman, 2001) into an explicit form. The mechanisms used during the articulation process promote effective ways to communicate and frame problems (Furlan *et al*., 2019). However, often the mechanisms employed are inadequate, at conveying the shared tacit knowledge (Nonaka and Takeuchi, 1995). This in turn, may trigger a process of meaningful dialogue in which individuals examine, through collective reflection, and discuss their existing beliefs, and perspectives, with others (Furlan *et al*., 2019). This process facilitates the articulation of tacit knowledge and converts it into explicit knowledge (Cowan *et al.,* 2000).

Within the literature, theoretical and empirical interest in knowledge articulation is evident. For example, Ractham and Sirsamran's (2018) research findings suggest articulation is associated with team performance. While Zollo and Winter's (2002) conceptual piece denotes articulation as a learning mechanism essential to the development of organisational operating routines. However, there is a scarcity of research on the mechanisms used to explicate tacit knowledge and the challenges encountered during the practice of articulation. In addition, prior studies, which have empirically examined Nonaka's externalisation mode have failed to probe into the nature of articulation (Dyck *et al*., 2005; Al Attar and Shaalan, 2016; Farnese *et al*., 2019). On account of this, it is necessary to understand the mechanisms used during the practice of articulation and the challenges encountered therein.

This research study aims to understand the articulation process within project teams in PBOs, specifically examining how knowledge is shared, focusing on the mechanisms used during the articulation process. The proposed research design intends to operationalise the research aim and address the following research questions (RQ):

RQ1 - How is knowledge shared in project teams?
RQ2 - How is knowledge articulated in project teams?
RQ3 - What mechanisms are used to articulate knowledge?

The forthcoming section provides the philosophical assumptions pertaining to this study, this is followed by the research design and method, the sampling strategy, data analysis and concludes with ethical considerations.

2.0 Philosophical assumptions

All researchers are guided by a set of principles that combine beliefs about ontology (the nature of reality), epistemology (creating knowledge), methodology (the process of seeking new knowledge) and human nature (the relationship between man and society) (Burrell and Morgan, 1979; Denzin and Lincoln, 2018). These beliefs shape how the researcher views and acts in the world and are regarded as one's philosophical position or stance. Hence, the researcher is more acutely aware of their assumptions and potential biases. Acknowledging one's philosophical position in advance of undertaking the research itself is critically important (Adcroft and Willis, 2008) to seeing how preconceived and embedded worldviews can be superimposed on the research direction and later, research findings. This is summed up by Adcroft and Willis (2008 p. 314) that, "Differing views of the world inevitably lead to differing views on how that world can be analysed and understood". The researcher in this study recognises her philosophical position is in interpretivism. Further acknowledgement is that the researcher is studying an organisation that she is not working in, and this brings additional self-review of different values systems to proposed participants in this research. In remaining aware of these differences and scale of subjectivity, the researcher understands decisions and judgements need to align with credible research practice at each stage of the research process (Saunders *et al*., 2016).

In Burrell and Morgan's (1979) four-quadrant schema, the principles of ontology, epistemology, methodology and human nature reflect four distinct paradigms: functionalist, interpretive, radical humanism, and radical structuralism. Each paradigm identifies separate world views of the social world or philosophical position, these world views are based on

assumptions concerning the nature of science and society. While Burrell and Morgan's framework presents the philosophical positions in their purest form, it has been acknowledged that the boundaries which defines each position is unclear and are considered transition zones. These transition zones suggest that the philosophical positions are not totally independent or completely separated, and therefore paradigms exist derived from a blend of the principles (Gioia and Pitre, 1990). Burrell and Morgan (1979) contend that their schema could be used to determine the intellectual roots of each world view, the philosophical position or frame of reference that researchers adopt, and one's frame of reference in respect to social theory. Following an analysis of Burrell and Morgan's (1979) schema, this research study leans towards the interpretivist paradigm, favouring knowledge as subjective. However, the researcher does not deny that an objective form of knowledge exists and recognises aspects of this research study may incorporate insights from the functionalist paradigms and therefore may reside in the transition zone (Gioia and Pitre, 1990).

Interpretivism is a philosophy defined by a need to understand the tenets of the social world at the level of subjective experience (Burrell and Morgan 1979). This philosophy assumes that reality is self-created and constructed through the meaning and understanding derived from social interaction and lived experience, particularly sharing experiences with others. Therefore, reality is personal and dependent on the individual. Interpretivism follows an ideographic approach to social science in that it seeks to acquire knowledge by understanding the essence of a phenomena through the participant's eyes. Interpretivism is informed by the concern to understand a phenomenon from an individual's perspective and lived experience (Burrell and Morgan, 1979), which is central to this research study.

This study attempts to understand the individuals' (i.e., the proposed participants in this research) understanding and experience of how knowledge is shared through articulation within project teams. Consequently, the methodological approach to subjective research should place the participants' interpretation at the centre of the study. To gain a deeper insight from the proposed participants' frame of reference the researcher aims to interpret how participants convey thoughts, ideas, and feelings in their actions (Denzin and Lincoln,

2018; Burrell and Morgan, 1979). This involves getting as close to the participants' reality as possible and recognising generalisations cannot be drawn from the richness of these experiences (Denzin and Lincoln, 2018; Burrell and Morgan, 1979).

For the reasons outlined, an interpretivist approach is adopted to address the research questions and study aims. The following section details the overarching research design approach to the study.

3.0 Qualitative research design

As previously stated, this research study seeks to acquire deeply embedded knowledge by understanding the essence of a phenomena from the perspective of the participant who has lived it. This is best understood within its natural setting, and thereby favours the interpretive paradigm. The nature of interpretivism lends itself to a qualitative approach (Kelliher, 2011). This is notwithstanding the fact that qualitative research can also take a positive approach (Lin, 1998; Dubé, and Paré, 2003). Central to this research study is knowledge sharing and articulation, existing research in this domain, has predominately been quantitative in nature (Kipkosgei *et al*, 2020; Hu and Randel, 2014). In this study, the qualitative approach will allow the researcher to explore knowledge sharing at a more visceral level, looking for deep, and rich information gathered from participants daily lived experience. What is known to date is knowledge articulation has been closely linked to knowledge sharing (O'Meara and Kelliher, 2020) and is recognised to aid in the conversion of tacit knowledge into an explicit form (Nonaka, 1994; Ambrosini and Bowman, 2001). Yet, this conversion process lacks understanding; indeed, to date, a scarcity of research addresses knowledge articulation (O'Meara and Kelliher, 2020). In this study, adopting a qualitative approach may help unearth the nuances of this process, thereby exposing the process of articulation during knowledge sharing within a given context (Hakanson, 2007), such as project-based organisations.

Ritchie *et al.* (2013) suggests that various qualitative research categories–contextual, explanatory, evaluative, and generative–determines the kind of knowledge produced. Table 1 outlines the different qualitative research classifications and the purpose of each. This

research study is not concerned with frequencies or incidents, nor is it concerned with developing new theory akin to the grounded theory approach (Strauss and Corbin, 1997); instead, the research interests lie in rigorously examining and exploring knowledge sharing and articulation in context. Therefore, this is an explanatory and contextual study, as it aims to explore how knowledge is shared in order to understand the articulation process within project teams.

Table 1: Qualitative research categories (Ritchie *et al*., 2013)

Qualitative research categories	Purpose of the research categories	Application to this study
Contextual	Focuses on exploring the understanding of a phenomena as experienced by the individuals. Used to describe and display phenomena in a real-world context.	Project-based organisations will be the contextual setting to explore the research phenomena, knowledge sharing.
Explanatory	Examines why a phenomenon occurs and the reasons for its occurrence.	This study aims to explore how knowledge is shared through the understanding of the articulation process.
Evaluative	Centred on the process of implementing a phenomenon and determining its effectiveness.	Not applicable – this study is not concerned with implementing or making interventions and assessing outcomes.
Generative	Concentrates on producing new ideas to the development of social theory or generate solutions to social problems.	Less applicable – this study is not concerned with producing new ideas as a contribution to the developing of theory or to the refinement of policy solutions. Although, there may be aspects of this study which aligns with this category, the study is more suited to the explanatory and contextual category.

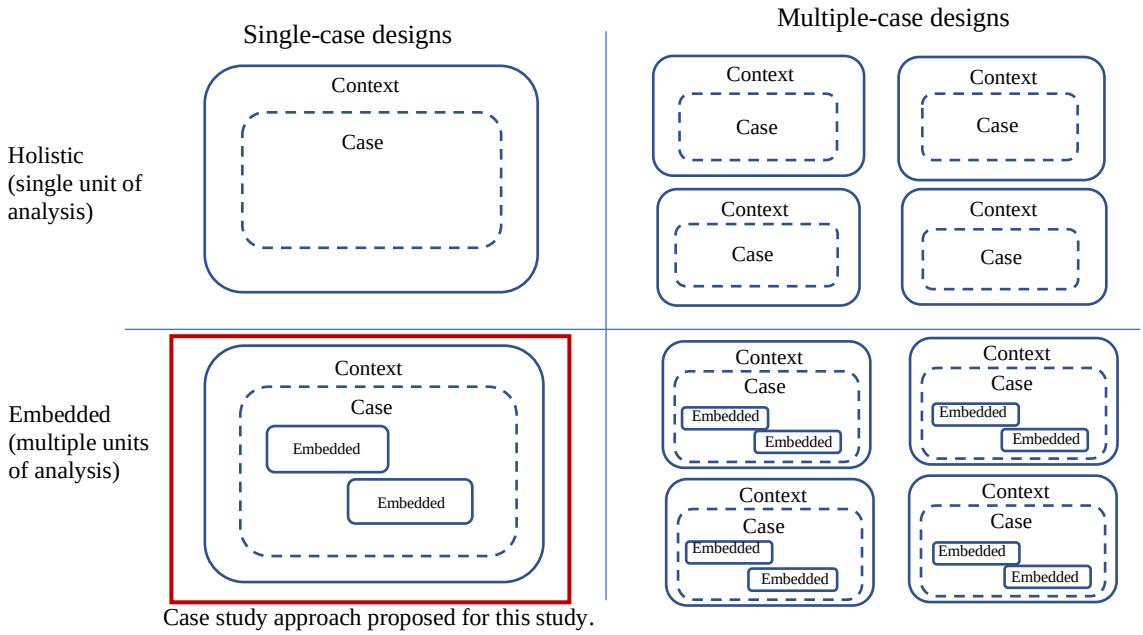
Having highlighted important features of the overall qualitative approach, the following section presents the more specific qualitative approach adopted.

4.0 Case study research design

The approach adopted is a case study approach. The case study approach is not exclusive to qualitative design. Indeed, it is an approach that fits well with both qualitative and quantitative designs (Yin, 2009). Furthermore, a case study approach can be interpretivist or positivist in nature (Eisenhardt, 1989; Walsham, 1995; Yin, 2009). Given the contextual and exploratory nature of this study, the study leans towards the interpretivist approach. The case study approach is deemed to be the most suitable method for the current study as it provides the opportunity to gain a deeper understanding of the phenomena being studied, i.e., knowledge sharing (Eisenhardt, 1989). The researcher is confident that this approach will contribute new knowledge to the knowledge sharing phenomena, while being mindful that the aim of this research is not to generalise the findings to other populations but to explore an under-explored phenomena. When individual perspectives or interpretations are central to the aim of the research, case studies can have significant benefits, particularly when *how* type questions are presented (Conaty, 2021). Following Yin (2009), the researcher argues that the case study approach is appropriate as it allows for the exploration of a contemporary event, over which the researcher has little or no control. This study intends to explore, in-depth, a deeply embedded organisational process, knowledge sharing, from multiple perspectives, within its natural setting. A case study approach allows the process of knowledge sharing to retain its holistic and meaningful qualities. Furthermore, the researcher does not manipulate the events that surround the phenomena as they unfold (Yin, 2009). Additionally, using this approach assumes that the context surrounding the case being studied is essential to understanding the case and therefore warrants examination (Ridder, 2017). This is pertinent to this research given that knowledge sharing is central to this study and knowledge is context specific, hence, it has no meaning if it is separated from its context (Klein and Myers, 1999). To understand how knowledge is shared among project team members, one must consider the context of the phenomenon's occurrence, given that the context surrounding knowledge shapes and enacts it. That is, knowledge sharing does not occur in a vacuum; it is grounded in the context in which it takes place (Nonaka, 1994). Therefore, context is relevant to this research study.

Case study research can take a single case study or a multiple case study approach. A single case study approach allows one to explore a phenomenon in depth within one case, whereas the multiple case study approach explores a phenomenon in depth within multiple cases (Yin, 2009). Yin (2009) observes that single or multiple case study research designs utilise a holistic or embedded variant of the approach; these in turn produce four different types of case study designs, as depicted in Figure 1. The holistic or embedded variant depends on the unit of analysis being analysed. For instance, a single unit of analysis is considered holistic, while multiple units of analysis are considered embedded.

Figure 1: Research designs for case studies (Yin, 2009)



This research study intends to investigate one organisation i.e., the case. The study will concentrate on the process of knowledge sharing within multiple project teams. i.e., the unit of analysis. Therefore, this study has multiple embedded units of analysis. Hence an embedded, single-case research design is recognised as the best fit for this research study. Regarding the contextual setting, this research study will explore one project-based organisation within the engineering, procurement, and construction sector (i.e., EPC sector) in Ireland; the contextual setting is further discussed in Section 5.0.

5.0 Selecting the case and unit of analysis

Selecting the appropriate case and unit of analysis is an important step in qualitative research because the quality of the conclusions inferred from the research findings are informed by the participants involved (Onwuegbuzie and Collins, 2007). The technique used to select the case and unit of analysis is driven by the purpose of the research and the research question. A non-probability, selection technique will be used as the preferred selection method for this research study. Non-probability selection technique helps researchers to subjectively select participants that represent the case under study. The study participants are carefully selected based on distinct characteristics (Ritchie *et al*., 2013). The process of knowledge sharing within multiple project teams, is distinct and central to this research study (the unit of analysis) therefore, it is essential that the profile of the case should rely heavily on knowledge sharing. Organisations which adopt project-based structures such as engineering, procurement, and construction (EPC) (Hobday, 2000; Sydow *et al*., 2004) are dependent on knowledge sharing, because knowledge sharing offers insights for future projects (Schindler and Epplier, 2003). Project teams are central to project-based organisations (PBOs) because team members rely on each other to complete a team task (Buvik and Rolfsen, 2015) and are the main transporters of knowledge (Ajmal and Koskine, 2008). Hence, the interdependent nature of project teams suggests knowledge ought to be shared amongst members. Therefore, PBOs provide a rich context for this study. Using a single-case research design will allow the researcher the opportunity to rigorously explore knowledge sharing within project teams.

As this study is not concerned with generalisation to a population but is concerned with participant perspectives a purposive sampling scheme will be used to select the interview participants for this research study. Purposive sampling is recognised as one of the main sampling approaches developed for qualitative research inquiry (Ritchie *et al*., 2013; Miles *et al*., 2014). It is a technique which is based on the calculated choice of participants due to the characteristics or particular features they possess (Patton, 2002; Ritchie *et al.*, 2013). Purposive sampling is used to identify and select information rich participants from which one learns from the insights of others (Patton, 2002). As this study seeks to explore knowledge sharing within project teams it is important to choose participants that meet a

predetermined criterion (Patton, 2002) and which will yield rich and thick information. Table 2 outlines the criteria for selecting the project team for the current study.

Table 2: Selection criteria for the project team

Criteria for selecting the project team for the current study
Team size ranges from 5-8 members.
A minimum of 80% team members participation is needed for interviews.
Team members may be permanent or temporary employees or sub-contractors to the selected organisation.

Sample size in qualitative research is justified by the idea of data saturation, whereby no new information is revealed in the data (Boddy, 2016). An appropriate number of team members should be selected to yield rich, thick data, whereby data saturation is met (Leech and Onwuegbuzie, 2008). Guest *et al.* (2006) argue that 12 interviews were enough to reach data saturation. While Alder and Alder's (2012) research suggests approximately 30 interview participants, are required to make an adequate sample for a qualitative research. The researcher's intention for this study is to interview four project teams, each team comprised of five to eight members. To ensure rich data are collected from a team perspective, 80% of team members' participation is needed for team member interviewing. This will yield a total of 20 to 24 interviews.

Project teams may be comprised of permanent and temporary employees as well as sub-contractors, given that the structure of PBOs differs from other business structures. In PBOs projects are the central unit of production, and the particular project needs determine the PBO's structure (Hobday, 2000). Hence, a discipline or skill external to the PBO may be needed to complete the project and is therefore sub-contracted out to another individual and/or organisation. Therefore, it is necessary to include sub-contractors as part of the project team selection criteria.

The following section details the most appropriate data collection methods intended to be used in this single case research study.

6.0 Research methods

This single-case research study will use a number of data collection methods, such as in-depth semi-structured interviews, document reviews, and observations. In addition, the researcher intends to use reflective journals to record her thoughts and opinions throughout the research study (Ortlipp, 2008). Using multiple data collection methods will allow the researcher to cross-check findings across data sets (Bowen, 2009). This process of triangulation adds rigour to the research, verifies the findings of the study and strengthens the credibility of the research (Lincoln and Guba, 1986).

6.1 Semi-structured interviews

In this research study the research aim is to explore how knowledge is shared, in context. Knowledge sharing by its nature is complex and difficult to understand. To gain a deep understanding of this phenomena the data collection strategy employed needs to facilitate inquiry and probing to elicit rich and thick accounts of participants' perspective of the phenomena. Such rich and thick accounts of perspectives give the researcher access to the nuances of changing interpretations (Walsham, 1995). Therefore, in-depth semi-structured interviews offer the most appropriate means for collecting in-depth data.

Semi-structured interviews are acknowledged as the most prominent data collection method used in qualitative research (Denzin and Lincoln, 2018). They are widely recognised as a key method for capturing participants' interpretation of phenomena within a given context (Walsham, 2006). Understanding participants' experiences through semi-structured interviews is, by its nature, a multi-layered interpretive process, whereby the researcher is trying to understand the participants' interpretations of a given phenomenon or experience (Smith and Osborn, 2007). Semi-structured interviews are based on human conversation (Denzin and Lincoln, 2018; Qu and Dumay, 2011), which allows both the researcher and the participant to engage in real-time dialogue (Pietkiewicz and Smith, 2014). This, in turn, aids in the development of rapport, whereby the participant feels comfortable and is assured that the researcher is interested in what they have to say (Leech, 2002). The development of rapport during the interview process is fundamental to the researcher's depth of access to the participants' perspectives, beliefs, knowledge (Alvesson, 2003; Tucker and Parker, 2019)

and perceived truth. This rapport thus lends itself to free and open expression; hence, richer knowledge is gained.

During the interview process, the researcher will lead the conversation based on an interview guide. Section 7.2 outlines the design of the interview guide. Comprised of predetermined themes or areas of interest, this guide will address the relevant research questions (Qu and Dumay, 2011). However, the interview guide (Appendix A) is considered flexible and subject to change (Adams, 2015). It allows participants to tell their story (Smith and Osborn, 2007) using their own terminology and language (Qu and Dumay, 2011). This flexibility allows themes to emerge that the researcher might not have foreseen (Smith and Osborn, 2007). Using semi-structured interviews, the researcher can change the ordering, style, and pace of the questions (Qu and Dumay, 2011), follow-up on any viewpoints that the researcher considers important, and to clarify ambiguous responses, which, in turn deepens understanding and makes better use of the opportunity to produce new knowledge (Denzin and Lincoln, 2018). Semi-structured interviews give way to non-verbal cues and subtle gestures such as voice tone and body language (Berg, 2001). Additionally, semi-structured interviews allow the researcher to discover more information through prompting questions, consequently facilitating richer data development (Tucker and Parker, 2019).

Overall, semi-structured interviews help illuminate complex issues. The interview guide acts as a structure that is fluid but ensures that all themes pertinent to the research aim are addressed. Although semi-structured interviews are considered an effective method of qualitative data collection, they are not without faults. Adams (2015) explained that semi-structured interviews require considerable time and effort, which involves preparation, setup, conducting the interview, and analysing the data. Section 7.1 details the interview preparation.

6.2 Documentation

"Documents plays an explicit role in data collection in doing case studies" (Yin, 2009, p.103). The documents selected to be incorporated into this study will be those that allow the researcher to answer the research questions. Given the research questions, the documents

selected will inform this study at two levels. Firstly, documentation relevant to the wider context of the organisation, given that the organisation is the case, such as publicly available sources (i.e., the company vision and mission statement), will be reviewed and analysed to understand the overall strategy in knowledge sharing. This analysis will also include the company web site to help the researcher gain understanding of the background context of which knowledge sharing functions. In addition, these documents may provide the researcher with insights into the organisation's attitude towards the phenomena being studied. The second level of documentation is pertinent to the unit of analysis, the process of knowledge sharing in project teams, and is therefore of main interest to the researcher. The researcher intends to concentrate mostly on documents relevant to knowledge sharing. Multiple documents such as, minutes of meetings, lessons learned, internal memos, and training manuals will be attained for analysis for this study, these documents, although historic, may reflect the knowledge sharing process. In addition, documents, electronic or hard copy, used during project teams meetings, or by the project teams that captures data which illustrates the articulation process through knowledge sharing will be analysed. Documentation can provide specific details to support and substantiate the information gathered from in-depth semi-structured interviews (Yin, 2009).

6.3 Observation

Preliminary discussions between the managing director, of the intended organisation for this single case study, indicated there may be potential for the researcher to undertake observations of meetings and presentations, as part of the data collection method. The level of access the researcher will have to the organisation will be established once the researcher makes a formal approach to the organisation. Consent from all team members will be needed for observations to take place (refer to Appendix D). Observations allow the researcher to see participants in their real-life setting and interactions between project team members, that gives a more holistic perspective of the case (Patton, 2002; Heigham and Croker 2009). This perspective is important because it is an opportunity to see the behaviour of the participant in a new light and potentially expose new aspects to a context that has not been depicted before (Patton, 2002).

Observation is a form of data collection using all of one's senses particularly looking and listening (McKechnie, 2008). It involves methodical note taking of incidents, behaviours, and artifacts (objects) within a social setting (Marshall and Rossman, 1989). Observation methods consist of non-participant observation, where the researcher has no other relationship with the participants being observed, and participant observation whereby the researcher interacts with the participants being observed while they are conducting their daily tasks. The researcher of this study intends to undertake the role of a non-participant (passive) observer, and therefore will be uninvolved with the participants. Given that the data collected from observations is filtered through the lens of what is familiar to the researcher, this could taint the research findings. Therefore, the researcher intends to practice bracketing (which is further discussed in section 9.2) and use reflective journals to help minimise observation bias. The data will be captured through field notes, aided by an observation guide (refer to Appendix B) which will supplement the data gained through the semi-structured interviews and documentation.

7.0 Research method operationalisation

The following section discusses the interview preparation process, including the interview guide design.

7.1 Interview preparation and interview guide

Considerable planning and preparation are necessary to support the interview process (Qu and Dumay, 2011). Kvale and Brinkman (2009, p. 89) stated that "the skills, the knowledge, and the personal judgement necessary for conducting qualitative interviewing of high quality requires extensive training". Active listening is fundamental to the interview process; it requires the researcher to concentrate fully on what the participant is saying and to detect when a connotation needs to be further investigated (Louw *et al*., 2011; Ritchie *et al*., 2013). Therefore, in preparation for the actual data collection process, the researcher will conduct two pilot interviews. The pilot interviews will help the researcher develop her interviewing skills and identify aspects of the interview guide that may need refinement. The design of the interview guide is addressed in Section 7.2. Prior to the interview, the researcher will connect with each participant via email and/or telephone. Additionally, an information

document (refer to Appendix E) outlining the purpose of the research study and the informed consent document which provides reassurance of personal and organisational confidentiality, will be provided (refer to Appendix C). Ethical considerations are discussed in Section 9.

The researcher's preferred method of data collection is face-to-face semi-structured interviews. However, due to the COVID-19 pandemic, she recognises that this may not be possible and as an alternative video conferencing interviews will be used. Although video conferencing interviews are recognised for having many advantages (Gray *et al*., 2020), subtle gestures such as body language may be missed. Each interview will be scheduled at the convenience of the participants and, with the participants' permission, will be recorded. In addition, field notes will be taken throughout the interview process.

7.2 Design of the interview guide

To aid the flow of the interview process (Ritchie *et al*., 2013), a preliminary interview guide has been prepared (refer to Appendix A). The interview guide identifies the main themes to be explored with each project team member. Themes identified are aligned with the research aim, the research questions, and the conceptual framework outlined in Paper 1 (reproduced in Appendix F). The interview guide will be trialled through pilot interviews and then refined if necessary. Various question styles will be used during the interviews. Table 3 outlines the question styles, which will be adapted for this research study. The questions are designed to identify and describe key elements of the knowledge sharing process. In addition, the sequencing of the questions are considered. The sequence of interview questions can aid in the development of rapport while helping participants acclimate to the interview process (Leech, 2002). For example, at the beginning of the interview, the researcher intends to use closed questions, moving into more open-ended questions as the interview progresses (Adams, 2015).

Table 3: Interview style questions (Adapted from Ritchie *et al*., 2013).

Type of Questions	Purpose	Example of question styles	Examples of application to the current research study
Probing	To elicit more information for clarity and understanding.	Can you say more about that?	Used throughout the interview process. *Can you give me an example? Why so? Can you expand on that?*
Open	To place the onus on the participant to provide the information.	What is your opinion about that?	Used throughout the interview process. *Based on your opinion do members of your team actively share experience and insights with other members of your team?*
Closed	To clarify details for understanding.	Yes/no or single word	Used to collect background information. *How long have you been working with this team?*
Non-leading (leading)	To lead the interviewee in a particular direction without influencing the response.	How did you feel about that?	Used throughout the interview process. *Are members of your team willing to share knowledge with others in their team or not?*
Mapping/follow-up	To redirect the question back to a response or an answer. The response is mapped to the research aims.	Can you talk me through the process?	Used throughout the interview process. *Can you explain how team members are encouraged to discuss problems that emerge?*
Prompts	To direct the interviewee's attention to a perspective or topic.	Do you see this phenomenon being relevant here?	Used throughout the interview process *Do you see the importance of sharing knowledge with others in your team?*

Semi-structured interviews incorporate a set of predetermined questions developed around various themes. The themes and questions formulated for this research study were guided by the conceptual framework outlined in Paper 1 (reproduced in Appendix F), the research study aim and the research questions, and thereby forms the preliminary interview guide (refer to Appendix A). Table 4 identifies the themes, linked to the research questions and the conceptual framework.

Table 4: Identified interview themes, theme objective, aligned with conceptual framework

Theme	Theme objective	Linked to the conceptual framework (CF) and research questions (RQs)
Knowledge holder's perspective		
A. Knowledge sharing	To explore whether knowledge is being shared, the participant's willingness to share knowledge, the type of knowledge shared, the frequency of knowledge being shared and management support.	CF: No. ① ② ③ ④ RQ 1. How is knowledge shared in project teams?
Team perspective		
B. Knowledge articulation. (Dependent on the response of theme A, recognising knowledge is being shared)	To explore articulation by identifying the existence and frequency of articulation (meaningful dialogue), whether team members are encouraged to participate diligently in meaningful dialogue and whether team members are encouraged to discuss different themes openly.	CF: No. ① ② ③ ④ RQ 2. How is knowledge articulated in project teams?
C. Challenges of knowledge sharing	To explore the type of challenges/inhibitors encountered during knowledge sharing.	CF: No. ① RQ1. How is knowledge shared in project teams? RQ2. How is knowledge articulated in project teams?
D. Enablers of knowledge sharing	To explore the type of enablers which facilitate the knowledge sharing process.	CF ① ② ③ ④ ⑤ RQ1. How is knowledge shared in project teams? RQ2. How is knowledge articulated? RQ3. What mechanisms are used to articulate knowledge?
Knowledge recipient's perspective		
E. Understanding the shared knowledge	To explore how the recipient understands the shared knowledge, whether self-reflection and inquiry takes place and whether collective team understanding is created.	CF: No. ② ③ ④ ⑤ RQ3. What mechanisms are used to articulate knowledge?
Knowledge holder's perspective		
F. Knowledge is not being shared	To explore and understand why knowledge is not being shared.	CF: No. ① ② ③ ④ RQ 1. How is knowledge shared in project teams? RQ2. How is knowledge articulated in project teams?

8.0 Analysis strategy

As previously stated, this study intends to explore, in-depth, the process of knowledge sharing. Using multiple data collection methods will allow the researcher to draw upon the many detailed findings identified across the varied data sets. This in turn will lead to a thick description pertaining to knowledge sharing and may unveil the nuances of this process. This is referred to as crystallisation (Ellingson, 2014). Therefore, it is imperative to the credibility of the research findings that the researcher details how she arrived at her findings (Walsham, 1995). The researcher intends to use reflective journals and diaries as a method to track her thought process during the analysis of the data. Consistent with Yin's (2009) case study analysis, comprised of pattern matching of the data, this study will be leveraging Braun and Clarke's (2006) thematic analysis framework, thereby pursuing a planned analysis strategy. Analysis of the data collected through interviews, documentation, and observation, will follow Braun and Clarke's (2006) six phases of analysis: familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes and finally producing the report. This analysis strategy is a recursive process (Castleberry and Nolen, 2018) that occurs concurrently with data collection (Eisenhardt, 1989; Miles *et al*., 2014). The coding phase of analysis is considered crucial (Miles *et al*., 2014) and will be inductive. Whilst the themes used in designing the interview guide will assist with the initial coding process, a pre-designed detailed coding frame will not be used.

Single-case research design entails the handling and development of large amounts of data, such as interview transcripts, field notes, documentary sources and reflective journals. This data needs to be managed efficiently, which in turn will aid in supporting the dependability and credibility of the research. NVivo will be used as a data management platform to store the data collected during this research study and, more importantly, to aid in the analysis of the data. This software supports the utilisation of coding, querying and mapping. The researcher intends to use the audio-to-text software application 'Temi' to transcribe the recorded interviews verbatim. The transcripts will be checked against the original audio recordings for accuracy (Braun and Clarke, 2006). Before the transcribed interviews are merged into NVivo, the participants will be given the opportunity to review their transcript

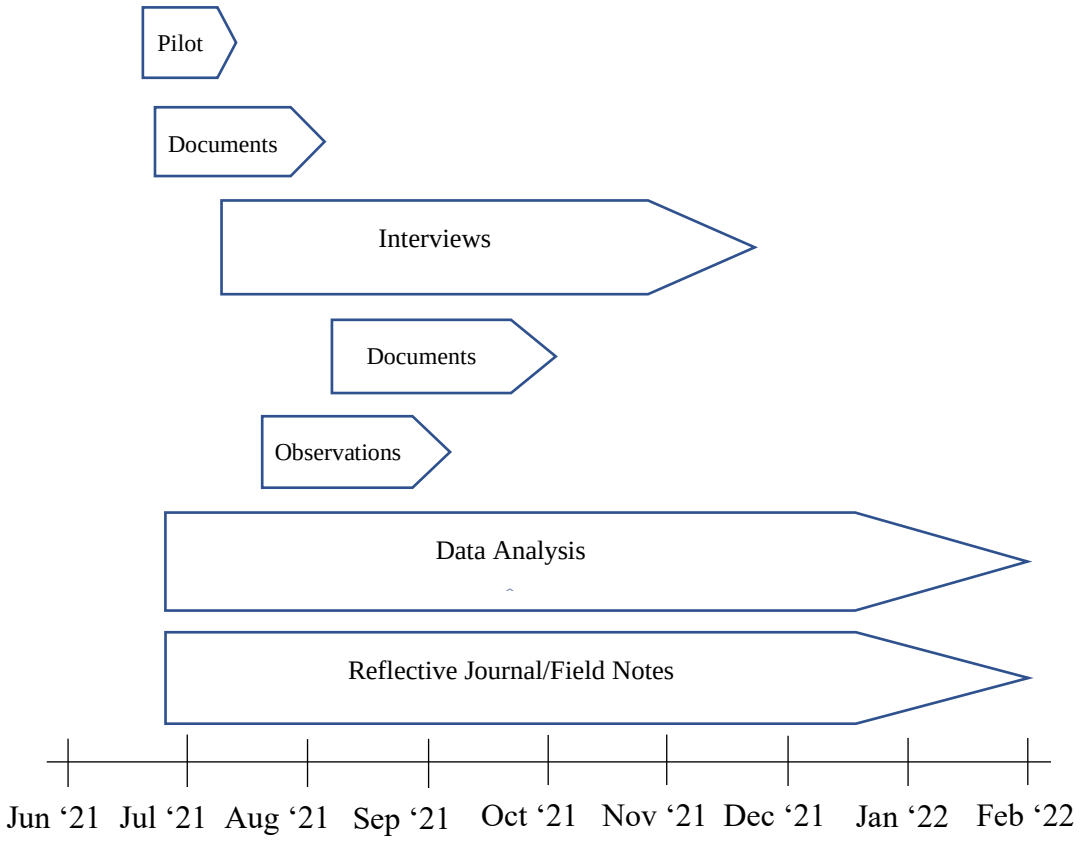
to ensure there is no distortion in the narrative; they may either approve the narrative or request that information be retracted from the narrative.

The transcribed interviews, the documentary sources and the observation field notes will be analysed in NVivo. This software will aid in the filtering and segmentation of the inputted data to recognise familiar codes and patterns. The memo feature will be used to maintain an accurate record of the researcher's decisions at various points of the analysis, thereby supporting and justifying the codes and themes applied in addition to the hierarchical structure of the data. This in turn will act as an audit trail for synthesising the findings (Houghton *et al*., 2016).

8.1 Implementation

Data collection and analysis is intended to take place over a nine-month period, between June 2021 and February 2022. A tentative timeline is illustrated in Figure 2.

Figure 2: Data collection and analysis tentative timeline



The researcher intends to conduct the pilot study in late June. There will be two forms of pilot in this study. One form will be used as an opportunity to practice the interview technique and does not involve participants from the intended contextual setting. Therefore, the data collected in this pilot will not be included in the study. The second form will involve one participant from the intended organisation, a functional manager. This pilot will help determine if the data collection instrument needs refinement. As this pilot does involve a participant form the intended contextual setting the data collected will be included in the study. Historical documents pertaining to the organisational context and the process of knowledge sharing (unit of analysis) is planned to be collected in late June. It is anticipated to take several days to filter through the documents, to determine which are relevant to the study before analysis can commence. This is expected to start in early July and, conclude early August. The interview process will commence mid July. Data collection and analysis from the interviews is expected to take up to six months (July to December). Additional documents, electronic or hardcopy, used during project team meeting and/or by the project teams will be collected and analysed alongside the interviews. Observations and analysis of observational field notes are likely to take place in conjunction with the data collection and analysis of the interviews. A further two months is factored into the timeline, this is to allow the researcher time to: cross-check the data collected from the various data sets (triangulation) (Lincoln and Guba, 1986); and to reflect on her intimate understanding of the many details collected from the data, to help identify themes or patterns (crystallisation) (Borkan, 1999; Ellingson, 2014).

9.0 Ethical assessment

Ethical consideration should be at the centre of research from the design stage right through to reporting findings (Ritchie *et al.*, 2013). Prior to commencing data collection, ethical approval will be sought from Waterford Institute of Technology, Business School Ethics Committee. In preparation for the ethics committee submission the researcher is mindful of potential ethical issues which may arise within this research study.

Organisation and individuals' confidentiality will be respected, therefore in order to protect the identity of the organisation and the interview participants all data collected will be treated

delicately and kept confidential. Interview transcripts, documentation and observational field notes will be cleaned to remove any connotation pertaining to the organisation and the participants involved. The data collected will be password protected and securely stored on an external hard drive. Prior to commencing the study, a consent form detailing confidentiality and an information sheet, outlining the purpose of the research study will be sent to all interview participants. All participants will be notified that their participation is voluntary, and they can request to withdraw from the study up until the point of data merge.

9.1 Gatekeeper bias

The sampling selection of potential research participants has an ethical aspect that researchers must consider. Researchers are obligated to give a clear indication on how they will reduce potential bias in the recruitment of participants while incorporating participant voluntariness (Singh and Wassenaar, 2016). The researcher recognises access to the research participants is through the managing director of the organisation. The managing director is securing consent for the researcher to make contact with the interview participants. Therefore, the managing director is essentially acting as the gatekeeper whereby he is controlling the recruitment of the research participants (Ritchie *et al*., 2013). This raises ethical concerns for the researcher in that, the researcher must ensure the gatekeeper is not placing pressure on participants to partake in the study. Furthermore, the researcher needs to ensure the gatekeeper is not cherry picking the participants to be included in the research, and thereby denying individuals the opportunity to participate (Ritchie *et al*., 2013). This in turn would impact the rigour of the research. The researcher along with the managing director, have agreed that a different point of contact, a functional manager, would be best for the study. This point of contact will aid in the organisation and coordination of access to participants and organisational documentation which in turn will help minimise gatekeeper bias. In addition, it will be suggested by the researcher, that a letter written by the managing director will be sent to all project teams, inviting the team members to volunteer for the study. The letter will emphasise that the team members are not compelled to take part in the study. This in turn should help further reduce gatekeeper bias.

9.2 Interview bias

Central to this research is understanding the process of knowledge sharing from the participants' perspectives, which is subjective by nature and lends itself to researcher bias. All researchers have preconceptions, beliefs, and assumptions about a given phenomenon. It is the researcher's responsibility to set aside or suspend their beliefs, to keep from influencing the participant's view on the topic and thus tarnish the research process (Tufford and Newman, 2012). Essentially the researcher needs to remain impartial and start from a clean canvas, such that all judgements and prior knowledge are put to one side. This process is referred to as bracketing. The researcher intends to implement the process of bracketing, this is a concept that is frequently associated with phenomenology. Although this research is not a phenomenological study, the researcher intends to borrow this concept and use it as a tool to suspend or isolate her own preconceptions and understanding of knowledge sharing. Bracketing is essentially a method used to encourage the researcher to maintain some distance between the researcher and the research topic (Tufford and Newman, 2012). It is where the researcher manages his or her subjective opinions, through reflexivity. Reflexivity, involves a deep thought process where the researcher retraces the steps back through his or her own life, recognising how he or she developed particular opinions and beliefs (Fischer, 2009)—opinions and beliefs that may influence the participant's understanding of the phenomenon (Gearing, 2004), and interfere with how the researcher views the study's data. Reflexivity means developing awareness of how one has formed particular understandings (Fischer, 2009). Therefore, it is essential for the researcher to engage in reflexivity, to identify preconceptions that can then be bracketed. The researcher intends to minimise bias using field notes, memos, and reflective journals. Bracketing adds credibility, and a level of rigour to the research.

10.0 The quality of the data

Researchers following an interpretive paradigm seek for data trustworthiness while researchers following a positivist paradigm seek for the truth in data (Lincoln and Guba, 1986). Validity and reliability are quality measures used to evaluate research (Sarantakos, 2013) and are central concepts to research in that they are concerned with the robustness of the research evidence (Ritchie *et al*., 2013). Validity (internal and external) refers to the

extent to which the findings accurately reflect the phenomenon being studied (Ritchie *et al*., 2013; Gibbert and Ruigrok, 2010). Reliability refers to replicability, that is researchers would arrive at the same results if the study were repeated (Denzin and Lincoln, 1994). Hence, reliability and validity are concepts derived from the origin of the natural science (positivist paradigm) and have been recognised by some scholars as inappropriate and unsuitable to judge the trustworthiness of qualitative research (Lincoln and Guba, 1986). Lincoln and Guba (1986) have established a trustworthiness criterion to replace quantitative measures. This criterion substitutes internal validity with credibility; external validity with transferability; reliability with dependability and objectivity with conformability. The researcher adopts Lincoln and Guba's (1986) trustworthiness criteria as an appropriate qualitative indicator of validity and reliability as used in the natural sciences. Table 5 below illustrates the trustworthiness components related to this case study design and their application to this research study. "Trustworthiness is the 'goodness' criteria for research" (Eriksson and Kovalainen, 2008, p.294). To demonstrate the value of research, it is essential the appropriate criteria or measure is chosen and implemented during the research design and analysis, this in turn, will judge the quality and integrity of the data collected and the data analysed.

11.0 Conclusion

This paper outlines the research methodology proposed for the empirical study of how knowledge is shared, focusing on the mechanisms used during the articulation process. Guided by an interpretivist approach, this study will follow a case study design. Project-based organisations are considered a good fit for the contextual setting of this research, given that they rely heavily on knowledge sharing. Knowledge sharing within multiple project teams is the focus of this research and is therefore the unit of analysis. Data collection will be undertaken through multiple and varied sources and analysed through thematic analysis. The sampling strategy selection criteria has been defined and ethical considerations are discussed. This research study proposes to enhance the existing body of literature pertaining to knowledge sharing and to provide insights for project-based organisations to the nuances of practice of knowledge articulation within teams.

Table 5: Trustworthiness criteria applicable to the current study.

Examining the quality of the data	Single embedded case study design	Application to the current research study
Credibility	Triangulation	This research study uses multiple and varied data sources such as interviews, documentation, and observations. This will allow the researcher to cross-check findings across data sets.
	Crystallisation	The compilation of the many details derived from the interviews, documents, observations, and reflective journals will produce thick description of the phenomenon.
	Member check	A written copy of the transcribed interview will be sent to the interview participants to review.
	Audit trails	A record of the researcher's decisions at various points of the analysis, will be maintained in a reflective journal. This in turn will support and justify the codes and themes applied. Thus, showing the strong logical link between the data collection and the findings.
	Interview preparation	Piloting the interview guide prior to the actual data collection process will allow for refinement of the interview questions. This will ensure the right questions are being asked to answer the research questions.
Transferability	Pattern matching	During data analysis pattern matching will be performed on the collected data to established consistency across all units of analysis.
Dependability and confirmability	Bracketing (reflexivity)	During data collection and analysis, the researcher intends to perform reflexivity. Reflexivity allows the researcher to bracket or suspended her preconceived opinions, and ideas pertaining to the research phenomenon. Reflective journals will be utilised to manage the researcher's subjective opinions and to track her thought process throughout the research study.
	Audit trails	The reflective journals will be used to maintain an accurate record of the researcher's decisions at various points of the analysis, thereby supporting and justifying the codes and themes applied. Thus, showing the strong logical link between the data collection and the findings.

References

Adams, W. (2015) *Handbook of Practical Program Evaluation* 4th Edn. Chapter: Conducting Semi-Structured Interviews, Publisher: Jossey-Bass.

Adcroft, A. and Willis, R. (2008) 'Philosophy A snapshot of strategy research 2002-2006' *Journal of Management History*, Vol. 14, No. 4, pp. 313-333.

Ajmal, M. M., and Koskinen U. K. (2008) 'Knowledge transfer in project-based organisations: an organizational culture perspective', *Project Management Journal,* Vol. 39, No. 1, pp. 7-15.

Al Attar, F. and Shaalan, K. (2016) 'Enablers and barriers of knowledge spiral: A case study,' *Proceedings of the 11th International Knowledge Management Organisation Conference Changing Face Knowledge Management Impacting Society*.

Adler, P. and Adler, P. (2012) In S. E. Baker and R. Edwards, *How Many Qualitative Interviews are Enough?* National Centre for Research Methods Review Discussion Paper, pp. 8–11.

Alvesson, M. (2003) 'Beyond Neopositivists, Romantics, and Localists: A Reflexive Approach to Interviews in Organizational Research', *The Academy of Management Review,* Vol. 28, No. 1, pp. 13-33.

Ambrosini and Bowman's (2001) 'Tacit Knowledge: Some Suggestions for Organisations', *Journal of Management Studies,* Vol. 38, No. 6, pp. 811-829.

Berg, B. L. (2001) *Qualitative Research Methods for The Social Sciences,* 4th Edn. Boston, Allyn and Bacon.

Boddy, C. R. (2016) 'Sample size for qualitative research', *Qualitative Market Research: An International Journal*, Vol. 19, No. 4, pp. 426-432.

Borkan, J. (1999) 'Immersion/crystallization.' In B. F. Crabtree, & W. L. Miller (Eds.), *Doing qualitative research,* pp. 179-194. Thousand Oaks, CA: Sage.

Bowen, A. G. (2009) 'Document Analysis as a Qualitative Research Method', *Qualitative Research Journal*, Vol. 9, No. 2, pp.27-40.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in Psychology', *Qualitative Research in Psychology,* Vol. 3, pp.77-101.

Burrell, G. and Morgan, G. (1979) *Sociological Paradigms and Organisational Analysis,* USA: Routledge publishing company.

Buvik, M. P. and Rolfsen, M. (2015) 'Prior ties and trust development in project teams – A case study from the construction industry', *International Journal of Project Management* Vol. 33, pp. 1484–1494.

Castleberry, A. and Nolen, A. (2018) 'Thematic analysis of qualitative research data: Is it as easy as it sounds?', *Currents in Pharmacy Teaching and Learning*, Vol. 10, pp. 807-815.

Conaty, F. (2021) 'Abduction as a Methodological Approach to Case Study Research in Management Accounting – an Illustrative Case', *Accounting, Finance, & Governance Review,* Vol. 27, No. 1, pp. 1-15.

Cowan, R., David, A. P. and Foray, D. (2000) 'The Explicit Economics of Knowledge Codification and Tacitness', *Industrial and Corporate Change,* Vol. 9, No. 2, pp. 211-253.

Denzin, K. N. and Lincoln, S. Y. (1994) *Handbook of Qualitative Research,* Thousand Oaks, London: Sage

Denzin, K., N. and Lincoln, S. Y. (2018) *Qualitative Research, 5th* Edn. Thousand Oaks, CA: Sage.

Dubé, L. and Paré, G. (2003) 'Rigor in information systems positivist case research: current practices, trends, and recommendations', *MIS quarterly,* Vol. 27, No. 4, pp. 597-636.

Dyck, B., Starke, A. F., Mischke A. G, and Mauws, M. (2005) 'Learning to Build a Car: An Empirical Investigation of Organisational Learning', *Journal of Management Studies,* Vol. 42, No. 2, pp. 387-416.

Ellingson, L. L. (2014) '"The truth must dazzle gradually": Enriching relationship research using a crystallisation framework', *Journal of Social and Personal Relationships,* Vol. 31, No. 4, pp. 442-450.

Eriksson, P. and Kovalainen, A (2008) *Qualitative Methods in Business Research,* 2nd Edn. Thousand Oaks, CA: Sage.

Eisenhardt, M. K. (1989) 'Building Theories from Case Study Research', *The Academy of Management Review,* Vol. 14, No. 4, pp. 532-550.

Farnese, M. L., Barbieri, B., Chirumbolo, A. and Patriotta, G. (2019) 'Managing Knowledge in Organizations: A Nonaka's SECI Model Operationalization', *Frontiers in Psychology,* Vol. 10, pp. 1-15.

Fischer, T., C. (2009) 'Bracketing in qualitative research: Conceptual and practical matters', *Psychotherapy Research,* Vol. 19, No. 4-5, pp. 583-590.

Furlan, A., Galeazzo, A. and Paggiaro, A. (2019) 'Organizational and Perceived Learning in the Workplace: A Multilevel Perspective on Employees' Problem Solving', *Organization Science* Vol. 30, No. 2, pp. 280-297.

Gearing, R. E. (2004) 'Bracketing in Research: A Typology', *Qualitative Health Research,* Vol. 14, No. 10, pp. 1429-1452.

Gioia, A. D. and Pitre, E. (1990) 'Multiparadigm Perspectives on Theory Building', *Academy of Management Review,* Vol. 15, No. 4, pp. 584-602.

Gibbert, M. and Ruigrok, W. (2010) 'The "What" and "How" of Case Study Rigor: Three Strategies Based on Published Work', *Qualitative Research Methods,* Vol. 13. No. 4, pp. 710-737.

Gray, M. L., Wong-Wylie, G., Rempel, R. G. and Cook, K (2020) 'Expanding Qualitative Research Interviewing Strategies: Zoom Video Communications', *The Qualitative Report,* Vol. 25, No 5, pp. 1292-1301.

Guest, G., Bunce, A. and Johnson, L. (2006) 'How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability', *Field Methods,* Vol. 18, No. 1, pp. 59-82.

Hakanson, L. (2007) 'Creating knowledge: the power and logic of articulation', *Industrial and Corporate Change,* Vol. 16, No. 1, pp. 51–88.

Heigham, J. and Croker, A. R. (2009) *Qualitative Research in Applied Linguistics A Practical Introduction* UK: Palgrave Macmillan.

Hobday, M. (2000) 'The project-based organisation: an ideal form for managing complex products and systems?', *Research Policy,* Vol. 29, pp. 871-893.

Houghton, C., Murphy, K., Meehan, B., Thomas, K., Brooker, D. and Casey, D. (2016) 'From screening to synthesis: using NVIVO to enhance transparency in qualitative evidence synthesis', *Journal of Clinical Nursing*, Vol. 26, pp. 873–881.

Hu, L. and Randel, E. A. (2014) 'Knowledge Sharing in Teams: Social Capital, Extrinsic Incentives, and Team Innovation', *Group & Organization Management,* Vol. 39, No. 2, pp. 213–243.

Jugdev, K. and Wishart, P. (2014) 'Mutual caring-resolving habituation through awareness: supporting meaningful learning from projects, *Project management Journal* Vol. 45, No. 2. pp. 66-82.

Kvale, S. and Brinkman, S. (2009) Interviews – *Learning the Craft of Qualitative Research Interviewing*, London: Sage.

Kelliher, F. (2011) 'Interpretivism and the Pursuit of Research Legitimisation: An Integrated Approach to Single Case Design.' In A. Bryant (eds.) *Leading Issues in Business Research Methods, Academic Publishing International*. pp. 44-61.

Kipkosgei, F, Son, S. Y. and Kang S. (2020) 'Coworker Trust and Knowledge Sharing among Public Sector Employees in Kenya', *International Journal of Environmental Research and Public Health,* Vol. 17, No. 6, pp. 1-17.

Klein, K. H. and Myers, D. M. (1999) 'A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems', *Management Information System Quarterly,* Vol. 23, No. 1, pp. 67-93.

Lee, P., Gillespie, N., Mann, L. and Wearing, A. (2010) 'Leadership and trust: Their effect on knowledge sharing and team performance', *Management Learning,* Vol. 41, No. 4, pp. 473–491.

Leech, B. L. (2002) 'Asking questions: Techniques for semi structured interviews', *Political Science and Politics,* Vol. 35, No. 4, pp. 665–668.

Leech, N. L., and Onwuegbuzie, A. J. (2008) 'Qualitative data analysis: A compendium of techniques and a framework for selection for school psychology research and beyond', *School Psychology Quarterly,* Vol. 23, No. 4, pp. 587–604.

Lin, A.C. (1998) 'Bridging positivist and interpretivist approaches to qualitative methods', *Policy Studies Journal,* Vol. 26, No. 1, pp.162-180.

Lincoln, S. Y. and Guba, G. E. (1986) 'But Is It Rigorous? Trustworthiness and Authenticity in Naturalistic Evaluation', *New Directions for Program Evaluation,* No. 30, pp. 73-84.

Louw, S., Todd, R. W, and Jimarkon, P. (2011) 'Active listening in qualitative research interviews.' *Proceedings of the International Conference*: *Research in Applied Linguistics.*

Marshall, C. and Rossman, B. G. (1989) *Designing qualitative research 4th* Edn, Thousand Oaks, CA: Sage.

McKechnie, L. E. F. (2008) Observational research, in L. M. Given (Ed.), *The Sage encyclopedia of qualitative research methods* (pp. 573–577), Thousand Oaks, CA: Sage.

Miles, B. H., Huberman, A. M. and Saldana (2014) *Qualitative Data Analysis,* Thousand Oaks, CA: Sage.

Mueller, J. (2014) 'A specific knowledge culture: Cultural antecedents for knowledge sharing between project teams', *European Management Journal,* Vol. 32, pp. 190-202.

Navimipour, N. J. and Yeganeh Charband, Y. (2016) 'Knowledge sharing mechanisms and techniques in project teams: Literature review, classification, and current trends', *Computers in Human Behavior,* Vol. 62, pp. 730-742.

Nonaka, I. (1994) 'A Dynamic Theory of Organisational Knowledge Creation', *Organisational Science,* Vol. 5, No. 1, pp. 14-37.

Nonaka, I. and Takeuchi, H. (1995) *The knowledge creating company,* New York: Oxford University Press.

O'Meara, M. and Kelliher, F. (2020) 'Exploring the process of articulating tacit knowledge in an organisational setting', Paper presented at the 34th *Annual British Academy of Management Conference,* 2-4 Sep, University of Manchester, Manchester.

Onwuegbuzie, A. J., and Collins, K. M. (2007) 'A Typology of Mixed Methods Sampling Designs in Social Science Research', *The Qualitative Report,* Vol. 12, No. 2, pp. 281-316.

Ortlipp, M. (2008) 'Keeping and Using Reflective Journals in the Qualitative Research Process', *The Qualitative Report,* Vol. 13, No. 4, pp. 695-705.

Patton, Q. P. (2002) *Qualitative research and evaluation methods,* 2nd Edn. Thousand Oaks, CA: Sage.

Pietkiewicz, I. and Smith, A. J. (2014) 'A practical guide to using Interpretative Phenomenological Analysis in qualitative research psychology', *Psychological Journal,* Vol. 20, No. 1, pp. 7-14.

Polanyi, M. (1966) 'The logic of tacit inference', *The Journal of the Royal Institute of Philosophy,* Vol. 41, No. 155, pp. 1-18.

Qu, Q. S. and Dumay, J. (2011) 'The qualitative research interview', *Qualitative Research in Accounting & Management,* Vol. 8, No. 3, pp. 238-264.

Ractham, V. V. and Srisamran, P. (2018) 'Effects of knowledge articulation and self-reflection on team performance', *Knowledge Management & E-Learning,* Vol. 10, No. 2, pp. 177–195.

Ridder, H. (2017) 'The theory contribution of case study research designs', *Business Research,* Vol. 10, pp. 281-305.

Ritchie, J., Lewis, J, Nicholls Mc Naughton, C. and Ormston R. (2013) *Qualitative Research Practice,* 2nd Edn. Sage publications.

Sarantakos, S. (2013) *Social Research* 4th Edn. UK: Palgrave Macmillan.

Saunders, M., Lewis, P. and Thornhill, A. (2016) *Research Methods for Business Students*. 7th Edn. Pearson Education Limited.

Schindler, M. and Eppler, J. M. (2003) 'Harvesting project knowledge: a review of project learning methods and success factors', *International Journal of Project Management',* Vol. 21, pp. 219-228.

Singh, S. and Wassenaar, D. R. (2016) 'Contextualising the role of the gatekeeper in social science research', *South African Journal of Bioethics and Law,* Vol. 9, No. 1, pp. 42-46.

Smith, J.A., & Osborn, M. (2007) Interpretative phenomenological analysis. in: J. Smith (Ed.), *Qualitative psychology: A practical guide to research methods* Sage publications: London, pp. 53- 80.

Strauss, A. and Corbin, J. M. (1997) *Grounded theory in practice,* Thousand Oaks, CA: Sage.

Sydow, J., Lindkvist, L. and DeFillippi, R. (2004) 'Project-Based Organizations, Embeddedness and Repositories of Knowledge', *Organisation Studies,* Vol. 25, No. 9, pp. 1475-1489.

Tufford, L. and Newman, P. (2012) 'Bracketing in qualitative research', *Qualitative Social Work,* Vol. 11, No. 1, pp. 80–96.

Tucker, B. P. and Parker, L. D. (2019) 'Researcher perceptions and choices of interview media: the case of accounting research', *Accounting and Finance,* Vol. 59, No. 3, pp. 1489-1517.

Walsham, G. (1995) 'Interpretive case studies in IS research: nature and method', *European Journal of Information System,* Vol. 4, No. 2, pp. 74-81.

Walsham, G. (2006) 'Doing interpretive research', *European Journal of Information System,* Vol. 15, No. 3, pp. 320-330.

Yin, R. K. (2009) *Case study research: Design and methods,* 4th Edn. Thousand Oaks, CA: Sage.

Zollo, M. and. Winter, G. S. (2002) 'Deliberate Learning and the Evolution of Dynamic Capabilities', *Organization Science*, Vol. 13, No. 3, pp. 339-351.

Appendix A: Preliminary Interview Guide

Date		Time	
Interviewee			

Thank you for your contribution to this research study. As indicated in the consent form the plan is to record the interview, which is scheduled to take approximately 45 minutes. This will ensure I do not miss any of your statements, additionally I will be taking notes.

As stated in the information sheet, I am keen to get your perspectives and experience on how knowledge is shared in project teams.

Background information

The information provided in this section is confidential and for administrative purposes only.

1) What is your role within the team? _____ (leader, sub-contractor)
2) How long have you been working with this team? _____
3) Have you worked with some of the team members before on other projects? _____

Theme A – Knowledge sharing (knowledge holder perspective)

RQ1 How is knowledge shared?

Based on your opinion:

1) Are members of your team willing to share knowledge with others in their team or not? Probe: How? Why?
2) Are members of your team willing to use their spare time to help other team members or not? Probe: examples?
3) Do members of your team actively share their experience (tacit) with other team members? Probe: How often? What format? Can you give me an example?
4) Do members of your team actively share their insights (tacit) with other team members? Probe: How often? What format? Can you give me an example?
5) Do members of your team use their own initiative to share knowledge with other team members? Probe: example?
6) Are members of your team proactive in helping others whether or not they ask for help? Probe: How often? Why? Explain?
7) Do members of your team share updates about the project, for example the progress of the project (explicit), with other team members?

Theme B - Knowledge articulation (tacit knowledge) – Dependent on the response of theme A (Team perspective).

RQ 2 How is knowledge articulated?

1) Approximately how often would team members meet to resolve work issues? Probe: examples.
2) If a problem emerged in the performance of your daily work, would it be discussed within your team? Probe: example
3) How does the organisation facilitate the discussion of problems that emerge?
4) In your team, if team members propose new ways of doing things, how well is this suggestion accepted by the other team members? Probe: Explain, elaborate
5) Are problems that emerge within your team, shared, and discussed among team members? Probe: example, how?
6) How are the results and clarification of each meeting recorded (if they are recorded)? Probe: Explain.
7) Would you ask another team member/s to teach you how to perform a task or function?

Theme C- Challenges of knowledge sharing (tacit knowledge)

1) What challenges have members of your team encountered while trying to share their knowledge? Probe: explain
2) How was this challenge overcome? Probe: how?

Theme D – Enablers of knowledge sharing (tacit knowledge)

1) What motivates you to share knowledge? Probe: explain
2) How important is the sharing of knowledge with others in your team? Probe: example?

Theme E– Understanding of the shared knowledge (knowledge recipient perspective) (tacit knowledge). RQ3 What mechanisms are used to articulate and share knowledge?

1) If there is a lack of understanding among the team members, regarding the shared knowledge, how is it clarified? Probe: Example, are mechanisms/methods such as metaphors, analogies and storytelling used? (tacit knowledge)
2) How are these mechanisms/methods used?
3) In your opinion which mechanism/method works best to help develop an understanding of the knowledge being shared?

Theme F- Knowledge is not being shared - refers to theme A questions

1) Why do you think team members are not willing to share their knowledge with others in their team? Probe: Explain
2) Why do you think team members do not actively share their experience with other team members? Probe: Explain
3) Why do you think team members do not actively share their insights with other team members? Probe: Explain

4) Why do you think members of your team are not willing to use their spare time to help others team members? Probe: explain?
5) Why do you believe the team members are not willing to share their knowledge?

Concluding the interview:
Is there anything else that you perceive as important in relation to knowledge sharing?

Thank you for your time.
Reassurance of confidentiality
Inform respondents that they will have access to findings/conclusions

Appendix B: Project Review Meeting Observation Guide

Location/Platform: _____

Purpose of the team meeting: _____

Number of attendees: _____

Date: _____

Start time: _____ End time: _____

The purpose of this observation is to understand the process of knowledge sharing in teams, therefore, areas of interest in this study are: how is knowledge shared, how is knowledge articulated and the mechanisms used to share knowledge.

RQ 1 How is knowledge shared?

Reports ☐

Tables ☐

Dashboards ☐

Discussions ☐

Notes: _____

_____

_____

_____

_____

RQ 2 How is knowledge articulated?

Dialogue ☐

Dialectic ☐

Notes: _____

_____

_____

_____

_____

RQ 3 What mechanisms are used to articulate and share knowledge?

Storytelling ☐

Metaphors ☐

Analogies ☐

Concept mapping ☐

Process mapping ☐

Notes: _____

_____

_____

_____

_____

Appendix C: Interview Consent Form

I have read and understood the information sheet provided and by choosing to give consent:

(please tick the box)

1) I am voluntarily participating in this study. ☐

2) I grant permission to record my interview. ☐

3) I understand that I can withdraw from the study up to data merging. ☐

4) I understand that my own and my organisation's details will be kept confidential. ☐

5) I understand that the anonymised data will be cited in the project/thesis and other publications. ☐

Signature

Participant _____ Date _____

Researcher _____ Date _____

Appendix D: Observation Consent Form

I have read and understood the information sheet provided and by choosing to give consent:

(please tick the box)

1) I am voluntarily participating in this study. ☐

2) I grant permission to be observed during project meetings. ☐

3) I understand that the researcher will be taking field notes which will not be attributed to any particular team member. ☐

4) I understand that my own and my organisation's details will be kept confidential. ☐

5) I understand that the anonymised data will be cited in the project/thesis and other publications. ☐

Signature

Participant _____ Date _____

Researcher _____ Date _____

Appendix E: Information Sheet

Researcher's name: Geraldine Hamill Cunnane

Project title: An exploration of knowledge articulation in teams within project-based organisations

What is the purpose of this research study?

The purpose of this study is to understand how knowledge is shared within project teams, within the engineering, procurement, and construction (EPC) sector. The study will explore the methods/mechanisms used to share knowledge.

This study seeks to answer the following research questions:
RQ1: How is knowledge shared in project teams?
RQ2: How is knowledge articulated in project teams?
RQ3: What mechanisms are used to articulate knowledge?

Why am I being asked to participate?

This study seeks to understand the process of how knowledge is shared in project teams, within the engineering, procurement, and construction (EPC) sector. Therefore, it is necessary that individuals who work as part of a team participate. Such individuals are being asked to participate because their experience and knowledge are specific to project teams within the EPC sector.

Do I have to participate?

No, participation is voluntary. If you choose to participate you will be asked to sign informed consent forms.

What would participation in the study mean for me?

Participating in the study would require you to be available for an interview that would take approximately 45 minutes. You will be asked several questions pertaining to how knowledge

is shared, and the methods used to share knowledge within your team. With your permission the interview will be recorded, to capture the conversation. Consent (refer to Appendix C) will be requested to have the interview recorded. The recording of the interview will be transcribed, however all references pertaining to you and your organisation will be removed from the transcriptions. You may also be involved in team observations during project meetings. Given that the researcher will be a passive observer there will be no interaction or communication with you. The observed meeting/s will not be recorded. However, consent (refer to Appendix D) will be sought from all team members and will only proceed if consent has been provided by all team members present at meetings being observed.

What are the benefits of participating?

While there are no direct benefits attached to this research for the participants involved, you will be contributing valuable knowledge to the understanding and practice of knowledge sharing and articulation, which could potentially help improve project team performance.

What are the risks associated with participating?

The risks associated with participating in the study are minimal. However, there is potential risk to confidentiality, but steps will be taken to minimise these risks. You will be assigned a random identification number/pseudonym if you participate in the study. This number/pseudonym, and not your name, will be associated with your responses. The number/pseudonym connecting your name to specific information about you will be kept in a separate, secure location

Can I withdraw at any point?

You may withdraw up to the point of data merge.

How will data gathered be managed and used in the study?

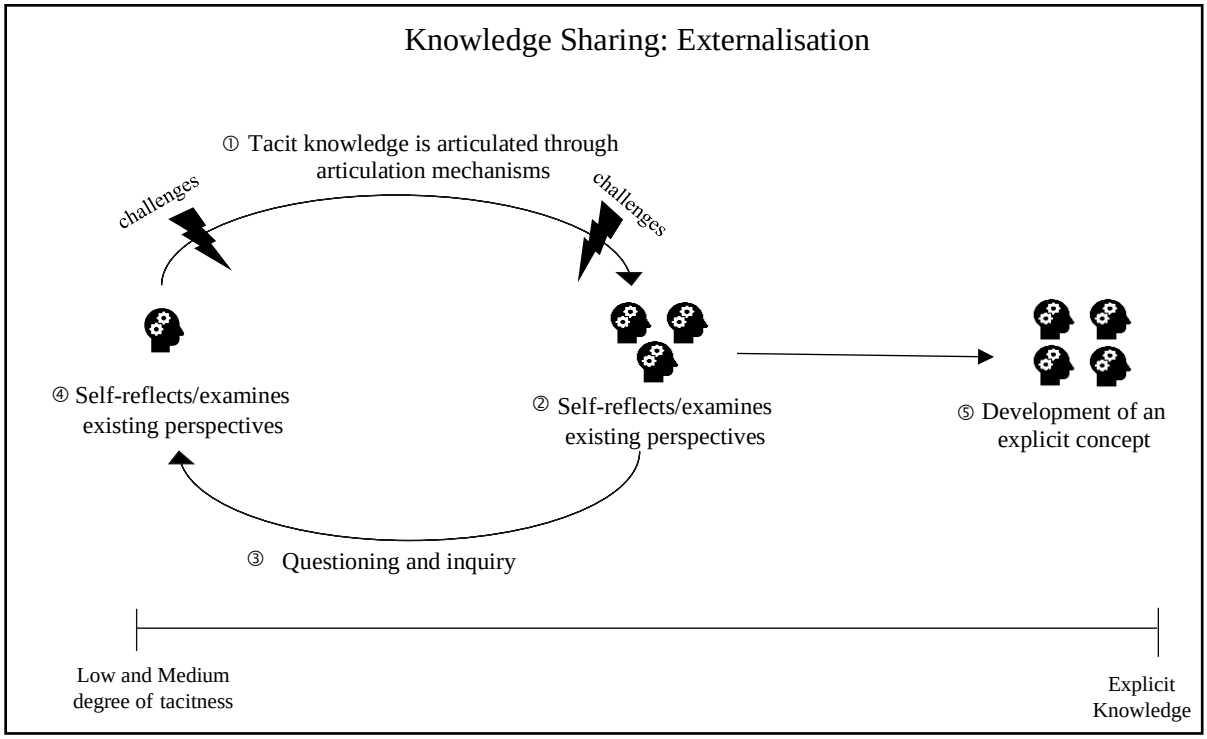
The key principles of the GDPR have been taken into consideration therefore, all data collected will be used for the purpose of this research study only. The data will be stored on a password protected external hard drive. Anonymity will be maintained by removing all

individual and organisational identifiers in any research data used in the thesis and any publications.

Can I verify aspects of the work and view a summary of the findings?

Yes, you will have the opportunity to review and validate the interview transcript. A copy of the interview transcript will be returned to you, providing you with the opportunity to recant any information.

Appendix F: Conceptual Framework



① Personal tacit knowledge is shared with team members through various articulation mechanisms (e.g., metaphors, analogies, storytelling)
② Team members self-reflect and recognise differences in perspectives.
③ Team members develop an understanding through questioning the individual.
④ Individual/s self-reflect understanding their perception through the perspectives of the other team members.
① ② ③ ④ An iterative process which continues until a collective explicit understanding is developed.
⑤ A preliminary model of the explicit concept is created.

Preface to Paper 3 – Design and Initial Findings

In October 2021, Paper 3 was presented online to the internal and external examination panel consisting of Dr. Meera Sarma, University of Liverpool (external examiner), and Prof Felicity Kelliher, WIT (internal examiner). The paper was recommended without revision. The examination panel offered some suggestions for consideration, and these are reflected in the version of the paper presented in this thesis. The findings presented in this paper, are situated in the context of a PBO. Notably, unique to this context is the diverse articulation methods employed by the team members, such as discussions, sketching and demonstration, to effectively convey their personal tacit knowledge. The application of these varied articulation methods exemplifies the knowledge holder's awareness of their team members' diverse learning styles, while also ensuring the effective articulation of their personal tacit knowledge into an explicit form.

Consideration of the examiners' commentary

The examiners recommended developing a map to illustrate to the reader how the themes emerged from the data and how they interconnected. In developing the visual, the researcher became cognisant of the importance of the chronological order of the themes. The themes were reordered to demonstrate the logical and meaningful connection between the themes (Braun and Clarke, 2012). This change was added to the final version of Paper 3.

Researcher's personal and professional development

Paper 3 operationalises the research design as detailed in Paper 2. Two pilot interviews were conducted. These interviews aided the researcher in assessing the interview guide and gaining experience with interviewing research participants. The researcher found the experience gained from the pilot interviews to be of great value to improve the quality and efficiency of her fieldwork overall. The researcher had limited interviewing skills, and the pilot interviews helped her improve her skills in preparation for the main study (Teijlingen and Hundley, 2001). For example, during the course of the pilot study interviews, the researcher found it difficult to keep track of which questions were answered, as the interviewees tended to answer more than one question at a time. This highlighted to the researcher the importance of knowing the structure of the interview guide thoroughly, to

prevent her repeating questions. While conducting the initial interviews the researcher, at points, recognised her own personal bias creeping in. This was a significant learning for her because, during the development of Paper 2, the researcher spent a significant amount of time examining herself through philosophy and practicing reflexivity (Fischer, 2009) to help identify her own preconceptions that could be suspended. Applying reflexivity to practice allowed the researcher to see the direct results of her work – a rewarding experience.

Reference

Braun, V. and Clarke, V. (2012) 'Thematic analysis' in: Cooper, H., Camic, P. M., Long, D. L., Panter, A.T., Rindskopf, D., Sher, K. J. (eds.), *Handbook of Research Methods in Psychology*, Research Designs, Vol. 2, pp. 57–71, American Psychological Association, Washington

Fischer, T., C. (2009) 'Bracketing in qualitative research: Conceptual and practical matters', *Psychotherapy Research*, Vol. 19, No. 4-5, pp. 583-590.

Teijlingen, E. van and Hundley, V. (2001) 'The importance of pilot studies', *Nursing Standard,* Vol. 16, No. 40, pp. 33–36.

Participant Name: Geraldine Hamill Cunnane 20084029

Research Supervisors: Dr. Seán Byrne and Dr. Collette Kirwan

Date: 15th November 2021

RESEARCH PAPER SERIES

PAPER 3: DESIGN AND INITIAL FINDINGS

An exploration of knowledge articulation in teams within project-based organisations

ABSTRACT

This paper outlines the initial findings in exploring how knowledge is shared and articulated within project teams, concentrating on the mechanisms used to articulate and share knowledge.

The research design for this study follows a qualitative case study approach. Semi-structured interviews, organisational documentation and observations are used as a means to collect the data. The interviewing process is currently taking place and has captured the perspectives and beliefs of team members, within a project-based organisation, pertaining to knowledge sharing. Additionally, documentation analysis specific to the organisational context is underway. Thematic analysis is employed for recognising, analysing, and reporting themes within the collected data. Preliminary themes are coming into view from the initial interviews, which includes, willingness to share knowledge; type of knowledge shared; methods used to share knowledge; barriers to knowledge sharing; knowledge sharing incentives; and strong team connections. Each of which influences the process of explicating tacit knowledge into an explicit form of knowledge. Thereby addressing the research questions, albeit within a limited context.

Keywords: Data collection, semi-structured interviews, project teams, project-based organisation

1.0 Introduction

This paper, the Design and Initial Findings, is the third paper of four in a sequence of research papers. The study explores the process of knowledge articulation, specifically the mechanisms used during articulation, in project teams. Knowledge articulation plays a significant role in the conversion of tacit knowledge into an explicit form during knowledge sharing (Nonaka, 1994; Rotenberg, 1983; Hakanson, 2007; Tell, 2016). Limited research exists pertinent to the practice of articulation therefore, further research is needed. The research design for this study follows a qualitative approach using an embedded, single-case research design (Yin, 2009). This paper operationalises the research design as proposed and defined in Paper 2. The paper validates the interview guide, the research method employed and outlines the implementation and analysis of findings from primary data collection, semi-structured interviews and secondary data collection, organisational documents. Furthermore, the implementation of the pilot study and the initial interviews are detailed, along with a discussion of the lessons learned therefrom.

The initial findings presented in this paper are project team members' perceptions of knowledge sharing and articulation within a team. This study addresses the following research questions (RQ):

RQ1 - How is knowledge shared in project teams?
RQ2 - How is knowledge articulated in project teams?
RQ3 - What mechanisms are used to articulate knowledge?

The following section commences with a discussion of the implementation of the pilot study and insights gained, next is the organisational profile and the team selection process. This section is followed by the interview preparation and lessons learned during data collection, concluding with data analysis and preliminary findings.

2.0 Pilot interviews

The pilot interview offered the researcher an opportunity to trial the interview instrument, enhance interviewing skills and identify any operational problems which may occur (van

Teijlingen and Hundley, 2001). Two pilot interviews were conducted. The first pilot interview was intended to help improve the researcher's interviewing skills. This interview involved an external academic, given that this participant was outside of the contextual setting the data collected was not included in the analysis. The second pilot interview involved the functional manager from the organisation which the data will be collected. This interview aimed to test the interview instrument to determine whether it was appropriate in context. As the participant in the second pilot interview is from the contextual setting the data collected was used to help the researcher gain greater insight on the organisation and the environment potential participants work in. From this exercise and the researcher's own reflective logs, insights were attained. Table 1 outlines the profile of the pilot interview participants.

Table 1: Profile of the pilot interviewees

Pilot		
	External to the contextual setting	**Internal to the contextual setting**
Job Title	Lecture	Functional Manager
Gender	Female	Male
Interviews conducted	Online Microsoft Teams	Online Microsoft Teams
Reason for selecting	The interviewee is known to the researcher. The interviewee teaches research methods is interested in the subject matter.	The interviewee is not known to the researcher The interviewee was involved in the researcher getting access to the team participant and is interest in the subject matter.

During the first pilot interview, with the participant outside of the contextual setting, the researcher became mindful of the importance of being astute to the structure of the interview guide. At times, the answering of one interview question would lead to the answering of several questions. This confused the researcher, in terms of tracking which questions may or may not have been answered (Gesch-Karamanlidis, 2015), which in turn resulted in questions not being asked and questions being repeated (see reflective log 1, Appendix A). Additionally, the researcher developed a greater understanding of the significance of silence

during the interview, to allow the interviewee time to think, and learned to avoid breaking the silence through interruption.

The second pilot interview, with the functional manager, raised the researcher's awareness to the possibility that team members may be part of more than one team, given that the interviewee was associated with all the project teams. If a participant is part of more than one team care must be taken to ensure that the participant is referring to the selected team when being interviewed. The following sections details the organisational profile and discusses the project team selection.

3.0 Organisational profile and project team selection

This research study is rooted in a contextual setting that relies heavily on knowledge sharing. Project-based organisations (PBOs) are recognised to rely on knowledge sharing given the interdependent nature of project teams to complete team tasks. The context for this study is conducted within an Irish, multinational, PBO, specific to the engineering, procurement, and construction sector. The managing director of this PBO is a personal contact of the researcher, however the researcher is not affiliated with the organisation. From the outset of this study the managing director expressed a keen interest in his organisation being involved in the research. The organisation is comprised of 22 directors and employs a direct workforce of greater than 400 employees. This organisation has a range of ongoing projects dispersed throughout the island of Ireland. The managing director supports this study and recognises the potential value this research could bring to the organisation, in terms of improving their knowledge sharing practices in project teams.

Participants from one project team were selected for the initial interviews. Focusing on participants from one team, rather than participants from a mix of teams, would help the researcher capture matters that are inter-team member related. Initially it was planned that 5-8 team members per team would be a suitable number for this research study (presented in Paper 2). However, when data was received, regarding the number of members in each team, it was identified that the number of members per team were larger than originally planned. Therefore, the team chosen was based on the number of members closest to the

suggested range. Hence, the selected team consisted of ten members. This team is referred to as Team A throughout this paper. An email (refer to Appendix B) along with the information sheet was sent to the members of Team A by the functional manager. The email invited the team members to volunteer for the study and stated that any parties interested in participating in the study should contact the functional manager who in turn would pass their contact information onto the researcher. The information sheet accompanying the email informed the team members about the purpose of the study and detailed the expected time requirements for the interview.

Eight team members responded to the original email, expressing interest in participating in the research study. This corresponds with the project team selection criteria outline in Paper 2, whereby a minimum of 80% team member's participation was suggested for the interviews. A follow-up email (refer to Appendix C) from the researcher was sent to the eight interested participants outlining more detail on the study. To maintain participant confidentiality each participant was assigned a code, beginning with A to represent the team, then TM to signify team member, and then a number (i.e., A Team Member 1), ATM2, ATM3, etc. A profile of the eight interview participants is outlined in Table 2 below.

Table 2: Profile of initial interview participants

Team A				
Title	**Gender**	**Duration employed with company**	**Duration working with this team**	**Duration working on this project**
Contracts Manager	Male	14 years	4 years	1.5 years
Project Engineer	Male	3.5 years	3.5 years	1 year
Project Manager	Male	6 months	6 months	6 months
Safety Officer	Female	8 months	8 months	8 months
Site Manager	Male	4.5 years	3 years	1.5 years
Site Engineer	Male	3 years	3 years	1.5 years
Construction/Project Manager	Male	2.5 years	2 years	6 months
Placement Engineer	Male	5 months	5 months	5 months

Having outlined the profile of the interview participants, the following section presents the interview preparation.

4.0 Interview preparation

Prior to undertaking interviews, each participant received an informed consent form (see Appendix D) and the interview guide (see Appendix E) to review. This approach ensured participants were fully aware of their rights in this study, but it was also an opportunity for participants to review and reflect on the interview questions. Interviews were coordinated primarily around the participant's schedule and were conducted online, via Microsoft Teams, with the participants at their place of work. Although the researcher's preferred method of interviewing is face-to-face, this was not possible due to Covid 19 restrictions (Dodds and Hess, 2020).

At the start of each interview, participants were thanked for their participation, assured of confidentiality, and permission to record the interview was confirmed. The interview process was led by the interview guide. The interview guide was constructed based on themes derived from the research questions and the conceptual framework but remained flexible in terms of allowing themes to emerge from the participants' responses. Seven semi-structured interviews, lasting in the range of 27-45 minutes, were conducted, transcribed, and analysed for this paper. The most recent interview has not yet been transcribed and analysed and therefore will not be part of the analysis presented in this paper. Table 3 details the schedule of the interviewing process for Team A. The duration of the interviews varied from 25 minutes to 45 minutes, the average duration being 36 minutes. Notwithstanding the interview duration, the interview guide schedule was completed in all interviews.

Table 3: Interviewing schedule[2]

Team A: Interview Schedule					
Code	**Interview Date**	**Interview recorded (Y/N)**	**Interview duration**	**Word count per interview transcript**	**Interview transcribed (Y/N)**
ATM1	5th July 2021	Y	45 mins	4,600	Y
ATM2	7th July 2021	Y	35 mins	4,655	Y
ATM3	21st July 2021	Y	40 mins	6,855	Y
ATM4	8th July 2021	Y	44 mins	6,487	Y
ATM5	8th July 2021	Y	31 mins	2,906	Y
ATM6	12th July 2021	Y	37 mins	5,531	Y
ATM7	2nd Sept 2021	Y	27 mins	5,025	Y
ATM8	10th Sept 2021	Y	25 mins	N/A	N
		Average	**36 mins** (Note 1)		
Note 1: The times indicated above are the times from which the recording commenced. The recording of the interviews did not start until the formal part of the interview began (i.e., after the project introduction).					

5.0 Interview insights

During the initial interviews, the researcher closely followed the interview guide to ensure the research questions always remained the focus. However, as the interviewing process evolved, the researcher could begin to guide the interviews to matters emerging that were relevant to the research objective. During the interviews insights pertaining to the interview guide and the researcher's interviewing skills were gained. In respect to the interview guide the researcher felt the guide needed to be refined in that some questions needed to be reworded, as some participants expressed difficulty in answering particular questions. Furthermore, the researcher felt questions needed to be added to the background section of the interview guide. Table 4 below outlines the changes made to the interview question and the justification for these changes.

[2] For confidentiality purposes the code applied to each interviewee are not linked to the profile outlined in table 2.

Table 4: Changes made to the interview questions

Original question	New question	Justification for the change
What challenges have members of your team encountered while trying to share their knowledge?	*What challenges have you encountered while trying to share knowledge with others in your team?*	The researcher felt that the focus of this questions needed to be changed from the interviewee's perception of their team members to how the interviewees perceive themselves towards a phenomena, given that they could reflect on their own experience.
Are members of your team willing to share knowledge with others in their team or not? Probe: How? Why?	*Are members of your team willing to share knowledge with others in their team or not? Probe: How?*	The use of the probing question 'why' in this question is too speculative, and therefore the researcher believes it needed to be removed.
N/A	*How long have you been working on this project?*	Adding this question to the background section of the interview guide will help the researcher gain a clearer understanding of the team demographics, which may be of further relevance later in the research study.

Additionally, the researcher developed a greater appreciation for the closing interview question as it allowed the interviewee the opportunity to provide further information, which they felt was relevant.

In respect to insights gained pertaining to the researcher's interviewing skills the researcher became sensitive to the possible use of leading questions and double-barrelled questions, whereby two questions were asked at the same time (refer to Appendix F). Excerpts from the participants' interview transcripts illustrate examples of a leading and a double-barrelled question.

Example of a leading question, excerpt from ATM2's interview transcript:

> *You just said, to get it (the issue) resolved. Is that your motivation for sharing your knowledge, is to get the issues solved?*

Example of a double-barrelled question, excerpt from ATM1's interview transcript:

> *Do you believe that you and your team members share the experience that you've gained from prior jobs, that you've worked on, with this team?*

The researcher realised more attention is needed to try and avoid the use of such questions as they may impact the research findings.

Furthermore, while listening to the audio recordings the researcher observed she had a tendency of repeating the interview question multiple times in succession. This meant the researcher was talking more than was necessary, which created semantic noise and took time away from the interview participants.

Example of rephrasing the interview question, excerpt from ATM's 1 interview transcript.

So, if you guys were discussing an issue and there was a lack of understanding between you, how would you clarify that misunderstanding? So, if one person or more than one in the team, during your morning meetings doesn't understand, how do you clarify or help them to understand the issue?

As a result of this experience the researcher realised that more care is needed when asking the interview questions.

6.0 Post-interview review

At the end of each interview the researcher made audio recordings capturing thoughts and feelings on each interview (refer to reflective log, Appendix A). This supported the researcher in identifying what did or did not work well during the interview process, which in turn helped improve later interviews.

The recorded interviews were transcribed and emailed to the participants for review. This allowed the participants the opportunity to clarify or retract any information provided. This was imperative to the rigour and member checking interview data, bearing in mind the interviews were conducted online and the possible loss of information or misinterpretation was magnified. None of the participants requested any changes to their transcripts. The next section presents the initial findings based upon the initial phases of analysis in the currently ongoing data collection process. Thematic analysis will be finalised in Paper 4, however, the initially emerging themes are presented in this paper.

7.0 Data analysis

Interview data and documentation will be examined for this study. Paper 2, Methodology, outlined the analysis strategy for this research. This study follows Braun and Clarke's (2006) six stages of thematic analysis framework, that involves: familiarisation with the data; generating initial codes; searching for themes; reviewing themes; defining and naming themes and finally producing the report.

The researcher was cognisant that the analysis strategy is an iterative process which involved an alternating movement throughout each stage as was needed (Braun and Clarke, 2006; Castleberry and Nolen, 2018). Furthermore, and in this study, data analysis occurred in parallel with data collection. This is currently evident in this research study as one interview and documentary review relevant to the process of knowledge sharing in project teams, the unit of analysis, remain to be analysed. The analysis of seven interviews has been completed, in addition to documents pertinent to the organisational context, the case has commenced. The software application NVivo acted as a data management platform to store the data collected and more importantly manage the data analysis. The memo feature in NVivo was used to maintain an accurate record of the researcher's decisions at various points of the analysis, which in turn supported and justified the codes and themes applied, while also acting as an audit trail for synthesising the findings (Houghton *et al*., 2016).

The transcription process for the initial interviews was completed via 'Temi' an audio-to-text software application. This application was incapable of transcribing the recorded interviews verbatim therefore, the researcher made changes to the initial transcripts. These changes involved rigorous checking and rechecking of the recorded interviews. As the researcher is not associated with the organisation being studied, it was necessary to listen to the audio recording of the interviews several times to help gain a better understanding of the contextual setting from which the data are gathered. The transcription process, along with listening to the audio recording and the re-reading of the interview transcripts afforded the researcher the opportunity to become familiar and intimate with the data. This process is consistent with Braun and Clarke's (2006) first stage of thematic analysis, familiarising yourself with your data.

Once each interview was transcribed it was imported into NVivo where the generating of the initial codes commenced. Codes are labels that assign symbolic meaning to the data (Miles *et al*., 2014). The coding process for this research study was primarily inductive in that the codes represented meaning as conveyed by the interview participants (Braun and Clarke, 2012). The first cycle of coding was descriptive whereby the codes described the topic of the data (Saldaña, 2015). During the first cycle of coding the researcher worked methodically through each interview transcript giving equal attention to each data item as suggested by Braun and Clarke (2006). In conjunction with the coding process the researcher used NVivo's reporting function which proved valuable in summarising the codes created from the interview transcripts (refer to Appendix G). A second cycle of coding was completed. This cycle of coding commenced after a considerable amount of time had lapsed from the completion of the first cycle of coding. This was intended as the researcher felt the gap in time would help her view the data in a new way. The second cycle of coding was conducted manually (see Appendix H) in that the researcher employed a hard copy strategy. This cycle was guided by the research questions, and the conceptual framework, this was to ensure that the codes produced were meaningful to the research study. Considering that the researcher was 'learning to do' thematic analysis (Braun and Clarke, 2012, p.60) she found it helpful to use Castleberry and Nolen's (2018) suggested questions the researcher should ask of the data (refer to table 5), to aid in the coding process.

Table 5: Questions the researcher should ask of the data (Castleberry and Nolen, 2018)

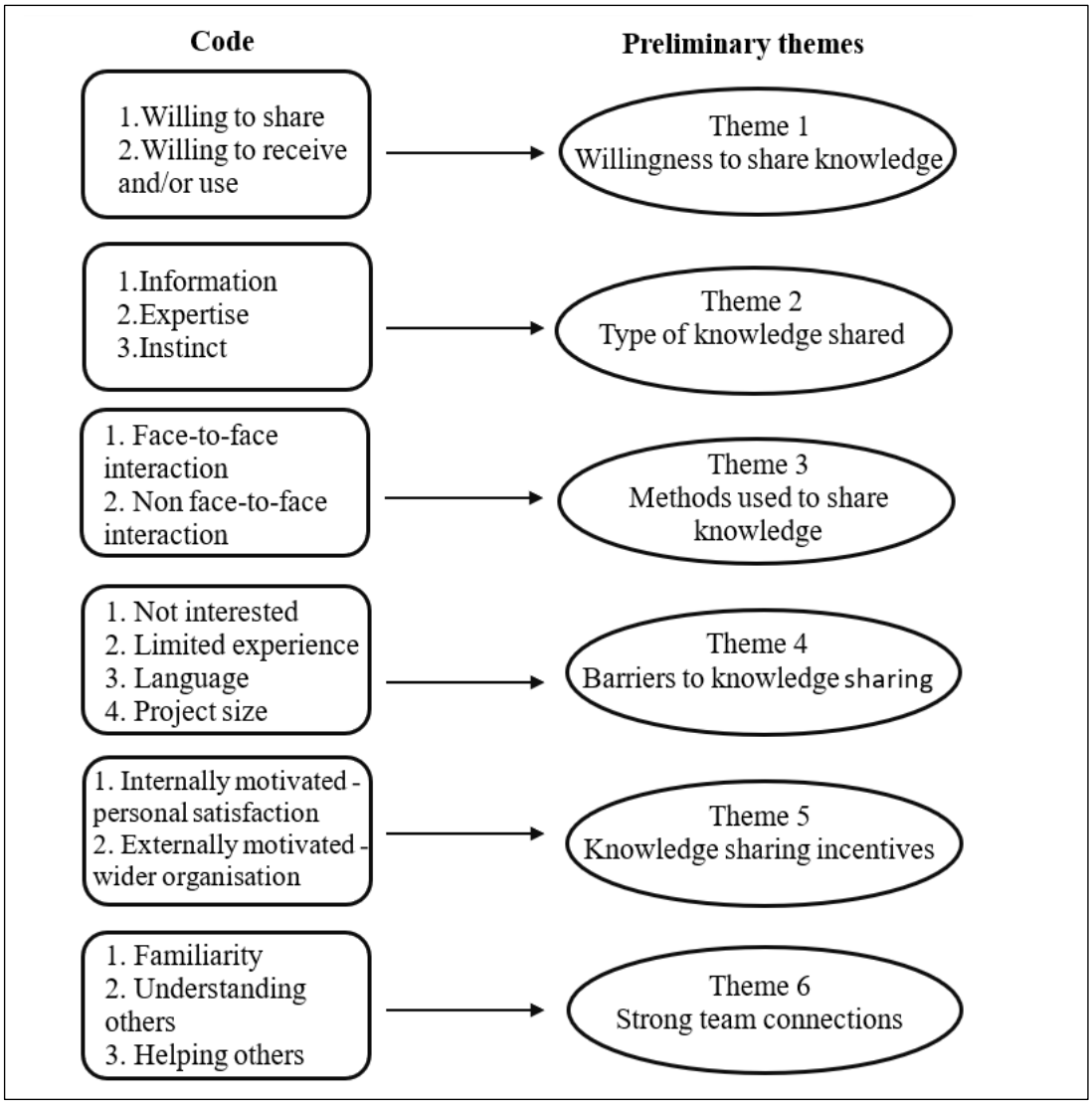
Questions the researcher should ask of the data as appropriate.		**Application (Illustrative examples)**
Q1	What is happening in the text?	Is knowledge sharing taking place? What mechanisms are used to articulate knowledge?
Q2	Who are the actors and what are their roles?	Who is the knowledge holder? Who is the knowledge receiver?
Q3	When is it happening?	What is happening preceding an event, during an event, or a reaction to an event?
Q4	Where is it happening?	Is it happening formally or informally?
Q5	What are the explicit and implicit reasons why it is happening?	Is it happening to complete the project, to help other team members or both?
Q6	How is it happening?	Is it happening through demonstration, sketching, discussion, or communication tools?

The manual codes from the second coding cycle were inputted into a new NVivo project. NVivo was used as a tool to help structure the codes given that many codes were created during this cycle. Much of the codes from the second cycle of coding were similar and were therefore clustered together. Other codes required the creation of a hierarchical coding structure whereby a parent code was created, followed by child codes as a subset (refer to Appendix I). This process is in keeping with Braun and Clarke's (2006) second stage of thematic analysis, generating initial codes. During the structuring of the manual codes in NVivo a note recording the purpose of the parent code was added. Additionally, NVivo memos were used to record the researcher's thoughts and reasoning behind the coding structure.

8.0 Preliminary findings

The following section details the preliminary findings of the study, based on data obtained on how knowledge is shared and articulated in project teams, and the mechanisms used during this process. Six nascent themes emerge from the data collected from the seven interviews conducted and analysed to date, and are illustrated in Figure 1 below, these are: Theme 1: willingness to share knowledge; Theme 2: type of knowledge shared; Theme 3: methods used to share knowledge; Theme 4: barriers to knowledge sharing; Theme 5: knowledge sharing incentives; and Theme 6: strong team connections. This process is consistent with Braun and Clarke's (2006) third stage of thematic analysis, searching for themes.

Figure 1: Preliminary themes and code mapping



The following section outlines the themes and discusses their relevance to this study.

8.1 Theme 1: Willingness to share knowledge

Data from the interview transcripts provide a strong indication that team members are willing to share and receive knowledge. ATM5's comment *"If we see landings or concrete poured too high, we could nearly tell by the eye. We'd just tell them, just explain it to the lads…."* this comment exemplifies the knowledge holder's willingness to share knowledge.

This perception is also shared by ATM7 where talk of sharing new ideas with the team was mentioned: *"Often the conversations would be, on the last site we did…. or on the last job we did….we did this before and this worked,…. let's (the team) try this and see if it works….. you're willing to give it a go."* This comment not only illustrates the knowledge holder's willingness to share knowledge but expands further to the knowledge receiver's willingness to listen and use the knowledge, which indicates a level of collective understanding between the team members. This is also captured by ATM3 who commented:

> *".....some of the guys are very experienced, the site manager….. So he'd bring his skills and his knowledge to how work is done and how it can be done correctly and different ideas on site for what they might've done in the past. Or where, what he has seen in the past and in his past career to improve the standards and the skills that we have on site here on the project."*

It is clear from the transcripts that the team members are not only willing to share knowledge but are also willing to receive and use the knowledge, all of which are essential to the articulation and knowledge sharing process. One's willingness to share knowledge may perhaps influence the type of knowledge shared. The next theme discussed will address the type of knowledge that is shared among the team members.

8.2 Theme 2: Type of knowledge shared

Generally, data from the interview transcripts signify there are different forms of knowledge being shared among the team members, such as information, expertise, and instinct. ATM3's comment *"We'd go through the minutes and an agenda, and we go through our standards on site."* reflects the sharing of information. While ATM5 stated *".....we could nearly tell by the eye ...."* This comment indicates a trigger for sharing knowledge, here the team member, through insight, observes a problem. ATM5 also states "*We'd just tell them…. how it's going to affect the next thing that's coming on…."* this acknowledges the sharing of expertise whereby through foresight the team member can identify potential future problems. This further suggests a shared meaning between the knowledge holder and the knowledge recipient. The sharing of expertise is also evident in ATM2's comment *".....one person takes a walk around the site..... they flag these issues. .... if they see something that's not up to scratch with safety, that is to be raised and then issued to the subcontractor…."*

However, ATM7's talk of sharing knowledge suggests sharing of a different type of knowledge other than information and expertise, that of instinct. *"You would have a gut feeling, there is no way they are going to do that……and that would be brought up at the co-ordination meeting."* The type of knowledge shared among project team members, is central to this research study, and maybe impacted by the methods used to share knowledge. The varied methods identified for sharing knowledge are discussed next.

8.3 Theme 3: Methods used to share knowledge

A significant theme to emerge from the interview transcripts is the methods used to share knowledge. Numerous methods have been employed by the team members to share knowledge such as, demonstration, sketching, discussions, and communication tools. These methods can be categories into two types: face-to-face interaction, and non-face-to-face interaction.

8.3.1 Face-to-face interaction

The use of face-to-face interaction, to share knowledge, within the team is prominent throughout the interview transcripts. Sharing knowledge through face-to-face interaction allows the knowledge holder the opportunity to check the receivers understanding (Salis and Williams, 2010). ATM1 discusses the best method used to share knowledge. *"I generally do everything by example, so I will run through what needs to be done myself. I'll do an actual explanation…. So, he's visually seeing."* This comment suggests the knowledge holder demonstrates live to the knowledge receiver the shared knowledge, within context. This requires the presence of both the knowledge holder and the receiver. ATM4's statement *"I suppose we have a whiteboard…... And usually that's the best way to explain to the construction team, it's to draw a sketch and that normally gets the point across."* Here ATM4 acknowledges sketching as the most effective method for sharing knowledge. Again, this form of knowledge sharing requires the presence of the knowledge holder and receiver. ATM2's comment is from the perspective of the knowledge receiver. *"They would give me a demonstration; let me do it and they would observe."* This comment goes a step further and illustrates the knowledge receiver imitating or practicing the shared knowledge, for the knowledge holder, thereby allowing them the opportunity to verify understanding.

Discussions, which are another form of face-to-face interaction, are frequently mentioned throughout the interview transcripts. This is evident in ATM1's remark relating to when issues are discussed *"We meet every morning, and we can discuss the issue in the morning then."* This remark suggests the organisation has formal practices in place, for the team, which facilitates the sharing of knowledge through discussions. This is also acknowledged in ATM3's statement concerning an issue that was raised *".....the progress meeting....every Thursday....that'd (issue) be raised then in the meeting and that issue, it would be discussed."*

A significant number of team members implied discussions also take place informally. This is represented in ATM6's comment, *"Suppose you just kind of have a chat..... A chat could take place anywhere.....You could be passing them (team member) along the way on the site."* This implies the discussion was unplanned and possibly accidental and the team member used their initiative to share knowledge. This indicates there is level of autonomy, for conducting work, within the team. This is also suggested in ATM7's comment "*You're bouncing it off your teammates beside you too see if they have the answer."*

8.3.2 Non-face-to-face interaction

Examples of knowledge sharing through non-face-to-face interaction are present throughout the interview transcripts. Many of the interview participants talked of sharing knowledge through various communication tools, which do not require face-to-face interaction, such as WhatsApp, email and FieldView[3]. These methods used, for sharing knowledge takes place asynchronously, in that the knowledge holder and receiver do not have to be present at the same time. ATM1's comment:

> *"....we all know that WhatsApp is not the official, sharing of information platform. Anything that we do send across in that (WhatsApp) it's just to get the message out quick....So the more people you're getting the message out to the more information you're sharing the more successful the project."*

[3] FieldView is a document control system that captures, shares, and reports all project data.

This statement also suggests that autonomy exists within the team, given that the team member made the decision to use WhatsApp as a tool to share knowledge, despite the understanding that WhatsApp is not a platform formally used by the organisation. Additionally, this comment indicates the team member is motivated by the success of the project.

FieldView is another type of non-face-to-face knowledge sharing platform and is mentioned frequently throughout the interview transcripts. Knowledge added to the system, by the knowledge holder, and knowledge retrieved from the system, by the knowledge receiver takes place asynchronously. ATM2 explains how the progress of the project is shared, "*….all information records go onto this FieldView system and everyone on site has access to this."* This suggests a formal knowledge management system is in place, which supports knowledge sharing institutionally. ATM1's statement *"We're all feeding the information into the same platform, which is called FieldView."* acknowledges that all team members contribute their knowledge to the knowledge management system. ATM4's talks of using the FieldView system for the retrieval of knowledge *"….such as FieldView…... keeping track of approval processes, and the construction status, drawings and changes."*

This theme, the methods used to share knowledge, is pertinent to this research study given that the methods used during the knowledge sharing process may determine the quality and richness of the shared knowledge. Therefore, it is imperative to understand the most appropriate methods used for the effective sharing of knowledge. Additionally, it is important to recognise the barriers which may influence the sharing of knowledge, which is discussed in more detail in theme 4 below.

8.4 Theme 4: Barriers to knowledge sharing

A consistent theme to emerge from the interview transcripts is barriers to knowledge sharing. Within this theme four barriers have been identified by participants which may hinder the knowledge sharing and articulation process. These include lack of interest; limited experience; project size; and language.

Lack of interest is identified by ATM3 who commented: *"Sometimes it could just be the lack of interest. ……. They might just not have an interest in whatever you're trying to sell to them. That probably is a struggle for people on site."* This barrier suggests the knowledge receiver may not be interested in the matter that is being shared.

Another barrier which is connected with the knowledge receiver is limited experience. ATM6 stated *"I suppose for someone with limited experience, it can be difficult sometimes for someone to explain something….."* This barrier signifies that the knowledge receiver may not be as experienced as the knowledge holder, and a common understanding of the shared knowledge does not exist between them.

Additionally, the size of the project has been acknowledged to act as a barrier to sharing knowledge. ATM4 stated, *"I suppose it (sharing knowledge) gets a bit difficult with scale. …… When you look at a project this size……it gets harder, because of the detail, you could spend an awful long time collecting this information and trying to share it. It could become a full-time project role, you know, and that's where it really gets difficult. That's, it, yeah it's scale."* This indicates the larger the project the greater the amount of information generated, which in turn needs to be managed to be shared. This could imply a need for the correct infrastructure that will allow the managing and sharing of large amounts of information.

ATM2 indicated that language acts as a barrier, during the communication process, between the knowledge holder and the knowledge receiver. ATM2 stated *"… the language barrier. I suppose we have a lot of foreign nationalists working here. So, I'm guessing like if I'm passing some information on to a worker and they don't really understand me. ….. that's a big problem…. that the people actually understand what information is being passed to them. ….That's definitely a problem on site. ….Like they (workers) actually understand what their task is."* This comment suggests that if the message being shared with the knowledge receiver is not understood correctly this could have greater implications to the overall project. ATM3's comment "*The big one in construction is the language barrier."* further supports language as a barrier to knowledge sharing. In contrast to barriers to knowledge sharing are incentives to sharing knowledge which are discussed further in Theme 5.

8.5 Theme 5: Knowledge sharing incentives

There are numerous mentions throughout the interview transcripts pertaining to incentives for sharing knowledge. These incentives are split into two distinct categories. One category suggests the participants share their knowledge for the benefit of the wider organisation. The other suggests knowledge is shared for the benefit of other people.

Sharing knowledge for the benefit of the organisation is captured in ATM6's comment: *"You want to get the project completed. ..... You want everyone on the same page...."* This perception is shared with ATM1 who stated that *"We will share as much information as possible to every team member so that we can all pull in together and get that task closed."* This observation suggests that some team members are incentivised by external motivations such as completing a task or project.

Sharing knowledge for the benefit of other people is illustrated in ATM3's comment were talk of the motivation to share knowledge was discussed. *".... like the knowledge I have if I thought it could benefit someone else, I'd be delighted to share it."* This is similar to ATM5's belief who acknowledged *"You are hoping the person you are sharing it with is going to learn something from it."* Both comments suggest that the incentive for the team members to share knowledge is driven by an internal personal satisfaction. Each incentive, the benefit of the project and to benefit other people, may act as enabling factors in the knowledge sharing process, which is pertinent to this research study.

8.6 Theme 6: Strong team connections

The interview transcripts indicate that a strong connection exists between the team members. This connection may act as an enabler to the sharing of knowledge within the project team. ATM1 talked of the benefits of working with the same team were *"....you know each other's skill sets and limits, expectations and all that stuff."* This observation indicates a level of familiarity between the team members, whereby each team members knows how the others perform within the team.

This is further supported by ATM7 comment "*We're working together so long. We know each other."* ATM5 talked of the importance of sharing knowledge with the team *"…if they (team members) don't understand the way you think you are not going to operate with each other."* ATM5 perceives a deeper level of understanding is necessary between the team members, for knowledge sharing to take place. ATM3 stated:

> *"….some of the guys are rostered on for XXXX [site checks]. At the moment they're not here, but the guys (other team members) are picking up their XXXX [site checks], at the drop of a hat. …. you nearly don't have to ask… take one for the team and do it."*

This comment highlights the willingness of team members to help others in the interests of the team. The type of relationship existing between team members may have some bearing on the type of knowledge shared.

8.7 Preliminary theme synthesis

Six preliminary themes have been presented in this paper: willingness to share knowledge; type of knowledge shared; methods used to share knowledge; barriers to knowledge sharing; knowledge sharing incentives; and strong team connections. Willingness to share knowledge emerged throughout the interview transcripts and is found to be valuable to the process of knowledge sharing, as well as to the type of knowledge being shared. A variety of methods have been recognised to aid in the knowledge sharing process, which can be categorised into two types: face-to-face and non-face-to-face interaction. These categories or methods could possibly be linked to the type of knowledge shared, along with the barriers to knowledge sharing. Within the interview transcripts internal and external motivation are seen to act as incentives to sharing knowledge. Data from the interview transcripts also signifies a strong team connection exists among the team members. Further analysis of the themes will be completed as part of Paper 4, this analysis will explore the potential relationships that may exist between the themes. Each of the themes identified from the interview transcripts are pertinent to the process of knowledge sharing and articulation.

During the interpretation of the preliminary themes the researcher realised that some of themes require more thought, in that some themes could perhaps be combined. Although each of the themes, have been identified separately, this is not the case during practice. The process of knowledge sharing is influenced by and dependent on each of the themes.

The following sections details the documentation collection and analysis undertaken to date for this research study.

9.0 Initial document gathering

Document collection and analysis is supplementary to semi-structured interviews (Peräkylä and Ruusuvori, 2018). As detailed in Paper 2 the archival documents selected for analysis inform this study at two levels. One being the organisational context (i.e., the case), and the other the process of knowledge sharing within project teams, (i.e., the unit of analysis). Manual document analysis is currently underway. In terms of the analysis of documents pertinent to the context of the organisation, publicly available sources such as the company web site, LinkedIn and Facebook page, have been analysed informally. This means a predefined protocol was not followed (Peräkylä and Ruusuvori, 2018), given that the contextual content lacked detail in terms of answering the research questions (Bowen, 2009).

Additionally, documentation analysis relevant to the process of knowledge sharing in project teams has commenced and is at an early stage. Additional documents, such as WhatsApp messages and daily diaries, have been requested from the functional manager, considering these documents were mentioned by the interview participants, during the interview sessions. As anticipated in Paper 2, it has taken the researcher some time to filter through the documents made available. The filtering process was to determine the documents relevance to the research questions. Further analysis of documents pertinent to the process of knowledge sharing will be completed as part of Paper 4. Table 6 below details the status of the document analysis.

Table 6: Status of document analysis

Document type		Access to the document	Documents accessed	Analysed
Context (The case)	Website	Public	Yes	Yes
	Facebook	Public	Yes	Yes
	LinkedIn	Public	Yes	Yes
	Company management chart	Private	Yes	Yes
Knowledge Sharing (The unit of analysis)	Core job responsibilities	Private	Yes	Yes
	Safety alerts	Private	Yes	No
	WhatsApp messages	Private	Awaiting	No
	Daily diaries	Private	Awaiting	No
	Internal memos	Private	Awaiting	No
	Minutes of meetings	Private	Awaiting	No

The analysis conducted as per table 6, which illustrates the company's website to the core job responsibilities, has provided essential contextual information to the analysis to date (see Appendix J, which details the document analysis process). This analysis afforded the researcher the opportunity to gain a better understanding of the research study context, being that it is a background which she is not familiar with. These documents suggest a context that values its employees and fosters a culture of transparency.

10.0 Conclusion

This paper illustrates the application of data collection and initial analysis using one project team, seven interview participants, and documents pertinent to the organisational context, (i.e., the case). These represent a small part of the intended data collection methods. Therefore, data saturation has not yet been met, and additional interviews and documents are required. The sampling method chosen intends to include four project teams, 20-24 interview participants, additional documents pertaining to the process of knowledge sharing, (i.e., the unit of analysis), and potential observations. Drawing from multiple data collection methods will yield in producing richer, thicker data, which is deemed necessary considering the exploratory nature of this study.

From the data collected to date prevalent themes have emerged which includes: willingness to share knowledge; type of knowledge shared; methods used to share knowledge; barriers to knowledge sharing; knowledge sharing incentives; and strong team connections. Further findings and a deeper analysis of the initial themes will be undertaken in the next paper, Paper 4, 'Findings and Discussion'. Additionally, Paper 4 will seek triangulation between the multiple and varied data sources, depending on pending access and permissions.

References

Bowen, A. G. (2009) 'Document Analysis as a Qualitative Research Method', *Qualitative Research Journal,* Vol. 9, No. 2, pp. 27-40.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, Vol. 3, No. 2, pp. 77–101.

Braun, V. and Clarke, V. (2012) 'Thematic analysis' in: Cooper, H., Camic, P.M., Long, D.L., Panter, A.T., Rindskopf, D., Sher, K.J. (eds.) *Handbook of Research Methods in Psychology*, Research Designs, Vol. 2, pp. 57–71. American Psychological Association, Washington.

Castleberry, A. and Nolen, A. (2018) 'Thematic analysis of qualitative research data: Is it as easy as it sounds?', *Currents in Pharmacy Teaching and Learning*, Vol. 10, pp. 807-815.

Dodds, S. and Hess, A. C. (2020) 'Adapting research methodology during COVID-19: lessons for transformative service research', *Journal of Service Management*, Vol. 32, No. 2, pp. 203-217.

Gesch-Karamanlidis, E. (2015) 'Reflecting on Novice Qualitative Interviewer Mistakes', *The Qualitative Report*, Vol. 20, No. 5, pp. 712-726.

Hakanson, L. (2007) 'Creating knowledge: the power and logic of articulation', *Industrial and Corporate Change*, Vol. 16, No. 1, pp. 51–88.

Houghton, C., Murphy, K., Meehan, B., Thomas, K., Brooker, D. and Casey, D. (2016) 'From screening to synthesis: using NVIVO to enhance transparency in qualitative evidence synthesis', *Journal of Clinical Nursing*, Vol. 26, pp. 873–881.

Miles, B. H., Huberman, A. M. and Saldana (2014) *Qualitative Data Analysis,* Thousand Oaks, CA: Sage.

Nonaka, I. (1994) 'A Dynamic Theory of Organisational Knowledge Creation', *Organisational Science,* Vol. 5, No. 1, pp. 14-37.

Peräkylä, A., and Ruusuvuori, J. (2018) 'Analyzing talk and text' in N. Denzin, & Y. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research,* 5th Edn. Thousand Oaks, CA: Sage.

Rotenberg, A. (1983) 'Creativity, Articulation, and Psychotherapy', *Journal of American Academy of Psychoanalysis,* Vol. 11, pp. 55-85.

Saldaña, J. (2015) *The Coding Manual for Qualitative Researchers*, Thousand Oaks, CA: Sage.

Salis, A and Williams, A. M. (2010) 'Knowledge Sharing Through Face-To-Face Communication and Labour Productivity: Evidence from British Workplaces, *British Journal of Industrial Relations,* Vol. 48, No. 2, pp. 436-459.

Tell F, (2016) ‘Knowledge Articulation’, in Augier, M and Teece, D.J., (eds) *The Palgrave Encyclopedia of Strategic Management.* London: Palgrave Macmillan, pp. 1-5.

van Teijlingen, E. R. and Hundley, V. (2001) ‘The importance of pilot studies’, *Nursing Standard,* Vol. 16, No. 40, pp. 33-36.

Yin, R. K. (2009) *Case Study Research: Design and Methods,* 4th Edn. Thousand Oaks, CA: Sage.

Appendix A: Post interview reflective logs, interviewer's thoughts, and feelings.

Reflective log 1

Insights from the pilot interview (excerpt from audio recording of the interviewer's thoughts after the interview). 5th July 2021

I feel like I am jumping around with the interview questions. Sometimes when one question is asked the interviewee answers more than one question. Because of this I am finding it difficult to keep an eye on which questions have been answered. I am really struggling tracking which question have been asked, to avoid repeating the questions.

Reflective log 2

Insights from the ATM2 interview (excerpt from audio recording of the interviewer's thoughts after the interview). 7th July 2021

The interviewee was very willing to share his information and knowledge with me. One word comes to mind forthcoming. I'm getting the impression this team works well together.

I experienced a few issues with the internet. It was difficult to hear and at some points the connection 'broke up'. I'm trying to follow the interview guide as much as possible, sometimes I do question whether am I asking the right questions. This is simply because I am not getting the answer I want, which I have to remind myself is me being bias.

Insights from the ATM3 (excerpt from audio recording of the interviewer's thoughts after the interview). 21st July 2021

I feel a lot more confident with this interview and I am more proficient at knowing where the questions are located on the interview guide. This helped prevent the repeating of questions. Now there was some repeating of questions, but this had a positive effect in the sense the interviewee gives a slightly different, stronger answer than previously stated. This was a good interview.

Insights from the ATM5 (excerpt from audio recording of the interviewer's thoughts after the interview). 8th July 2021

This interview was the most bizarre interview to date. The interviewee is clearly a very busy man. He was answering the telephone during the interview and left the interview to go and speak to another guy. I suppose that's the nature of his job. In terms of his responses to the interview questions it was difficult to engage with the participant and the majority of his response to the interview questions were all one word answer, yes/no. This coupled with the noise from other people in the office was very distracting for me.

Appendix B: Initial email inviting the team members to volunteer in the study

From: [redacted]
Sent: Friday 25 June 2021 17:51
To: [redacted]
Cc: [redacted]

Subject: DBA Research study - Knowledge Sharing
Importance: High

Hi All,

We are working with Geraldine Hamill Cunnane who is undertaking a DBA (Doctorate of Business Administration) in WIT and is undertaking a thesis on the subject of - *An exploration of knowledge articulation in teams within project-based organisations,* which is basically how knowledge if shared within project based teams and the focus is specifically safety related knowledge.

We are hoping that this study will provide with some [redacted] beneficial learnings that we can use to improve knowledge sharing. Three of our projects will participate in the study, with the [redacted] project chosen as the first of these projects and each of you will be invited to take part in the study. This would involve being interviewed by Geraldine. The attached information sheet provides more information.

Participation in the study is voluntary, however the project can only be used if there is sufficient take up. Ideally the interviews would start w/c 5th July.

Please let me know if you are happy to take part and once, I have all responses I will send your information to Geraldine and she will provide further information directly to you.

Thanks for taking time to consider this,

Regards,

[redacted]

Appendix C: Email sent from the researcher to the interested participant

Geraldine Hamill Cunnane <20084029@mail.wit.ie>

to:

date: 3 Jul 2021, 13:42

subject: Knowledge Sharing Research

Dear [redacted]

thank you for agreeing to participate in this research study. This study aims to explore how knowledge is shared within project-teams in project-based organisations. The interview is expected to take approximately 45 minutes and will be conducted online via teams. With your permission the interview will be recorded.

I have attached the interview guide which details the questions I intend to ask, if you wish you can review in advance, however it is not necessary. I have also attached the informed consent document which needs to be completed and emailed back to me, prior to the interview.

I intend to start the interview process the week of the 5th of July ending the 8th of July (4 days). Can you please confirm a day and time which suits your schedule to conduct the interview. I look forward to hearing from you.

Kind regards

Geraldine

Appendix D: Consent Form

Consent Form

I have read and understood the information sheet provided and by choosing to give consent:

(please tick the box)

1) I am voluntarily participating in this study. ☐

2) I grant permission to record my interview. ☐

3) I understand that I can withdraw from the study up to data merging. ☐

4) I understand that my own and my organisation's details will be kept confidential. ☐

5) I understand that the anonymised data will be cited in the project/thesis and other publications. ☐

Signature

Participant _____ Date _____

Researcher _____ Date _____

Appendix E: Interview Guide

Date		Time	
Interviewee			

Thank you for your contribution to this research study. As indicated in the consent form the plan is to record the interview, which is scheduled to take approximately 45 minutes. This will ensure I do not miss any of your statements, additionally I will be taking notes.

As stated in the information sheet, I am keen to get your perspectives and experience on how knowledge is shared in project teams.

Background information

The information provided in this section is confidential and for administrative purposes only.

1) What is your role within the team? _____
   (leader, sub-contractor)
2) How long have you been working with this team? _____
3) Have you worked with some of the team members before on other projects? _____
4) How long have you been working on this project? _____

Theme A – Knowledge sharing (knowledge holder perspective)

RQ1 How is knowledge shared?

Based on your opinion:

1) Are members of your team willing to share knowledge with others in their team or not? Probe: How?
2) Are members of your team willing to use their spare time to help other team members or not? Probe: examples?
3) Do members of your team actively share their experience (tacit) with other team members? Probe: How often? What format? Can you give me an example?
4) Do members of your team actively share their insights (tacit) with other team members? Probe: How often? What format? Can you give me an example?
5) Do members of your team use their own initiative to share knowledge with other team members? Probe: example?

6) Are members of your team proactive in helping others whether or not they ask for help? Probe: How often? Why? Explain?
7) Do members of your team share updates about the project, for example the progress of the project (explicit), with other team members?

Theme B - Knowledge articulation (tacit knowledge) – Dependent on the response of theme A (Team perspective).

RQ 2 How is knowledge articulated?

1) Approximately how often would team members meet to resolve work issues? Probe: examples.
2) If a problem emerged in the performance of your daily work, would it be discussed within your team? Probe: example
3) How does the organisation facilitate the discussion of problems that emerge?
4) In your team, if team members propose new ways of doing things, how well is this suggestion accepted by the other team members? Probe: Explain, elaborate
5) Are problems that emerge within your team, shared, and discussed among team members? Probe: example, how?
6) How are the results and clarification of each meeting recorded (if they are recorded)? Probe: Explain.
7) Would you ask another team member/s to teach you how to perform a task or function?

Theme C- Challenges of knowledge sharing (tacit knowledge)

1) What challenges have you encountered while trying to share their knowledge? Probe: explain
2) How was this challenge overcome? Probe: how?

Theme D – Enablers of knowledge sharing (tacit knowledge)

1) What motivates you to share knowledge? Probe: explain
2) How important is the sharing of knowledge with others in your team? Probe: example?

Theme E– Understanding of the shared knowledge (knowledge recipient perspective) (tacit knowledge). RQ3 What mechanisms are used to articulate and share knowledge?

1) If there is a lack of understanding among the team members, regarding the shared knowledge, how is it clarified? Probe: Example, are mechanisms/methods such as metaphors, analogies and storytelling used? (tacit knowledge)
2) How are these mechanisms/methods used?
3) In your opinion which mechanism/method works best to help develop an understanding of the knowledge being shared?

Theme F- Knowledge is not being shared - refers to theme A questions

1) Why do you think team members are not willing to share their knowledge with others in their team? Probe: Explain
2) Why do you think team members do not actively share their experience with other team members? Probe: Explain
3) Why do you think team members do not actively share their insights with other team members? Probe: Explain
4) Why do you think members of your team are not willing to use their spare time to help others team members? Probe: explain?
5) Why do you believe the team members are not willing to share their knowledge?

Concluding the interview:

Is there anything else that you perceive as important in relation to knowledge sharing?

Thank you for your time.

Reassurance of confidentiality

Inform respondents that they will have access to findings/conclusions

Appendix F: Reflective log, insights from the initial interviews

1. I seem to have phrased one question in a leading manner. More care is needed to avoid this as this may impact the findings.

   Example of a leading question:
   You just said, to get it (the issue) resolved. Is that your motivation for sharing your knowledge, is to get the issues solved?

2. I really need to be careful with how I pose the interview questions. I appear to be asking double-barrelled questions. This seems to be happening because I am confused, as to whether the questions should be asked from the interviewee's perception of the team members, or from the view of how the interviewee perceive themselves.

   Example of a double-barrelled question:

   Do you believe that you and your team members share the experience that you've gained from prior jobs, that you've worked on, with this team?

Appendix G: Sample of cycle one coding structure in NVivo

Nodes\\Benefits of implementing the concept

Nodes\\ Concept created to solve issue of noise and dust

Nodes\\Description of the concept created for the dust and noise

Nodes\\Example of a proposed idea - making concrete blocks

Nodes\\Incident report outline the safety breach

Nodes\\Things will be missed if knowledge is not shared

Nodes\\Waste of time if knowledge was not shared

Nodes\\Depends on the issue whether it will be discussed

Nodes\\Devices used on site to share knowledge

Nodes\\Different people may see the issue

Nodes\\Everyone is made aware of this problem. It's kinda vital.

Nodes\\Example of how WhatsApp is used on site

Nodes\\Examples of the type of issues on site

Nodes\\Examples of the type of issues on site\Dust and Noise - issues

Nodes\\Examples of the type of issues on site\Example of a problem that has emerged

Nodes\\Examples of the type of issues on site\ground works

Nodes\\Examples of the type of issues on site\safety breach - issue

Nodes\\Examples of the type of issues on site\type of issue - drawings

Nodes\\Examples of the type of issues on site\Uses initiative to solve issue

Nodes\\Examples of the type of issues on site\Using own experience to determine issue

Nodes\\Examples of the type of issues on site\Varied types of issues - quality-safety

Nodes\\Feels disheartened when people are uninterested

Nodes\\Generally issues are clear

Nodes\\Getting the information to the right people, like there's no point if you find an issue with something and not telling the right people~

Nodes\\How knowledge is shared\Different platforms for sharing knowledge

Nodes\\How knowledge is shared\Different platforms for sharing knowledge\All issues are feeding into the same platform

Nodes\\How knowledge is shared\Different platforms for sharing knowledge\different types of issues using different platforms

Nodes\\How knowledge is shared\Different platforms for sharing knowledge\Document the issue on the platform

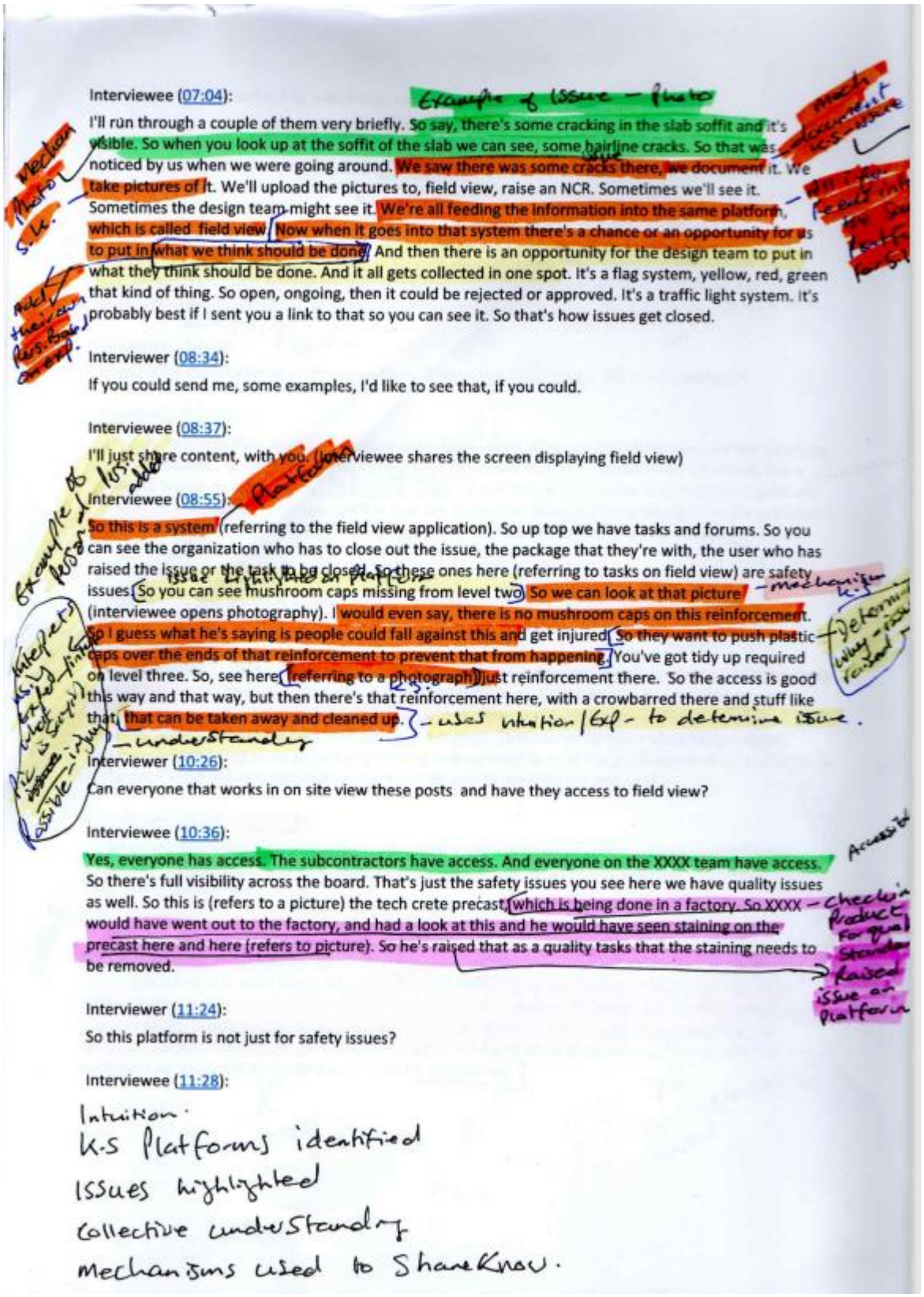
Nodes\\How knowledge is shared\Different platforms for sharing knowledge\Live register records and tracks issues

Nodes\\How knowledge is shared\Different platforms for sharing knowledge\Platform for sharing knowledge

Nodes\\How knowledge is shared\Different platforms for sharing knowledge\share issue via email

Nodes\\How knowledge is shared\Different platforms for sharing knowledge\WhatsAPP groups for sharing knowledge

Appendix H: Sample of cycle two manual coding



Interviewee (07:04):

I'll run through a couple of them very briefly. So say, there's some cracking in the slab soffit and it's visible. So when you look up at the soffit of the slab we can see, some hairline cracks. So that was noticed by us when we were going around. We saw there was some cracks there, we document it. We take pictures of it. We'll upload the pictures to, field view, raise an NCR. Sometimes we'll see it. Sometimes the design team might see it. We're all feeding the information into the same platform, which is called field view. Now when it goes into that system there's a chance or an opportunity for us to put in what we think should be done. And then there is an opportunity for the design team to put in what they think should be done. And it all gets collected in one spot. It's a flag system, yellow, red, green that kind of thing. So open, ongoing, then it could be rejected or approved. It's a traffic light system. It's probably best if I sent you a link to that so you can see it. So that's how issues get closed.

Interviewer (08:34):

If you could send me, some examples, I'd like to see that, if you could.

Interviewee (08:37):

I'll just share content, with you. (Interviewee shares the screen displaying field view)

Interviewee (08:55):

So this is a system (referring to the field view application). So up top we have tasks and forums. So you can see the organization who has to close out the issue, the package that they're with, the user who has raised the issue or the task to be closed. So these ones here (referring to tasks on field view) are safety issues. So you can see mushroom caps missing from level two. So we can look at that picture (interviewee opens photography). I would even say, there is no mushroom caps on this reinforcement. So I guess what he's saying is people could fall against this and get injured. So they want to push plastic caps over the ends of that reinforcement to prevent that from happening. You've got tidy up required on level three. So, see here (referring to a photograph) just reinforcement there. So the access is good this way and that way, but then there's that reinforcement here, with a crowbarred there and stuff like that, that can be taken away and cleaned up.

Interviewer (10:26):

Can everyone that works in on site view these posts and have they access to field view?

Interviewee (10:36):

Yes, everyone has access. The subcontractors have access. And everyone on the XXXX team have access. So there's full visibility across the board. That's just the safety issues you see here we have quality issues as well. So this is (refers to a picture) the tech crete precast which is being done in a factory. So XXXX would have went out to the factory, and had a look at this and he would have seen staining on the precast here and here (refers to picture). So he's raised that as a quality tasks that the staining needs to be removed.

Interviewer (11:24):

So this platform is not just for safety issues?

Interviewee (11:28):

Intuition.
K-S Platforms identified
Issues highlighted
Collective understanding
Mechanisms used to Share Know.

Appendix I: Sample of cycle two coding entered into NVivo

Nodes\\Barriers to sharing knowledge

Nodes\\Barriers to sharing knowledge\disconnect

Nodes\\Barriers to sharing knowledge\Language barrier

Nodes\\Barriers to sharing knowledge\limited experience

Nodes\\Barriers to sharing knowledge\Not care

Nodes\\Barriers to sharing knowledge\Not hearing

Nodes\\Barriers to sharing knowledge\Not thinking

Nodes\\Barriers to sharing knowledge\Overcome barriers

Nodes\\Barriers to sharing knowledge\scale

Nodes\\Barriers to sharing knowledge\too late

Nodes\\Barriers to sharing knowledge\too much talking

Nodes\\Barriers to sharing knowledge\Uninterested

Nodes\\Concept created

Nodes\\Concept created\Acceptance of concept created

Nodes\\Concept created\Analysis of concept before adapted

Nodes\\Concept created\Benefit of concept created

Nodes\\Concept created\Example of good ideas accepted

Nodes\\Consequence of not sharing knowledge\no benefiting anyone

Nodes\\Consequence of not sharing knowledge\Things will be missed

Nodes\\Consequence of not sharing knowledge\Trouble

Nodes\\Consequence of not sharing knowledge\Waste of time

Nodes\\Depending on the issue will determine whether it is shared and who it is shared with

Nodes\\Disheartening

Nodes\\equipment to facilitate the discussion of problems

Nodes\\example asking for help

Nodes\\Example of issues raised

Nodes\\example of knowledge not being shared

Nodes\\example of why practical is better than verbal

Nodes\\final say because of experience

Nodes\\Flow of knowledge - issue

Nodes\\Flow of knowledge - issuing drawings

Nodes\\Gathers information

Nodes\\getting the right information to the right people

Nodes\\Good idea - accepted

Nodes\\I suppose in construction, it's fairly set in its ways

Nodes\\Idea shared with others

Nodes\\importance of sharing knowledge

Nodes\\Incentives to sharing knowledge\Improve the team

Appendix J: Document Analysis

The analysis of the publicly available sources i.e., organisation's website, LinkedIn, and Facebook pages involved the researcher reviewing the documents to assess their relevance in addressing the research questions. This encompassed examining the content of each page for key words and phrases that contribute to answering the research questions. Documents unrelated to the research questions were excluded, while those directly linked to addressing the research questions were retained and further analysed by the researcher. Throughout the analysis process an Excel spreadsheet was used to maintain an organised record of the researcher's analysis. The researcher carefully read through each document, extracting relevant information pertaining to the organisational context (the case) and knowledge sharing (the unit of analysis). This included phrases, keywords, images, and videos. Each piece of data was labelled in the Excel spreadsheet. This allowed for ease of categorising and grouping of the data. Furthermore, the data was cross-referenced within the Excel spreadsheet to ensure consistency of the findings. For example, if knowledge sharing was detailed on the company website, the researcher reviewed the company's LinkedIn page, particularly the videos, to verify that knowledge sharing was taking place. Contextual information was drawn from the data, shedding light on the practices of knowledge sharing taking place within the organisation. These insights contributed to the development of the themes.

Preface to Paper 4 – Findings and Discussion

Paper 4 was developed between November 2021 and March 2022 and was presented, in person, to the internal and external examination panel at WIT in April 2022. The examination panel included Dr. Meera Sarma, University of Liverpool (external examiner), and Prof Felicity Kelliher, WIT (internal examiner). The paper was recommended without revision. The examination panel offered some suggestions for consideration. These suggestions mostly related to clarifying the themes focusing on articulation and more clearly differentiating between RQ 1 (How is knowledge shared?) and RQ2 (How is knowledge articulated?). These suggestions were taken onboard and are reflected in the version of the paper presented in this thesis.

Paper 4 builds on the fieldwork discussed in Paper 3. It details the application of a single case study design. Paper 4 outlines deep and rich findings from research undertaken in one Irish PBO, within the engineering, procurement, and construction sector. An interesting finding of this Irish PBO is the team members' willingness to share their personal tacit knowledge with one another. This willingness is pivotal for ensuring the success of a project, given the interdependent nature of project tasks that require team members with diverse skills to collaborate effectively.

These insights gained regarding the process of articulation during knowledge sharing reflect the perspectives of 26 interview participants from four project teams and documents relevant to the organisational context (the case) and knowledge sharing (the unit of analysis).

Researcher's personal and professional development

The interviews gave the researcher insight into the life experiences and perspectives of project team members. Through the interviews, the researcher gained a deeper understanding of how projects are conducted and managed. The importance of note taking during the interviews was also a significant insight for the researcher. This became evident during the analysis stage in that the researcher referred back to her notes, which captured important details and nuances relevant to organisational context that were not easily recognisable in the video recordings. The structure of the DBA programme gives the researcher the option

to submit the Findings and Discussion together in Paper 4. With the necessary attention given to the presentation and analysis of the themes, it was deemed more appropriate to have the discussion in the follow-on section, Section 3. Section 3 of the final thesis includes the discussion, recommendations, and conclusion.

Doctor of Business Administration (DBA)

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Date: 2nd June 2022

RESEARCH PAPER SERIES

PAPER 4: FINDINGS AND DISCUSSION

An exploration of knowledge articulation in teams within project-based organisations

ABSTRACT

The objective of this study is to explore how knowledge is shared and articulated within project teams, concentrating on the mechanisms used to articulate knowledge. The research objective is guided by the conceptual framework, which views the knowledge sharing process through the lens of Nonaka's (1994) externalisation mode of the SECI (socialisation, externalisation, combination, and internalisation) model.

This paper presents the findings from the study. 26 Semi-structure interviews were conducted with four project teams, within one project-based organisation (PBO). Additionally, documentation analysis specific to the organisational context and to knowledge sharing, the unit of analysis, was completed. Four key themes are prevalent within the data: willingness to articulate knowledge; methods used to articulate knowledge; barriers to knowledge articulation and facilitators of knowledge articulation. These themes provide insights into the research objective and offers guidance to project teams, particularly within project-based organisations.

Keywords: Themes, project teams, knowledge articulation, willingness to articulate knowledge

1.0 Introduction

Limited research exists concerning the practice of knowledge articulation (Hakanson, 2007; Ractham and Srisamran, 2018; O'Meara and Kelliher, 2020). Articulation plays a fundamental role in the externalisation process, where tacit knowledge is converted into an explicit form (Nonaka, 1994), particularly during knowledge sharing. The quality and richness of the shared knowledge, during the process of externalisation is dependent on the mechanisms used during articulation (Ambrosini and Bowman, 2001; Weldemariam and Garfield, 2019). Therefore, this study explores how knowledge is shared and articulated, in teams within project-based organisations, concentrating on the mechanisms used to articulate knowledge.

This paper, Paper 4 Findings and Discussion, is the final paper in a cumulative series of papers. The objective of Paper 4 is to detail the research findings of the study. This paper examines the process of knowledge sharing and articulation and develops the findings outlined in Paper 3. Six preliminary themes were identified in Paper 3, and after further analysis of the full data set, four key themes have emerged: willingness to articulate knowledge; methods used to articulate knowledge; barriers to knowledge articulation and facilitators of knowledge articulation. Each theme is discussed, along with how they respond to the research questions. This paper provides insights into the overall research objective and offers guidance to teams, particularly within project-based organisations.

The next section details the research application of design, followed by data collection and the analysis process. Thereafter, a brief discussion is presented on how the research has evolved since initial findings were presented in Paper 3 'Design and Initial Findings'.

2.0 Research design

The research design used in this study is a single case design, following a qualitative, interpretivist approach. This design operationalises the research objective: Exploring how knowledge is shared within project teams, concentrating on the mechanisms used to articulate knowledge, and addresses the following research questions (RQ):

RQ1 - How is knowledge shared in project teams?
RQ2 - How is knowledge articulated in project teams?
RQ3 - What mechanisms are used to articulate knowledge?

A single case study design fits well with the contextual and exploratory nature of this research. This approach supports an in-depth understanding of the practice of knowledge sharing within a natural setting, that being a project-based organisation (Eisenhardt, 1989; Gioia *et al*., 2012). Semi-structured interviews act as the primary source of data, and this is further supported by organisational documentation to answer the research questions (Eisenhardt, 1989; Yin, 2009). The researcher pursued the possibility of observing meetings and presentations, as part of the data collection method, however this was deemed unfeasible in a Covid-era (Dodds and Hess, 2020), as on-site visits would have been required. Paper 3 presented the preliminary findings from seven interview participants from one project team (referred to as Team A), and documents relevant to the organisational context, (i.e., the case). In the intervening time a further 19 interviews were conducted across three project teams (referred to as Team B, C and D), and additional documents relevant to the process of knowledge sharing (i.e., the unit of analysis) were analysed.

2.1 Data collection

Data collection commenced in June 2021 and concluded in January 2022. This process involved selecting, co-ordinating, scheduling, and conducting interviews, in conjunction with the collection and coordination of organisational documents.

The process of selecting and inviting the additional team members to volunteer in this study followed the same protocol outlined in Paper 3. Teams A, C and D had greater than 80% team member participation, while Team B had 75% team member participation. Furthermore, Team B is the smallest of the four teams. Table 1 below details the profile of the interview participants across all four project teams.

Table 1: Profile of interview participants

Title	Duration employed with company	Duration working with this team	Duration working on this project
Team A			
Contracts Manager	14 years	4 years	1.5 years
Project Engineer	3.5 years	3.5 years	1 year
Project Manager	6 months	6 months	6 months
Safety Officer	8 months	8 months	8 months
Site Manager	4.5 years	3 years	1.5 years
Site Engineer	3 years	3 years	1.5 years
Construction/Project Manager	2.5 years	2 years	6 months
Placement Engineer	5 months	5 months	5 months
Team B			
Project Manager	16 years	10 years	10 months
Site Manager	5 years	4 years	2 years
Senior Site Engineer	2.5 years	10 months	10 months
Team C			
Contracts Manager	6 years	13 months	13 months
Project Manager	8 months	6 months	6 months
Health and Safety Officer	1 year	6 months	6 months
Services Coordinator	6 months	6 months	6 months
Site Manager	6 months	6 months	6 months
Senior Engineer	18 months	8 months	8 months
Team D			
Services Coordinator	6 weeks	6 weeks	6 weeks
Design Coordinator	4 years	1 year	1 year
Contract Surveyor	3 months	3 months	3 months
Project Manager	5 months	5 months	5 months
Junior Contract Surveyor	5 months	5 months	5 months
Health and Safety Officer	2.5 years	10 months	10 months
Junior Services Coordinator	2 months	2 months	2 months
Contracts Manager	2.5 years	15 months	15 months
Site Admin	2 months	2 months	2 months
In total, 26 interviews were conducted, which included 3 female participants and 23 male participants. The gender mix represents the profile of the sector. The low number of female participants working in the construction sector is consistent with the Central Statistics Office data (CSO, 2019).			

Interview participants are primarily senior team members, and the absence of junior team members and operatives is noted as a limitation of this research study. The majority of the

team members in Team A and B have worked together for some time and are quite familiar with each other. Team C and D are relatively new teams and have not been established as long as Team A and B. These contextual factors were considered by the researcher during the analysis of the data.

During the interview process the interview guide (see Paper 3, Appendix E), was used to direct the interview. Throughout each interview, the interviewer followed up on or probed any viewpoint which she considered was important to answering the research questions. Similar to the interviewing process of Team A (detailed in Paper 3) all interviews were co-ordinated around participants' schedules and were conducted online, through Microsoft Teams, with the participants at their place of work. Permission to record the interviews was confirmed. In total, 26 semi-structured interviews were conducted, transcribed and analysed for this study (Adler and Adler, 2012). At the conclusion of each interview the researcher audio recorded her thoughts and feelings on each interview (refer to Appendix A). Table 2 below outlines the operational details of the interviewing process for each of the four teams. To maintain participant confidentiality a coding system was applied for all participants. The first letter (A, B, C or D) represents the team, TM denotes team member, followed by a number (i.e., Team A, Team Member 1 is labelled ATM1). The duration of the interviews ranged from 25 minutes to 65 minutes with the average duration being 39 minutes. The interview guide schedule was completed in all interviews.

Table 2: Interview Schedule[4]

Code	Interview Date	Interview duration	Word count per interview transcript
Team A: Interview Schedule			
ATM1	5th July 2021	45 mins	4,600
ATM2	7th July 2021	35 mins	4,655
ATM3	21st July 2021	40 mins	6,855
ATM4	8th July 2021	44 mins	6,487
ATM5	8th July 2021	31 mins	2,906
ATM6	12th July 2021	37 mins	5,531
ATM7	2nd Sept 2021	27 mins	5,025
ATM8	10th Sept 2021	25 mins	4,100
Team B: Interview Schedule			
BTM1	17th Nov 2021	51 mins	6,900
BTM2	17th Nov 2021	48 mins	6,755
BTM3	23rd Nov 2021	32 mins	3,785
Team C: Interview Schedule			
CTM1	19th Nov 2021	41 mins	6,672
CTM2	29th Nov 2021	25 mins	2,997
CTM3	29th Nov 2021	50 mins	6,540
CTM4	30th Nov 2021	40 mins	5,789
CTM5	30th Nov 2021	38 mins	5,989
CTM6	14th Dec 2021	65 mins	11,597
Team D: Interview Schedule			
DTM1	19th Nov 2021	31 mins	4,144
DTM2	22nd Nov 2021	40 mins	5,473
DTM3	22nd Nov 2021	39 mins	7,299
DTM4	26th Nov 2021	46 mins	6,254
DTM5	2nd Dec 2021	29 mins	4,184
DTM6	2nd Dec 2021	31 mins	4,282
DTM7	2nd Dec 2021	40 mins	6,086
DTM8	3rd Dec 2021	35 mins	4,271
DTM9	3rd Dec 2021	40 mins	5,908
Average		**39 mins (Note 1)**	
Total number of words		**145,084**	

Note 1: The times indicated above are the times from which the recording commenced. The recording of the interviews did not start until the formal part of the interview began (i.e., after introducing the study).

[4] For confidentiality purposes the code applied to each interviewee are not linked to the profile outlined in table 1.

Semi-structured interviews are the primary source of data collection, supplemented by document collection and analysis (Peräkylä and Ruusuvori, 2018). Documentation can provide additional information and help substantiate the data gathered from semi-structured interviews (Yin, 2009). Documents providing information about the organisational context and the process of knowledge sharing have been analysed (refer to Appendix B). Table 3 details the documents analysed for the four teams. The range of documents made available from the project-based organisation compliment and enrich the data collected during the interviews.

Table 3: Documents analysed

Document type		**Access to the document (Note 1)**
Context (The case)	Website	Public
	Facebook	Public
	LinkedIn	Public
	Company management chart	Private
Knowledge Sharing (The unit of analysis)	Core job responsibilities	Private
	Safety alerts	Private
	Lessons learned	Private
	Quality observations	Private
	Safety reports	Private
	Images of whiteboards	Private
	Images of progress	Private
Note 1: Public documents are documents that are accessible to the general public. Private documents are confidential documents that can only be accessed within the organisation.		

2.2 Data analysis

This study employed Braun and Clarke's (2006) six stages of thematic analysis framework to analyse the data, this entailed: familiarisation with the data; generating initial codes; searching for themes; reviewing themes; defining and naming themes and finally producing the report. All 26 interviews have been analysed using the framework. The analysis process for the initial seven interviews followed stages one to three of the framework and the same process was followed for the remaining 19 interviews. The full data set, the completed interviews and documentation received, were imported into NVivo. This software application was used to manage the analysis of the data; additionally the memo and annotation feature in NVivo were used to record the researcher's observations and thoughts

(refer to Appendix C). To ensure the accuracy of the themes, in that the themes adequately represented the coded data the researcher reviewed the themes manually (Braun and Clarke, 2006; Byrne, 2021). This is consistent with stage four of the framework. This process involved the transferring of the themes, the codes, and the associated data excerpts from NVivo into an Excel spreadsheet (refer to Appendix D). The spreadsheet was printed, and each quote was extracted from the document, and analysed separately (refer to Appendix E). This involved numerous iterations for the researcher, alternating between the earlier stages of the framework, familiarisation with the data, generating initial codes and searching for themes. This resulted in the rearranging of numerous themes whereby some coded excerpts were renamed, some were removed, and other excerpts were added to the themes (Braun and Clarke, 2006). The restructuring of the themes were inputted into the existing NVivo project. Further data analysis was conducted until a final coding structure was established (refer to Appendix F). Table 4 details the changes made to the preliminary themes and outlines the final themes.

Table 4: Changes made to the preliminary themes

Six Preliminary Themes	Changes made to the preliminary themes	Four Final Themes
1. Willingness to share knowledge	No changes – this theme is further supported, however the name has been changed to reflect the research objective.	1. Willingness to articulate knowledge
2. Types of knowledge shared	This theme is embedded and present throughout the theme 'methods used to articulate knowledge' and does not warrant to be a standalone theme	
3. Methods used to share knowledge	This theme is further supported, however the name has been changed to reflect the research objective.	2. Methods used to articulate knowledge
4. Barriers to knowledge sharing	No changes – this theme is further supported, however the name has been changed to reflect the research objective.	3.Barriers to knowledge articulation
5. Knowledge sharing incentives	The theme was merged with a new theme 'facilitators of knowledge articulation'.	4. Facilitators of knowledge articulation
6. Strong team connections	The theme was merged with a new theme 'facilitators of knowledge articulation'.	

In the table above the six preliminary themes are knowledge sharing. The four final themes that have emerged from the analysis of the full data set are all articulation. Theme 1: Willingness to articulate knowledge, Theme 2: Methods used to articulate knowledge, Theme 3: Barriers to knowledge articulation, and Theme 4: Facilitators of knowledge articulation. These findings address RQ2 and RQ3 specifically the process of and the mechanisms associated with knowledge articulation.

The following section discusses how knowledge is shared, and addresses RQ1, in addition to each of the themes associated with the process of knowledge articulation. This is consistent with stage 5, defining and naming themes, of Braun and Clarke's (2006) thematic analysis framework.

3.0 Findings

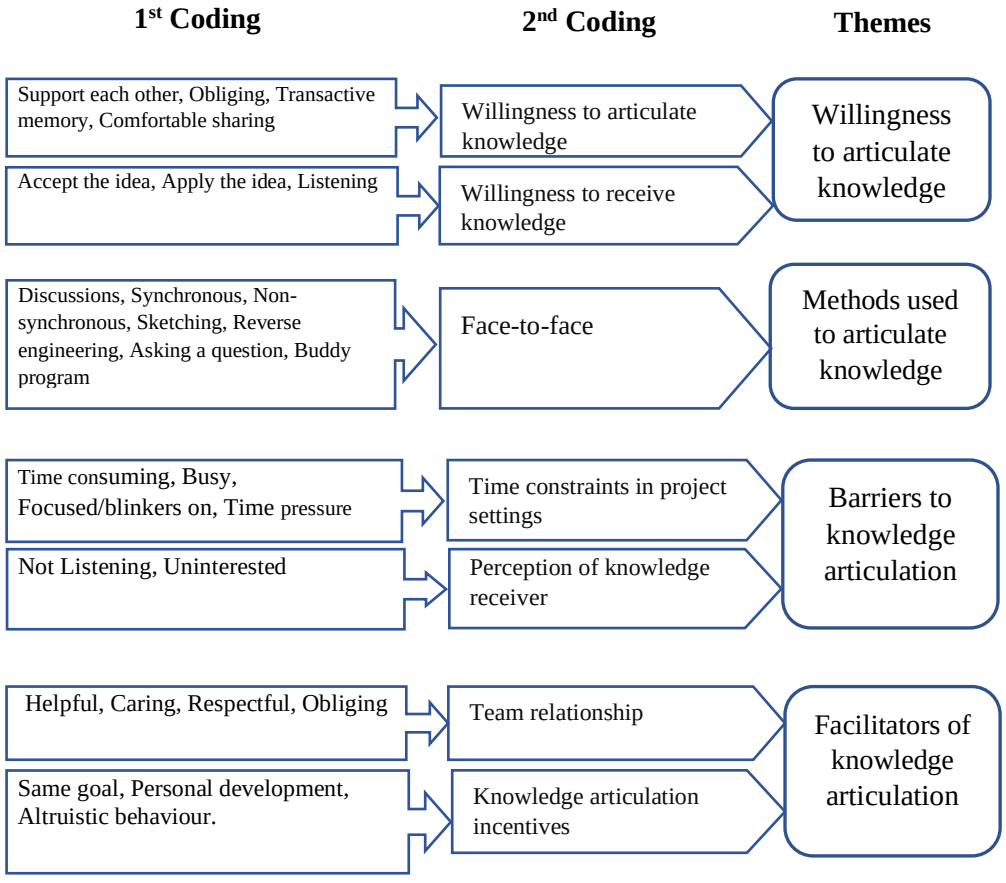
The findings show that knowledge sharing encompasses the sharing of all forms of knowledge (i.e., explicit and tacit knowledge). Knowledge is shared using varied technologies such as a knowledge management system, a document control system, and videos. These methods of sharing knowledge take place asynchronously, in that the knowledge holder and the knowledge receiver do not have to be present at the same time.

The interview participants refer to knowledge sharing occurring through multiple systems, such as SharePoint and FieldView. The retrieval of information, such as lessons learned from a previous project, is illustrated in participant DTM3's comment: *"…if I'm starting to…put ceilings up in a months' time, I can go on there (SharePoint) and find out what issues have there been with ceilings. … there might be something that might just jog the memory."* The team member uses the system as a tool to bring awareness to potential problems and to help recall past experiences. Participant CTM6 describes how team members share their experience with other team members: *"…what we actually do is document…. lessons learned. So, we've made a mistake on the job, or we've had an experience on the job. … we record that, do a small little synopsis, …a few photographs, and that gets shared up onto our knowledge bank within the business on SharePoint".* This comment illustrates the capturing of an experience in an explicit form. This is added to the SharePoint system and

made available to the wider organisation. This is further supported by the lessons learned document detailed in Appendix G. The document was extracted from the knowledge management systems and highlights an error which occurred on one of the project sites.

From the analysis process four themes have developed and are illustrated in Figure 1 below. These are: Theme 1: Willingness to articulate knowledge, Theme 2: Methods used to articulate knowledge, Theme 3: Barriers to knowledge articulation, and Theme 4: Facilitators of knowledge articulation. These themes are significant to the process of knowledge articulation. Knowledge articulation is a creative process whereby personal tacit is conveyed in explicit form. This takes place as part of the wider process of knowledge sharing, however at a much deeper level.

Figure 1: Final themes and coding



The themes are detailed in the subsequent sections and are supported with accounts of the team members' perspectives.

3.1 Theme 1: Willingness to articulate knowledge

The knowledge holder's willingness to articulate knowledge is important during the articulation process given that the extent of the knowledge being communicated is dependent on the willingness of the knowledge holder giving others access to their personal tacit knowledge (de Vries *et al*., 2006). This theme reflects the knowledge holder's and knowledge receiver's perspectives in the articulation process. For the knowledge holder, it exemplifies a voluntary action, carried out by them to articulate their knowledge with others. For knowledge receivers, it demonstrates their receipt and acceptance of the knowledge holder's knowledge,

This study gathered data from one Irish PBO in the engineering, procurement, and construction sectors. Members of the four teams interviewed work in diverse roles, such as *"...project manager... site managers... and engineers..."* (DTM3). They also reflect diverse age groups, including *"The XXX [team members name] beside me, he's 50 years of age. ...then there's another lad he's 35 and then I'm only...22."* (DTM7). There are also different levels of expertise, such as *"...people have different strengths based upon their background, experience, knowledge and all the rest."* (BTM2). It was revealed that a team member's willingness to articulate knowledge is driven by their knowledge of the task being performed. Furthermore, within the teams there is a recognition of an unofficial hierarchy. This has a positive effect on the team members' willingness to articulate knowledge and is inferred based on the language used by the interview participants such as *"young lads", "senior"*, and *"junior"*.

BTM3 discusses helping other team members:

> *"I suppose, I'd consider myself good, for my background. I'm in the construction for nearly 20, 25 years. Uh, for young lads, I always try to help them out and pull them into one side, say if I see something's not right, where I can make life easier for them."*

The knowledge holder displays a level of pride in their knowing and understanding of the profession. They are willing to articulate their insights with the team's junior members to help them learn about the profession. This is reinforced in CTM6's statement, noting how a team member conveys their skills and expertise with other team members:

> *"…like the project manager on the job, …when the young engineers were going out, setting out, he imparted some knowledge … in terms of his experience of…. setting out pads and holding down bolts …. watching them (team members) doing it he (project manager) could see that there was…potential for a mistake to be made."*

The knowledge holder (i.e., the project manager) observes and assesses the team members (i.e., young engineers) perform a specialised task. Based on prior experience, the knowledge holder sees a potential risk that could ultimately delay the project. Furthermore, the knowledge holder recognises that the junior members of the team do not have the experience to be aware of the risk, and the knowledge holder is willing to guide these junior members in the task.

Team members willingly articulate knowledge when they foresee the likelihood of a problem occurring. This is captured in BTM3's statement:

> *"…we were doing groundworks…. the fellas doing the groundworks said we'll put in a T … into the line to pick up another line. I said, we can't use T's. We can only use sweeping T's or a 45 T. … because on the previous job, we use T's, and it (the line) was after blocking."*

The knowledge holder instinctively communicates insights gained from prior experience to prevent the problem from happening. Participant CTM5 illustrates how a team member willingly communicates their expertise because they see a better way to complete the task:

> *"I wanted a site manager to …use a particular stone 6 F stone. He said 'look XXXX [Team members name], if you use 6 F stone, I think it'll damage the concrete. Please use 8 0 8, I think it's a better idea'.' I said, 'XXXX [Team members name] knock yourself out (permission granted to apply the new idea), if it makes a better job … Please do it'. XXXX [Team members name] is probably in his fifties. And he's well experienced above me. "*

The knowledge receiver listens to and agrees to apply the knowledge. This suggests the knowledge receiver has confidence in and values the knowledge holder's opinions and ideas, thereby showing respect.

The extracts from the interview transcripts illustrate team members willingness to articulate, receive, and implement expert knowledge. This is also supported by the witness statement document detailed in Appendix H. This document is part of a safety report which outlines a

team member's perspective of an incident which occurred with Team C. Through reflection the team member notates their experience of the incident, and their learnings from the incident. This is subsequently shared with other project teams throughout the organisation.

The transcripts show that the team members are willing to articulate their knowledge as well as receive and use the articulated knowledge, both of which are necessary for the articulation process. The next section discusses Theme 2: Methods used to articulate knowledge.

3.2 Theme 2: Methods used to articulate knowledge

The methods used to articulate knowledge determines the quality and richness of the knowledge being communicated, thereby aiding in the knowledge receiver's understanding. This, in turn, creates a collective understanding between the receiver and the holder. The interview transcripts detail various articulation methods used to transfer personal tacit knowledge, such as sketching, discussions, and senior team members sharing with junior team members. These methods require the simultaneous presence of the knowledge holder and knowledge receiver. Furthermore, the findings shows that a combination of articulation methods may be used to ensure a firm understanding of the knowledge being communicated.

3.2.1 Whiteboard sketching

Members of the four teams tend to intuitively use sketching, to express their opinions and thoughts, in generating collaborative ideas or solutions to problems. This involves the interplay of diverse team members freely adding their meaning and/or understanding to a sketch. The use of sketching as a method to articulate knowledge considers each individual's ideas and thoughts.

Participant BTM2 believes *"...we (the team) are very much visual beings..."* and considers sketching as the most appropriate articulation method for externalising a thought or an idea, as it allows the knowledge holder to convey their knowing visually. Sketching, as a method used to articulate knowledge, is frequently mentioned in the interview transcripts. CTM5 also talks of the team being *"...very visual people."* and goes onto say:

> *"...we drew it (idea) up ...there could be three or four of us around the whiteboard. Somebody would say, 'I'm not with that (not understanding)' 'Well, then you take a*

pen and go over there (to the whiteboard)'... Everyone is putting something up, it's like a sketch. ....Now you can see it (the sketch) starting to build up the picture in your head..."

This quote suggests an idea is communicated through sketching, and conversation as a means of articulation. The statement reveals how team members contribute equally to the development of the understanding of an idea. Sketching the idea makes it visible to the other team members. This helps form an understanding in their minds (i.e., knowledge receiver), which triggers the knowledge receiver to reflect on their existing knowing, and a difference is identified indicating a lack of understanding. The knowledge receiver adds their meaning to the sketch, thereby building a picture. This is an alternating process which continues between the team members until a collective, explicit understanding of the idea is created. This shows that mutual respect exists between the team members. The use of sketching is further supported in participant DTM5's comment, who uses sketching, in a casual setting, as a method to help externalise their understanding of an idea to other team members:

"You'd sketch it (idea) out the way you'd think it should be done. And then they (team members) might take the pen off you and sketch another bit. ... you see that a lot on site actually."

Similar to participant CTM5's statement, this quote indicates that team members collectively add their meaning, derived from their experience to the sketch. This process helps clarify a joint understanding of the idea. Using sketching as a method to articulate knowledge is also supported in Image 1, pictured in Appendix I. This image represents Team C's use of sketching as a collective method to clarify the understanding of an idea. This created a common understanding of the idea among the team members.

3.2.2 Daily formal discussions to informal tea break chats

Participants commonly cite formal and informal discussions as ways to articulate knowledge. The 'Daily whiteboard meeting' is the most prominent type of formal discussion, while 'Tea breaks' and 'Onsite chats' are the most prevalent methods used for informal discussions.

Participant CTM1 believes most discussions take place because of *"problems"* and refers to discussions taking place in a more formal setting involving all team members*: "...if we all have an idea, we would just put it up there and we'll discuss it and try and get over it (find a solution)."* This comment indicates that all team members actively engage in a discussion, where all opinions and views are considered until an agreed solution is found. DTM7's comment also refers to a planned formal setting where team members take part in the discussion:

> *"...we'll get together and we'll all say our input. ...our opinions could be all different. It could be three different ideas. Three of them could be wrong. Three of them can be right. It's just up to us to kind of merge together, come up with an agreement and try to overcome the issue. ... to make a joint decision."*

The team members express their thoughts and ideas, which are then combined to construct a collective understanding. Participant ATM8 speaks of team members building on each other's ideas to solve a problem: *"...it's amazing how often... I've had people come up with a solution, by just listening to ...somebody else's idea. Adapting it, it becomes sort of the perfect solution. So, the big thing is to make sure you have those sorts of conversations...".* This illustrates how the team members collaborate together to develop a solution to a problem.

Participant CTM5 talks of how problems are discussed within the team:

> *"I bring experience, I've got mechanical engineers, they bring their experience. I've got site managers and senior engineers, and they bring their experience, too. So, we all communicate and talk. If we've got a problem or an issue, we talk to each other about it and I/we resolve it."*

This statement acknowledges the interdependent nature of the project, where specialists from varied disciplines work together to complete the project. The diversely skilled team members are brought together as equals to share their expertise and knowledge to aid in finding a solution. *"Ultimately everyone feeds into it (the decision) and buys into it (the decision)... once the decision is made."* (DTM9).

A significant number of interview transcripts suggests that informal discussions, as a way to articulate knowledge also takes place. Informal discussions are a more natural form of communication, allowing team members to discuss ideas and problems freely. This is evident in DTM3's comment: *"I know that…they (team members) will talk and meet on site, in their office, at their desks, in the canteen and things will be discussed, as in…how can we do this a bit better? This is a problem? What can we do?"* This illustrates the team members naturally having impromptu discussions in a variety of random locations. DTM1 is passionate about the benefits of having casual discussions between team members.

> *"...a few times we've had …tea in the evenings at about three or four o'clock and that's the best, …it's better than any meetings that we have, because …they (team members) talk about maybe situations they have here that are similar to other jobs they were on. … and how they sorted them before and how that might help now on this job."*

This comment acknowledges the informal and unplanned transfer of valuable knowledge amongst the team members, who jointly articulate their skills and expertise. This takes place through reflection, where team members compare their past experiences with the current situation through stories. The findings also suggest that the physical proximity of the team members working in the same building or in the same room aids in the practice of knowledge articulation. This is evident in CTM4's comment: *"…if there's something that I'm unsure of, I'll run in next door to XXXX [Team member's name], or I'll run into someone that I think might be able to help me make an informed decision."* This allows for the immediate clarification of an issue and the solving a problem. This is further reinforced by participant DTM4's statement: *"...I sit right beside my senior and it's just the two of us. So, I'd be bugging (annoying) him a lot of times, ...with any questions that I'm not sure of and trying to get help from him, on something that I can't figure out."*

CTM4's talks of using various articulation methods to help clarity an idea:

> *"…we'll have a chat about it. If you don't get it, then I'll sketch it up on the board. And if you still don't get it, then we'll go and have a look at the area, and if you still don't get it, we'll keep trying until you do get it."*

Using varied methods to articulate an idea illustrates the extent the knowledge holder will go to ensure the knowledge receiver has a thorough understanding of their meaning of the idea.

Furthermore, it acknowledges the knowledge holder willing to invest their time in articulating their knowledge with others. This is further reinforced in BTM1's statement:

> *"I can...show them (team members) and explained to them on the model[5]. I might have to jump up to the whiteboard and sketch something. ...if they still don't understand, ... let's stick on the boots, go down to the site and... we review and demonstrate."*

3.2.3 Senior to junior articulation

Insights from the interview participants suggest that the less experienced team members (i.e., knowledge receivers) work alongside the more experienced team members (i.e., knowledge holders) in their daily work. Skills and experience are passed from the knowledge holder to the receiver as the knowledge receiver observes, listens, talks, and does. This is a naturally occurring and well-accepted act, which is illustrated in participant CTM6's comment discussing how knowledge is transferred:

> *"...senior members of the team walk with more junior members of the team. Imparting your experience on what you are seeing in terms of there's an issue there, that they (junior members) might not pick up ...or here's a quality issue that I've experienced in the past and we need to watch out for...."*

This comment reveals how the knowledge holder's insights and expertise are communicated to the knowledge receiver through observation and conversation while walking the project site. ATM7's remarks discuss how junior members of the team develop their skills:

> *"...you'll watch them (junior team members), you see them kind of struggling.... You jump in, 'why don't you do this, prioritise this one, over that? You'll get this one done.' ...You will try and guide them in the right direction, the best you can."*

This comment illustrates that the knowledge receiver is developing skills in addition to a professional language through practical 'doing' in a real situation. Here, the knowledge holder observes the knowledge receiver performing a task. Constructive feedback is given to help the team members improve how they perform. Through verbal instructions, the knowledge holder directs the attention of the knowledge receiver to various aspects of the specialised task. This prompts the knowledge receiver to think and reflect on the task from the viewpoint of the knowledge holder, thereby visualising it. This, in turn, creates a

[5] 3D modelling software.

collective, explicit understanding of the transferred tacit knowledge between the knowledge holder and the knowledge receiver.

Furthermore, DTM9 depicts how insights and skills are imparted from the more experienced team members (i.e., knowledge holder) to the less experienced team members (i.e., knowledge receiver) in this statement:

> *"I have, a junior XXXX [Team members name] I'd be giving him… examples of what I've done in the past… We had to witness a test …. So, he got the phone call and I said… make sure you have A, B, C done before you meet up with the guy. And make sure he has these certain things in place. So, I then went out with him … which is his first time witnessing it (the test). …and I kind of lead … it showed my colleague … what to do the next time."*

Preparing for a specialised task, the knowledge holder verbally communicates insights into the requirements needed to complete a task, preparing the knowledge receiver for what to expect. In this way, the knowledge receiver gets to observe the task being performed by the holder. This allows the receiver to witness subtle behaviours performed by the holder. These behaviours maybe subliminal to the knowledge holder and therefore can only be conveyed through observation. Furthermore, this process allows the knowledge receiver to gain insight into what might happen if they perform the same task.

The interview transcript findings show that team members use a diverse range of methods to articulate their knowledge. Furthermore, some of the methods are used in conjunction with one another, while others are used separately. Theme 3: Barriers to knowledge articulation is discussed in the next section.

3.3 Theme 3: Barriers to knowledge articulation

This theme is understood through two sub-themes: (a) time constraints in project settings, and (b) the knowledge holder's perception of the knowledge receiver. This theme recognises the factors which prevent or limit the process of knowledge articulation taking place.

3.3.1 Time constraints in project settings

The interviewees indicated that a key barrier in project settings involves time constraints and heavy workloads that limit or prevent the process of knowledge articulation between the team members. Project team members refer to the project site being *"very active"* (DTM4), *"fast-paced"* (CTM3), or *"busy as hell"* (ATM7).

Participant CTM3 remarks on whether team members share their insights with other team members:

> *"....sometimes and sometimes not, and probably the reason for that is, ...when you're on a fast paced, ...construction project, you are very, very, very limited for time as to, ...the depth that you can go on to share experiences..."*

This comment shows that team members are challenged by time constraints because of their busy work environment. This limits the time available for knowledge articulation, which in turn influences the extent of knowledge being articulated. This is further reinforced by DTM2's comment discussing how team members proactively help other team members:

> *"I think given the time they (team members) would, there's huge pressures on site, and pressure from time pressures. ...most of the time you're pretty busy trying to look after your own. You're looking after your own bits and pieces (tasks)."*

This comment suggests team members are willing to help other team members through articulation; however, the pressure to deliver under tight schedules may prevent or limit this from happening.

Knowledge articulated when team members have spare time was discussed with participant BTM2, who gaily comments, *"When we get spare time."* suggesting that spare time is a rarity. BTM2 goes on to say *"…there isn't enough time in the day, the week, and in the year to do enough work with what I am associated with or any of us are".* This excerpt suggests that regardless of the amount of time given to complete their tasks, it would still not be enough because there is always more to do. This implies that team members may be willing to articulate their knowledge; however, it is unlikely they would have enough time to do so.

DTM4 believes team members would not be proactive at helping others unless an issue or a problem is very obvious e.g., *"glaring"* for help to be offered. DTM4 goes on to say, *"…having no spare time, not that everyone looks out for themselves, but … you would be trying to get your own work done."*. This comment indicates that a level of care exists among the team members; however, their own deadlines are their priority.

BTM1 discusses using a knowledge management system to retrieve information, commenting: *"It's not that efficient…if it (the system) slows me down, … I'm not going to use it; the workload is so much anyway."*. This comment signals an intensity and urgency to access information, but internal systems are not necessarily able to respond within the timeframe of the user, thus becoming an unexpected barrier to the process.

3.3.2 Knowledge holder's perception of the knowledge receiver

There are various references in the transcripts suggesting that the knowledge holder's perception of the knowledge receiver acts as a barrier to the knowledge articulation process. The most obvious perception is *'not listening'*. This is evident in DTM8's comment discussing challenges confronted while trying to communicate their knowledge: *"…people who just don't want to listen…"*. This is reinforced in DTM3's statement acknowledging having witnessed team members not listening: *"…sometimes you get…where people are not listening. …one guy's … not listening to what the other guy is saying."*. Participant BTM1 believes: *"…as soon as, …you get the impression, that's, well, nobody's listening to you. You're not going to give your advice…"*. This comment indicates that the articulation process will halt once the knowledge holder perceives that the knowledge receiver is not listening.

Participant CTM3 comments on what causes members to stop sharing their knowledge: *"…if you try to share knowledge, two, definitely three times, and that person is not interested, well, I just move on…"* This comment shows that the knowledge holder is willing to articulate knowledge with the receiver, even though doubting the knowledge receiver is interested. If the knowledge holder experiences this perception of uninterest from the receiver three times, this confirms their doubt, at which point the knowledge articulation process will stop. The data extracts indicate the extent of the tacit knowledge being

articulated is dependent on the knowledge holder's perception of the knowledge receiver. The next section discusses Theme 4: Facilitators of knowledge articulation.

3.4 Theme 4: Facilitators of knowledge articulation

Facilitators of knowledge articulation are factors which aid in the knowledge articulation process. This theme is understood through two sub-themes: (a) the team relationship, and (b) knowledge articulation incentives.

3.4.1 Team relationship

The interview transcripts from the four teams – Teams A, B, C, and D – indicate that the relationship among the team members acts as an enabler to knowledge articulation, despite differing relationship types within each of the teams. Team A and Team B members display strong connections through a familiarity between the team members. This could be because the majority of the team members (i.e., Team A 63% and Team B 66%) have worked together previously: *"…there is a relationship there with us all, because we've been together so long."* (ATM8). Teams C and D display an eagerness to help other team members. This could be because many of the team members are relatively new to the organisation (50% of Team C members have been employed eight months or less; 67% of Team D members have been employed five months or less). None of the Team C and Team D members have worked together previously.

For example, a strong team connection is evident in the following BTM1's statement:

> *"…myself and the … XXXX [team members name] we're the earliest in, so we always… have breakfast together in the canteen. … we encourage that, we promote it. It creates a great team bond. And then inadvertently, 'Oh, by the way, we must sort this out'. Or 'I must look at that'…."*

The statement suggests the team members have taken the time to have informal breakfast meetings where knowledge articulation takes place naturally. These meetings have become routine, implying that the team members have developed a friendship in the background of their work relationship. BTM1 continues: *"…we try and avoid talking about work…"* This is a team attempt to diversify their conservations by focusing on non-job topics, further indicating connection on a personal level.

Participant ATM8 believes that keeping core team members together enhances the practice of knowledge articulation and states: *"... you know people's flaws, you know their strengths. Your productivity and things can be streamlined an awful lot better when that core is held, ...I can see it on this project."* This indicates that over time a deeper level of knowing develops between the team members, which can be advantageous to completing the project.

CTM1's remark shows a keenness to help other team members: *"I find, everyone very helpful. Because as I'm new…so I'm asking a lot of questions and I haven't had any pushback (refusal) yet."* This comment, coming from the knowledge receiver's perspective, recognises that the other team members are accommodating and supportive in giving their knowledge when asked. DTM5's comment also depicts a team supportive of its team members: *"...they're all very helpful and, there seems to be a good kind of comradery, you know, I don't think there's anybody out there paddling their own canoe (on their own), so to speak.... I think that's one thing I did find when I joined that ... everybody was ... they were a good bunch…"* This comment further acknowledges that an inclusive team environment exists, whereby no team member is left out or forgotten.

3.4.2 Knowledge articulation incentives

The findings show that the team members are internally motivated to articulate their knowledge, for example, when *"... teaching the lads something new…"* (BTM3), and they are externally motivated to articulate their knowledge *"...for the greater good of the project."* (CTM3).

Articulating knowledge for personal motivation is clearly depicted in participant DTM8's comment:

> *"I enjoy sharing anything that I can contribute to, that people may not already know about. ...It just gives you a sense of satisfaction knowing that…you're helping…and you're making some form of a difference."*

This comment illustrates that knowledge holders communicate their knowledge for the benefit of the knowledge receivers, prompting a feeling of pleasure and satisfaction. Furthermore, the knowledge holder does not expect anything in return; hence, this is a

selfless act. Articulating knowledge for personal motivation is reinforced in CTM3's statement:

> *"…I would try and share knowledge with them (junior team members), …I think that's a very nice thing to do, that's very satisfying."*

The knowledge holder is willing to articulate knowledge with the knowledge receiver (i.e., junior team member) for the benefit of the receiver. This is experienced by the holder as an act of gratification where they feel joy and satisfaction.

Participant CTM4 discusses why knowledge articulation is important to them:

> *"If I want to move up in my career … the easiest way for me to move up is if there's someone to come in and fill in behind me.…so if I can teach the lad below me, everything that I know, the chances are it'll be a lot easier for me to move up … cause he'd be there to fill the gap."*

The knowledge holder's incentive to articulate knowledge is driven by a collective interest, in that both the receiver and the holder are likely to gain from the act of articulating personal tacit knowledge.

DTM4's comment demonstrates that team members are motivated to articulate knowledge for the benefit of the project: *"…sharing knowledge…it's going to improve the works that is happening on site."* This is reinforced by CTM2's statement identifying the motivation for articulating knowledge as: *"…determination to get the job done and do a good job."* DTM5 believes that the more knowledge is shared *"… the more …problems can be foreseen"* therefore preventing problems from occurring. BTM1 discusses the consequences of not sharing knowledge in their role: *"If I don't share …knowledge and information with them (team members), well then, it's (the project) going to fail on site."* This indicates that the success of the project will be jeopardised if knowledge is not shared.

Four key themes have been presented in this paper: willingness to articulate knowledge; methods used to articulate knowledge, barriers to knowledge articulation and facilitators of knowledge articulation. Each theme has been recognised to be valuable to the knowledge articulation process.

4.0 Conclusion

This paper details the application of a qualitative interpretivist approach of a single case study design. Data collected from four project teams, i.e., 26 interview participants and 11 private and public documents, took place over a period of 8 months, (i.e., June 2021 to January 2022). One Irish PBO, within the engineering, procurement and construction sector, is the context of this study. This paper explains the manual analysis process conducted along with further data examination in NVivo software, using Braun and Clarke's (2006) thematic framework. The research findings, explains how knowledge is shared and articulated within project teams, concentrating on the mechanisms used to articulate knowledge, under four themes: willingness to articulate knowledge; methods used to articulate knowledge, barriers to knowledge articulation and facilitators of knowledge articulation. Next in this study is the writing of the discussion, conclusions, and recommendations sections, which will focus on the relevance of the findings in relation to the research objective and the research questions.

References

Adler, P. and Adler, P. (2012), in S. E. Baker and R. Edwards, *How Many Qualitative Interviews are Enough?* National Centre for Research Methods Review Discussion Paper, pp. 8–11.

Ambrosini and Bowman's (2001) 'Tacit Knowledge: Some Suggestions for Organisations', *Journal of Management Studies,* Vol. 38, No. 6, pp. 811-829.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, Vol. 3, No. 2, pp. 77–101.

Byrne, D. (2021) 'A worked example of Braun and Clarke's approach to reflexive thematic analysis', *Quality & Quantity,* Vol. 53, No. 3, pp. 1391-1412.

Central Statistics Office Ireland (2019) [online] Available at: https://www.cso.ie/en/releasesandpublications/ep/p-wamii/womenandmeninireland2019/work/ (Accessed 12th May 2022).

Dodds, S. and Hess, A. C. (2020) 'Adapting research methodology during COVID-19: lessons for transformative service research', *Journal of Service Management*, Vol. 32, No. 2, pp. 203-217.

de Vries E. R., van den Hooff, B. and de Ridder, A. J. (2006) 'Explaining Knowledge Sharing: The Role of Team Communication Styles, Job Satisfaction, and Performance Beliefs', *Communication Research,* Vol. 33, No. 2, pp. 115-135.

Eisenhardt, M. K. (1989) 'Building Theories from Case Study Research', *The Academy of Management Review,* Vol. 14, No. 4, pp. 532-550.

Gioia, D. A., Corley, K. G. and Hamilton, A. L. (2012) 'Seeking qualitative rigor in inductive research: Notes on the Gioia methodology', *Organizational Research Methods*, Vol. 16, No. 1, pp. 15-31.

Hakanson, L. (2007) 'Creating knowledge: the power and logic of articulation', *Industrial and Corporate Change,* Vol. 16, No. 1, pp. 51–88.

Nonaka, I. (1994) 'A Dynamic Theory of Organisational Knowledge Creation', *Organisational Science,* Vol. 5, No. 1, pp. 14-37.

O'Meara, M. and Kelliher, F. (2020) 'Exploring the process of articulating tacit knowledge in an organisational setting', Paper presented at the 34th *Annual British Academy of Management Conference*, 2-4 Sep, University of Manchester, Manchester.

Peräkylä, A., and Ruusuvuori, J. (2018) 'Analyzing talk and text' In N. Denzin, & Y. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* 5th Edn, Thousand Oaks, CA: Sage.

Ractham, V. V. and Srisamran, P. (2018) 'Effects of knowledge articulation and self-reflection on team performance', *Knowledge Management & E-Learning,* Vol. 10, No. 2. pp. 177–195.

Weldemariam, S. G. and Garfield, J. M. (2019) 'Framework for Externalisation of Tacit Knowledge in Participatory Agricultural Research in Ethiopia: The Case of Farmers Research Group', *Proceedings of the 52nd Hawaii International Conference on System Sciences.*

Yin, R. K. (2009) *Case study research: Design and methods,* 4th Edn.: Thousand Oaks, CA: Sage.

Appendix A: Reflection noted during data collection

September 2nd, 2021

This interview participant was genuinely happy and almost grateful to be part of this research study. Interestingly this participant emphasised patience as a major trait needed for knowledge sharing to take place, as well as the knowledge holder needing to take the time to help the team members receiving the knowledge to understand the shared knowledge.

November 19th, 2021

I've just realised that some of the interview participants refer to technology as an example of how their team members or they themselves share their knowledge. I wonder is this because the knowledge management system is relatively new (2 years). Quite a few structured meetings seem to take place also, these meeting appear to encourage the team members to speak out and share their knowledge, whether it be an idea or a problem. Forecasting is commonly mentioned as a topic of discussion during these meetings. Furthermore, it is not uncommon for team members to ask other team members for advice, whether it be in a formal or informal meeting.

10th December 2021

Reflecting on the interviews it is evident that knowledge sharing flows freely and naturally within each of the four team environments. The team members often refer to the word 'open' for example, 'this is a very open environment', 'we are very open', 'we openly communicate', this openness seems to aid in the team member's willingness to share their knowledge. Furthermore, the team members tend to use a variety of different articulation methods to ensure others understand their knowing. Sketching seems to be one of the favoured methods used to articulate knowledge. There is a strong level of care, be it, for the project or for the team members. Furthermore, respect and equality exist among the team members, whereby all voices are listened to. However, this is a very busy environment, where time is of utmost importance. I have witnessed the busyness during the interview sessions, whereby, team members would stop the interview to answer their telephone or respond to a question asked by another team member.

Appendix B: Document Analysis

Documents pertinent to the knowledge sharing and articulation, included images, safety reports and lessons learned reports. These documents were imported into Nvivo for analysis. To facilitate the analysis process the researcher organised the documents according to their type, distinguishing between text-based and image-based documents. This categorisation allowed for efficient navigation and retrieval of documents. For the analysis of the text-based documents the researcher employed Braun and Clarke's (2006) thematic analysis Each document was methodically examined ensuring equal attention to each element of the documentary source This iterative process led to the identification of sections of the documents, relevant to knowledge sharing and articulation, which were subsequently coded. The generated codes from the documents were merged with the codes generated from the interview transcripts, contributing to the development of the overall themes. Descriptive codes were used to analyse images, detailing the content of the image, the significant of the image/s within the PBO context and/or their relevance to knowledge sharing and articulation. The image-based codes further enriched the nuances of the development of the overall themes.

Appendix C: Samples of memo and annotation feature in NVivo

Image 1: Sample of memo feature in NVivo

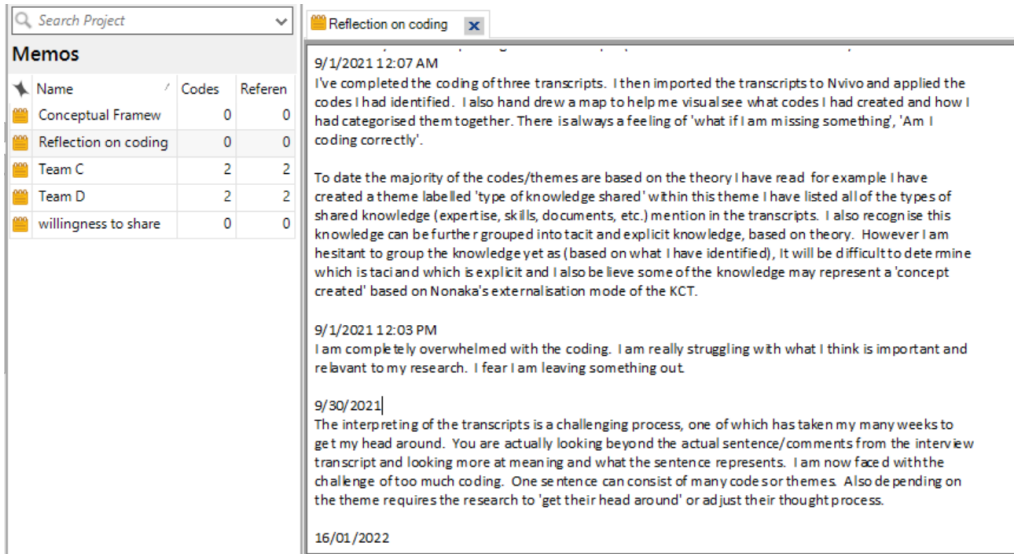
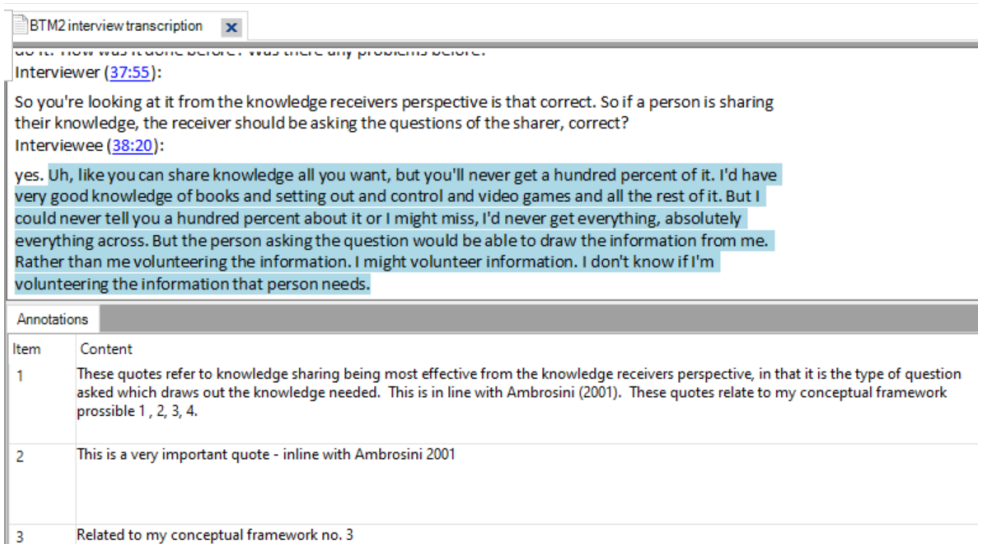
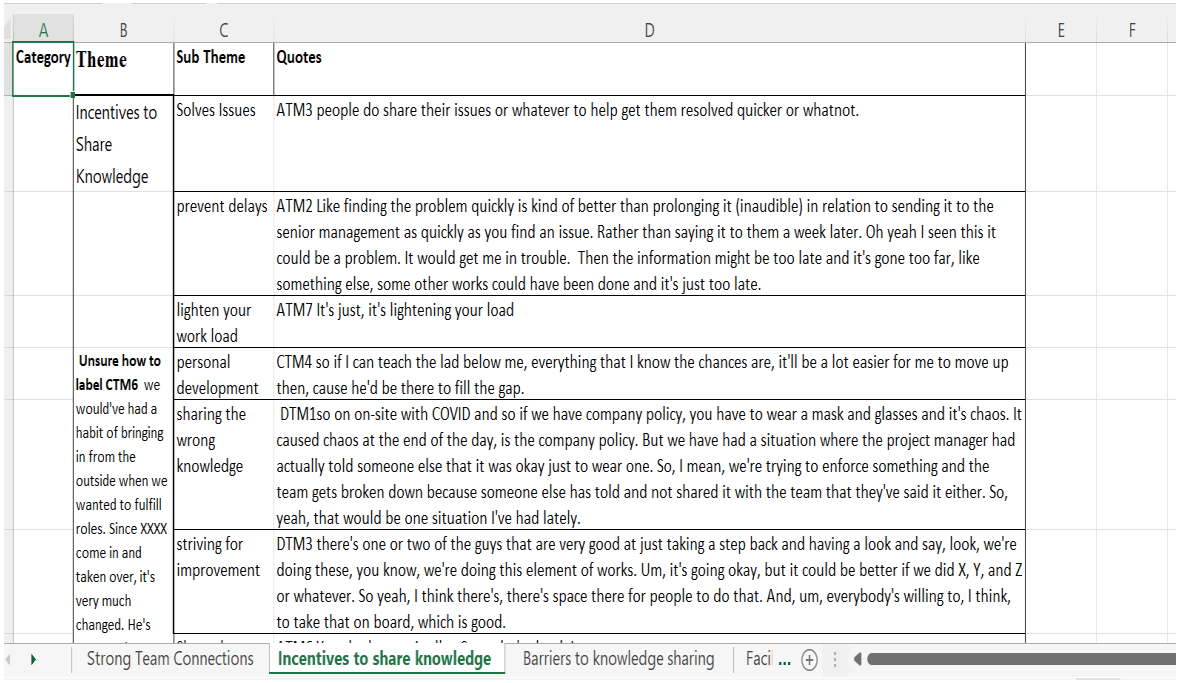


Image 2: Sample of annotation feature in NVivo



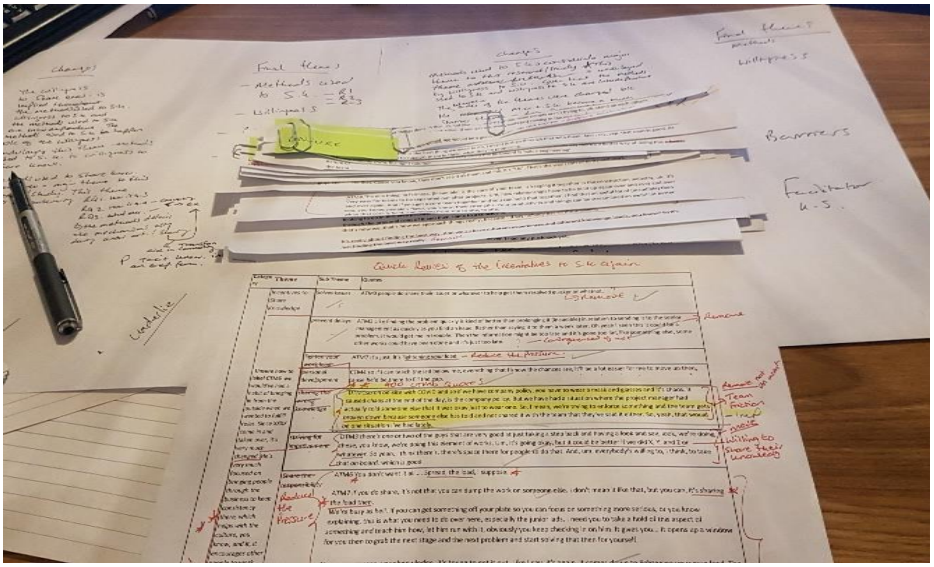
Appendix D: Sample of data excerpts in Excel

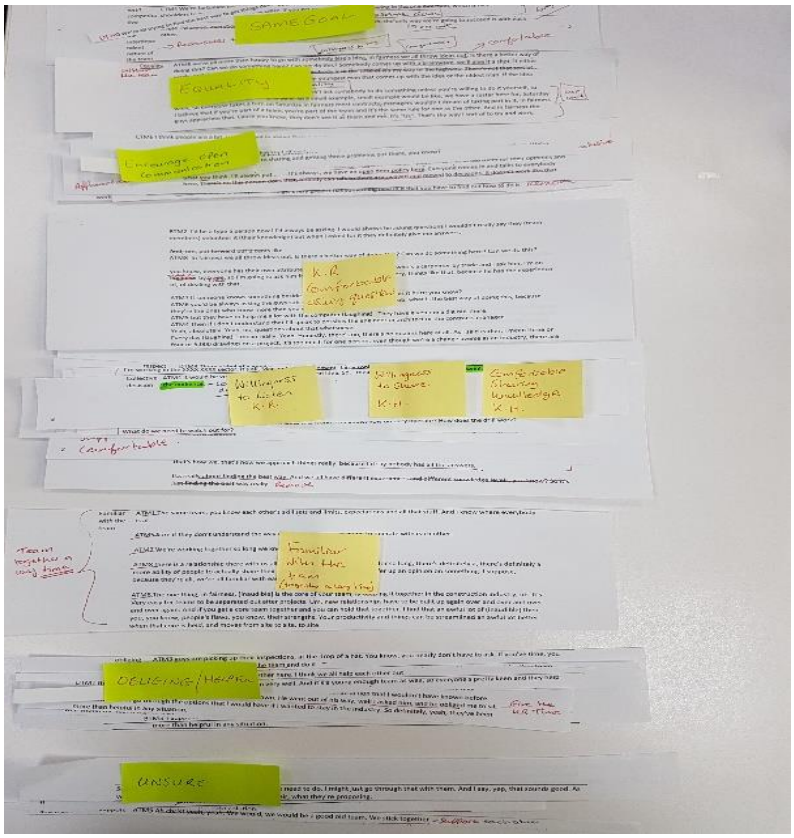


Category	Theme	Sub Theme	Quotes
	Incentives to Share Knowledge	Solves Issues	ATM3 people do share their issues or whatever to help get them resolved quicker or whatnot.
		prevent delays	ATM2 Like finding the problem quickly is kind of better than prolonging it (inaudible) in relation to sending it to the senior management as quickly as you find an issue. Rather than saying it to them a week later. Oh yeah I seen this it could be a problem. It would get me in trouble. Then the information might be too late and it's gone too far, like something else, some other works could have been done and it's just too late.
		lighten your work load	ATM7 It's just, it's lightening your load
	Unsure how to label CTM6 we would've had a habit of bringing in from the outside when we wanted to fulfill roles. Since XXXX come in and taken over, it's very much changed. He's	personal development	CTM4 so if I can teach the lad below me, everything that I know the chances are, it'll be a lot easier for me to move up then, cause he'd be there to fill the gap.
		sharing the wrong knowledge	DTM1so on on-site with COVID and so if we have company policy, you have to wear a mask and glasses and it's chaos. It caused chaos at the end of the day, is the company policy. But we have had a situation where the project manager had actually told someone else that it was okay just to wear one. So, I mean, we're trying to enforce something and the team gets broken down because someone else has told and not shared it with the team that they've said it either. So, yeah, that would be one situation I've had lately.
		striving for improvement	DTM3 there's one or two of the guys that are very good at just taking a step back and having a look and say, look, we're doing these, you know, we're doing this element of works. Um, it's going okay, but it could be better if we did X, Y, and Z or whatever. So yeah, I think there's, there's space there for people to do that. And, um, everybody's willing to, I think, to take that on board, which is good.

Strong Team Connections | Incentives to share knowledge | Barriers to knowledge sharing | Faci ...

Appendix E: Manual review of the themes





Appendix F: Coding structure

Coding Hierarchial Structure (Methods used to share knowledge)

Name	Code Type	Folder Location	List Level	List Order	Aggregate	Nickname	User Assigned Color
Synchronous	Node	Nodes	2	87	No		None
Discussions	Node	Nodes	3	90	No		None
Mentoring_Buddy System	Node	Nodes	3	89	No		None
sketching	Node	Nodes	3	88	No		None
Asynchronous independent of time	Node	Nodes	2	93	No		None
technology	Node	Nodes	3	95	No		None
whatsapp messages	Node	Nodes	3	94	No		None

Appendix G: Lesson learned document

Lessons Learned Summary	
Background Details	
A simple clerical error of an external dimension being used on the internal wall of the prefabricated insulated gutter, resulted in gutter sitting 75mm above the purlin it was designed to sit on. On first placement of the gutter it was evident that there was a serious issue that had the potential o have serious implications for the project program. Lead times for new gutters were estimated at 4-5 weeks. This was the least preferred corrective measure.	
Identification Method	Other (Specify)

Comments	Created By	Date
Identified during installation	XXXXXXXX	10/6/2021 1:33:53 PM

Lessons Learned Type	Non-Conformance:
Is the Lessons Learned related to a Non-Conformance or Loss of Process?	Yes
Process?	

Loss Of Proccess / Non-Conformance (LoP / NCR)	
Causes Types	Measurement
Cause Details	
A simple clerical error of an external dimension being used on the internal wall of the prefabricated insulated gutter, resulted in gutter sitting 75mm above the purlin it was designed to sit on.	
Impact / Potential Impact:	Time
Corrective & Preventative Action Type(s)	Rework / Repair
Corrective Action Details	
Subcontractor removed materials from site back to their fabrication facility. The gutters were then reworked to the correct dimensions.	
Preventative Action Details	
Samples of prefabricated to be offered up in future where possible. Off-site inspections to be carried out by contractors where feasible to inspect bespoke fabrications	

Reccommendations - Lessons Learned	
#	**Reccommendation**
1	Where program allows it, contractors are to provide sample panels for inspection/comment prior to manufacturing of same. Where feasible contractors are to carry out their own off-site inspections for any bespoke fabrications that on the critical path.

Appendix H: Safety report and witness statement

Safety Report

NEAR MISS REPORT FORM

This is a confidential document, for internal use only. Not to be issued to any third party without approval from EHS Manager.

PART 1: NEAR MISS DETAILS

Contract Name: XXXX | Contract No.: XXXX

Location on Site: XXXXXX

Reported by: XXXXXXXX

Date: 05.07.2021 | Time: Approximately 10.00am

Details of Near Miss Incident:

During off-loading structural steel off a flat-bed truck trailer, the telehandler fork touched a close centred timber skid and nudged two 4 foot lengths of steel onto the ground, within the exclusion zone on the opposite side of the trailer from which the telehandler was operating. This event was caused by the skids being close centred to suit the short steel that was sited on the outside of the trailer and by the longer steel in the centre of the load causing a blind spot for the banksman. Please see photographs of this undesired event – on page 4 of this report.

Key Near Miss Information

- RAMS - The possibility of steel toppling off a trailer during un-loading was mentioned in the RAMS, however, the RAMS are currently being amended by XXXXX to reflect the mitigation measures discussed as part of this investigation with XXXXX XXXXX and a specific risk assessment compiled on same.
- Daily Safe Start - Falling Objects from Trailers was mentioned in Daily Safe Start.

NEAR MISS CATEGORY:

Categor	Description	Action Required	Mark X
CAT 1:	Serious Near Miss with high potential for serious injury/ damage	Works stopped in incident location until investigated. Stand-down of subcontractor as required. Incident Review Meeting	
CAT2:	Near Miss low risk of serious personal injury or damage	Complete investigation + submit report	X

SIGN OFF:

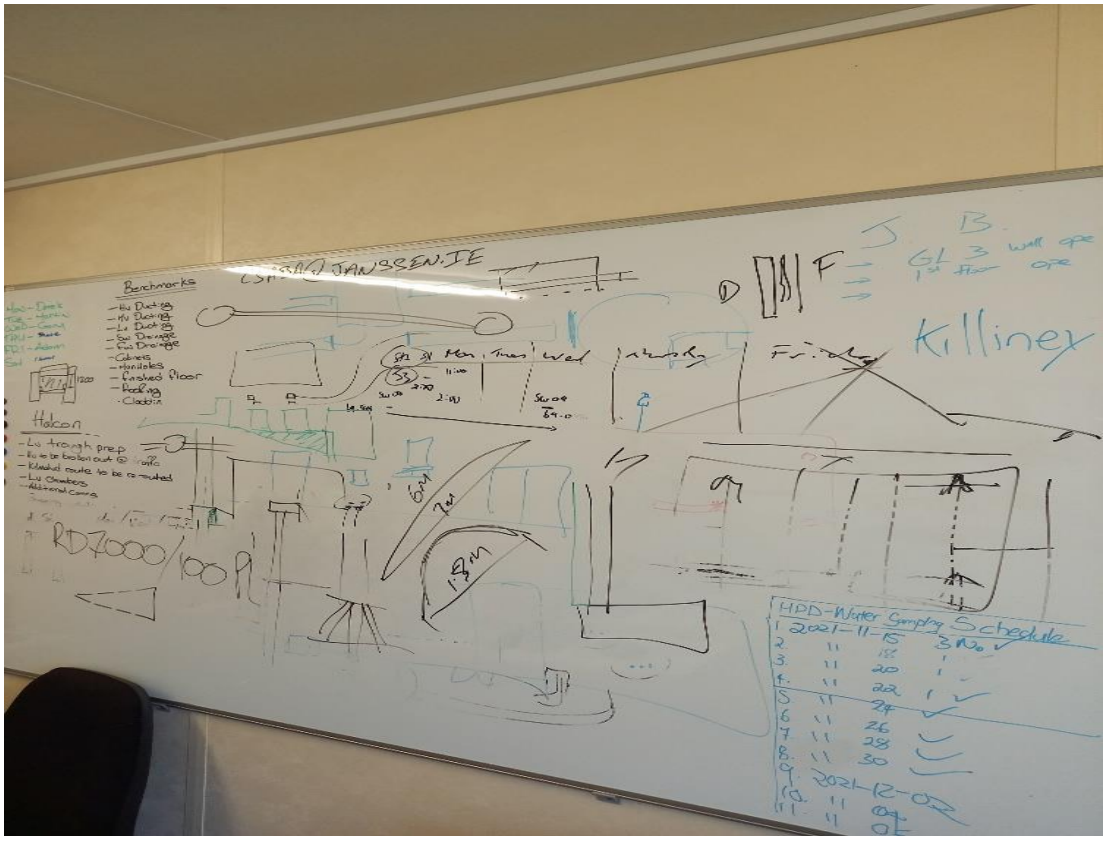
Signature: | Position: Date: 07.07.2021

Witness Statement

Company Name		Project Title	
Location		Contract No.	1344
Name of Witness		Date of Incident	5.7.2021
Address	Nart Swanns cross Rochcorry co. Monaghan.		
Occupation	Truck Driver & Banksman.		
Statement		Page 1	of 2

At around 10.00 am Today I was directing Paddy on the telehandler offloading the Structural steel off the Flatbed trailer. There were 2 pieces of Short Steel on the outside of the load & one of Paddy's Forks touched one of the Skids & the 2 pieces of steel toppled to the ground. The Skids below the outer Short Steel were not visible & the Fork Snagged it whilst lifting the previous longer piece of steel. It would help in Future if the Shorter steels were stacked in the centre of loads with the longer steels on the outside. This would ensure visibility when off-loading & all close centered Skids would be off-loaded from the centre of loads, leaving the wide spaced skids on the outside so that the Forks couldn't Snag them. This would be a Safer Sequence of off-loading and would avoid greatly the risk of Steel being toppled to

Appendix I: Image 1 Sketching



SECTION THREE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

1.0 Introduction

This section discusses the study's findings, evaluating and comparing them to the literature while focusing on how they address the overall research objective:

> Exploring how knowledge is shared and articulated within project teams, concentrating on the mechanisms used to articulate knowledge.

The findings discussed offer new insights into the articulation process in particular the context in which knowledge sharing takes place, the qualities of team members who are willing to articulate their knowledge, and the type of methods used during the articulation process.

The literature identifies the importance of project-based organisation (PBO) team members' recognising the project's interdependent nature and that they appreciate that project tasks require all team members' joint specialist skills. No team member can complete a project or task alone (Mueller, 2014). Consequently, team members must articulate knowledge with other team members for the project's success. Articulation plays a fundamental role in the externalisation process, where a team member's personal tacit knowledge is transformed into a form others can understand, that is, explicit knowledge (Nonaka, 1994). Externalisation involves transitioning knowledge from an individual's subjective tacit knowledge to a collective objective form of knowledge by merging with and confirming other team members' knowledge (Tsoukas, 2009). The process of converting tacit knowledge into explicit knowledge taps into the mechanisms used to articulate a team member's tacit knowledge. The quality and richness of the knowledge being converted during the articulation process relies on these mechanisms (Ambrosini and Bowman, 2001; Weldemariam and Garfield, 2019). Although literature identifies that articulation is important in the conversion of tacit to explicit knowledge, little research attention has been given to this process (Hakanson, 2007; Ractham and Srisamran, 2018; O'Meara and Kelliher, 2020). This study provides a fine-grained understanding of the articulation process during externalisation (Nonaka, 1994). It sheds light on this complex process, adding nuance and detail to expand existing knowledge on how project teams articulate knowledge within PBOs.

To more fully understand this process, this study addresses three research questions:

RQ1 – How is knowledge shared in project teams?
RQ2 – How is knowledge articulated in project teams?
RQ3 – What mechanisms are used to articulate knowledge?

The findings of this study are derived from 26 semi-structured interviews with members of four project teams working in a PBO. Documents confidential to the organisation and those accessible to the general public supplement the interview data.

Section 3 of the thesis proceeds as follows: first the research findings presented in Papers 3 and 4, that address the research questions are discussed. Next two frameworks, informed by the literature and the findings of this study, are presented. The section concludes with a discussion of the study's contributions to practice and literature. The study's limitations are considered and suggestions for future research are offered.

2.0 Discussion

Insights from the detailed findings presented in Papers 3 and 4 of the Cumulative Research Paper Series are discussed in this section. Four themes emerged from the in-depth analysis of the data collected. These are:

Theme 1 - Willingness to articulate knowledge.
Theme 2 - Methods used to articulate knowledge.
Theme 3 - Barriers to knowledge articulation.
Theme 4 - Facilitators of knowledge articulation.

The themes identified in Paper 4 served as a platform from which developed the overall findings of the study presented in Section 3. These findings were developed through an iterative process, moving back and forth from the data and the literature. During the final stages of the analysis and Paper 4 analysis addressing the research questions was the focus of attention. However, the discussion here (in Section 3) involves linking the research

question/s with the relevant theme/s (see Appendix A). Therefore, the themes were rigorously re-examined in the context of the research questions, drawing knowledge from prior literature and insights from the rich data obtained from the fieldwork. As identified in the literature, knowledge sharing and articulation is a complex process, consisting of many elements which are both connected and interdependent. As such, the themes detailed in Paper 4, overlap, and inform multiple dimensions of the knowledge sharing and articulation process. In this Section, the three research questions are discussed, drawing on the findings presented in Paper 4 and prior literature.

2.1 Knowledge sharing in project teams (RQ1)

RQ1 seeks to explore how knowledge is shared. In this regard, consideration is given to the context in which knowledge is shared. To explore this aspect the themes emerging from the findings (discussed in Paper 4) are examined to surface the context of knowledge sharing.

2.1.1 Sharing explicit knowledge in project teams

The findings show that explicit knowledge (i.e., information) is shared in a formal setting during pre-scheduled meetings and through the use of varied communication tools. This is consistent with Sanchez (2005) and Mueller (2015), who posit that organisational formal processes aid in sharing explicit knowledge. Formal pre-scheduled meetings are standard practice across the organisation. These formal meetings take place, in real time, on a specified day and time and occur daily, weekly, biweekly, and/or monthly, whereby the dates and times are set and are rarely changed. The meetings involve team members from different skill domains and different skill levels. The meetings take place either though video conferencing applications, such as Microsoft Teams, or in person. The meetings are driven by a particular team member, such as the site manager or safety manager. During such meetings information on specific items or tasks pertaining to quality, safety, and progress is shared. For example, in the daily meetings an overview of the intended day's progress is shared, including existing problems, potential problems, and solutions. Explicit information is communicated during these meetings detailing previous work done (i.e., reflecting on what did or did not go well) and the work for that particular day (e.g., '*who's working where and who's doing what*' CTM4). These formal meetings essentially keep the team members

informed on what will occur on-site that day. This is important because of the skills dependent nature of the tasks and the sharing of resources, such as equipment, within this PBO context.

In this formal context, knowledge shared with team members is linear in that information pertaining to a particular task is directed at the team member responsible for the task, offering clarification to the team member and also informing other team members, so they are cognisant of which trade or skill is working in a particular site area. This is a fast paced, structured process. Other team members may step in and voice their concerns and opinions, adding to the conversation if a decision has the potential to impact their task's progress. However, this is at a superficial level, as the intricate details of problems or issues are not generally discussed in these formal meetings.

The findings suggest that explicit knowledge is also shared in digital format. In most cases, during the formal meeting the information shared is written on a whiteboard for further clarity (see Appendix B, which illustrates the structured explicit knowledge the team members share). In this particular organisation information displayed on the whiteboard is captured as a photograph and uploaded onto a knowledge management system, known as FieldView. It is then made available to those present at the meeting and others associated with the project, such as senior managers and directors. This finding is consistent with previous research which acknowledges the role of knowledge management systems used as a tool to further facilitate the sharing of knowledge (Bock *et al*., 2005; Hariharan, 2005; Kim *et al*., 2014). The research findings also highlight that explicit knowledge can be shared using different communication tools, such as WhatsApp, email, and walkie talkies. These tools are used as a means *"…to get the message out quick…"* (ATM1), particularly if there is the potential of a problem occurring.

2.1.2 Sharing tacit knowledge in project teams

The findings show that the sharing of tacit knowledge occurs predominately in an informal setting, such as on the project site or during tea breaks. By their nature, such informal settings require, in person, the knowledge holder/s and the knowledge receiver/s.

2.1.2.1 Onsite tacit knowledge sharing

Knowledge shared onsite takes place unexpectedly and is predominantly around the resolution of an existing problem or prevention of a potential problem. Tacit knowledge sharing is more prevalent in this setting, occurring regularly onsite, at the problem location. This frequent exchange of knowledge is understandable given that onsite problems are a common occurrence on construction sites (Stark *et al*., 2014). Onsite tacit knowledge sharing occurs between, high experienced and low experienced team members (high-low), and between high experienced and high experienced team members (high-high).

High-low tacit knowledge sharing may involve team members from the same or different skill domain. For example, an experienced engineer sharing their tacit knowledge with a less experienced engineer (same skill domain) or a team member experienced in technology sharing their technical skills, with the construction manager, who has less technical experience (different skill domains). What is central to high-and-low tacit knowledge sharing is the topic being shared. In this situation the findings suggest that team members with high experience will actively share their knowledge when they identify a team member with less experience struggling with a task. When team members struggle with a task, problems can arise which in turn could have an adverse effect on the project's outcome. Knowledge sharing in this context takes place slowly, given that time is needed to discuss the matter thoroughly and clarify any queries raised by the less experienced team member. Therefore, knowledge sharing takes place collectively. High-low tacit knowledge sharing helps develop the less experienced team member's knowledge which in turn reduces the occurrence of problems that may impact negatively on the outcome of the project. Although knowledge is shared at the problem location that is not to say a solution is formed at the problem location. The findings reveal that high-low tacit knowledge sharing may continue to another location, such as the site office. This is dependent on the less experienced team members understanding of the knowledge conveyed at the problem location and whether further discussion is necessary to address the problem.

High-high tacit knowledge sharing mainly involves different skill domains such as knowledge sharing between project managers, and engineers. Bear in mind that the

interdependent nature of project task(s) relies heavily on the team members' abilities to combine their different skills (Mueller, 2014). In this situation, the team members come together as specialised equals within their given domain, to devise a solution to an existing or potential complex problem. Here the team members comfortably and confidently articulate their knowledge in a free-flowing iterative manner. High-high tacit knowledge sharing occurs at a slow pace. The findings indicate that the time taken to share knowledge varies depending on the complexity of the problem and prior experience of similar problems. For example, more time will be needed to devise a solution to a new and unfamiliar problem than for a problem that is familiar to the team members. Similar to high-low tacit knowledge sharing, the findings show, that a solution may not be formed at the problem location. Depending on the complexity of and/or familiarity with the problem knowledge sharing may continue at another time and/or location. The resources available and the sequence of works to be followed has to be considered carefully, given the interdependent nature of the project tasks.

2.1.2.2 Tea-break chats

The findings show that knowledge shared between team members during tea-breaks is a regular occurrence which takes place organically. Here team members with different skill levels and from different skill domains are present. However, they are not intentionally brought together to solve a problem. Through casual conversation difficulties or problems concerning a task are shared among the team members. In this setting (informal) the team members are forthcoming in volunteering their opinions and ideas and seem to genuinely want to help solve the problem at hand. This discussion is usually in the form of storytelling where the team members reflect and share their prior experiences. Storytelling gives individuals the opportunity to share their own experience and perception. In more formal settings or channels, sharing of experiences and perceptions are typically filtered. However, through storytelling individuals express themselves more freely and say more than they would normally (Ambrosini and Bowman, 2001).

Table 1 below summarises the context of explicit and tacit knowledge sharing in project teams and reveals insights into the context surrounding how knowledge is shared (RQ1).

Table 1: How explicit and tacit knowledge are shared in project teams

	Explicit knowledge shared	**Tacit knowledge shared**		
Context of knowledge sharing:	Formal	Informal		
Location	On site meeting room/s	Onsite interaction: high experience and low experience (high-low)	Onsite interaction: high experience and high experience (high-high)	During tea-breaks
Format	Structured	Unstructured	Unstructured	Unstructured
Frequency	Pre-scheduled daily, weekly, biweekly, and monthly meetings	Frequently	Frequently	Occasionally
Platform	In-person and/or online meetings and through the use of technology	In-person interactions	In-person interactions	In-person interactions
Single or transitory location	Single location	Transitory location	Transitory location	Transitory location
Format of exchange:				
Pace	Fast	Slow	Slow	Slow
Process	Linear (one directional)	Collective (bi-directional)	Collective (bi-directional)	Collective (bi-directional)
Planned or spontaneous interaction mode	Planned	Spontaneous	Spontaneous	Spontaneous
Team members' skill-levels and domains	Different skill-levels and different skill domains	Different skill-levels and the same or different skill domains	Same skill-levels and different skill domains	Different skill-levels and skill domains
Instigated by	Upper management	Team member/s	Team member/s	Team member/s

This study found that the context surrounding how tacit knowledge is shared is significantly different from how explicit knowledge is shared. Within this PBO, tacit knowledge sharing occurs naturally and frequently, among the team members, and is understood to be an accepted part of the project's onsite daily routine. This reflects the interdependent nature of the project, where specialists from different skill domains work together to complete the project. In comparison, the sharing of explicit knowledge takes place within formal structures implemented by upper management such as scheduled meetings which occur on specific days and times.

The literature acknowledges that knowledge sharing requires a specific context, which can be formal or informal (Mueller, 2014; Bell *et al*., 2016; Wen and Wang, 2022). However, Mueller (2014) and Wen and Wang (2022) did not recognise the different forms of knowledge, explicit and tacit, may require different contexts for sharing. While Bell *et al.* (2016) considers both forms of knowledge require a distinct context, which can be either formal or informal, these contexts are centred around the use of different technologies. This literature does not capture the nuances of how tacit and explicit knowledge are shared within an informal and formal context. This study extends our understanding and delves deeper into how tacit and explicit knowledge are shared, among team members, within informal and formal settings. Having considered how knowledge is shared (i.e., context) the next section discussions the complexity of the articulation process, i.e., the conversion of personal tacit knowledge into an explicit form that is understood by others (Nonaka, 1994; Hakanson, 2007; Ractham and Srisamran, 2018). The findings from this study highlights the nuances of this process. In doing so RQ2 'How is knowledge articulated in project teams?' is addressed.

2.2 Knowledge articulated in project teams (RQ2)

Knowledge articulation is understood to be the process of converting personal tacit knowledge, using various mechanisms into a comprehensible (explicit) form. While knowledge articulation is recognised as a subset of knowledge sharing it is not a distinct or separate type of knowledge sharing. The findings show how knowledge is articulated in

project teams is influenced by the willingness of the team members to articulate their knowledge, and the team members' interpersonal relationship.

2.2.1 Team members' willingness to articulate their knowledge

It was found that the willingness of team members to articulate their knowledge with other, acts as the primary force in the articulation process. The extent of the knowledge being articulated is dependent on the knowledge holder's willingness to give others access to their personal tacit knowledge (de Vries *et al*., 2006). Therefore, the incentive which drives the team members to articulate their knowledge is important to understand. The findings reveal that team members' willing to articulate their knowledge with others is influenced by the level of knowledge they have concerning the task being performed. When willing team members articulate their knowledge, they do so in an unassuming manner while also being confident in the knowledge they are articulating. They believe the knowledge they are articulating is of value to the task being performed and, in many cases, to the knowledge receiver. This is consistent with the findings of Bock *et al*. (2006) and Bilginoglu and Yozgat (2018), who argued that self-assured individuals who believe their knowledge is valuable to the team or organisation, are more willing to articulate their knowledge with others. While these studies were conducted in different countries (Korea and Turkey respectively) and within different sectors, it would seem the results are similar to this PBO context.

Furthermore, it was found that willing team members displayed a high level of care for knowledge receivers, particularly senior members who articulated their knowledge to junior members. In some cases, the senior team members showed empathy towards the junior members. Senior team members understood what junior team members were experiencing, because they had been in that situation before. The findings show the senior team members mimic the parental figure role, whereby they take the junior members *'under their wing'* (BTM1), guiding and helping junior members gain knowledge from senior members' learnings, and ensuring the job is done correctly. Senior team members adopting a parental role strongly aligns with the dynamic context of PBOs, where teams are formed and disbanded based on specific tasks. This finding provides a deeper understanding of the

articulation process, in that it highlights the diverse roles that team members undertake within a PBO.

The findings suggest that the team members who are willing to articulate their knowledge do so to benefit the knowledge receiver, but also out of self-interest recognising that everyone gains from '*the greater good of the project*' (CMT3). In some instances willing team members who articulated their tacit knowledge to other team members did so for personal satisfaction, expecting nothing in return. These team members appeared to genuinely want to and enjoyed helping others, and they got pleasure from the positive results of their efforts. Willing team members went out of their way to assist other team members, reflecting a sense of shared interest. The team members considered it worth their effort to invest time in helping others and recognised the negative consequence to the project if they did not. This indicates that the team members acknowledge that their individual efforts contribute to the collective success of the team and subsequently the overall success of the project. Therefore, it would seem that team members who are willing to articulate their knowledge are incentivised by a collective interest, the overall success of the project and by altruistic behaviour, self-satisfaction which acted as a facilitator towards the articulation process: a theme acknowledged in the research findings. This finding is consistent with prior studies that demonstrated that individuals who display altruistic traits act as facilitators for knowledge articulation (sharing) (Wu *et al*., 2009). However, Wu *et al.* (2009) took a single dimensional approach to knowledge, in that they did not recognise the multifaceted nature and varied types of knowledge being communicated. As a result of taking a multidimensional approach to knowledge articulation, the findings of this study show the complexity inherent in knowledge articulation and provides a much deeper and richer understanding of the attitudes and behaviours of altruistic team members during the articulation process.

2.2.2 Team members' interpersonal relationships

The majority of the team members, in all four teams, showed a favourable attitude towards knowledge articulation whereby they wanted to, rather than felt they had to articulate their knowledge to other team members. The findings show the team members were willing to

articulate their skills, expertise, and insights to others because they understood that knowledge articulation is integral to the project's success; that it is central to preventing and reducing on-site disruptions and completing tasks because of the joint effort needed to finish the project. The findings also show that the practice of knowledge articulation took place naturally; a routinised, reoccurring-type behaviour within each of the four teams. This behaviour is supported, manifested, and practised by the team's senior members. They encourage other team members to *'speak up'* (DTM2) and share their ideas and opinions, to disclose shortfalls and mistakes, thus instigating an openness policy. This process shapes the perceptions and behaviours of new and junior team members. It helps them to feel safe and comfortable expressing their thoughts and opinions and to recognise the importance of doing so. An open and safe environment encourages team members to be themselves and is characterised through mutual respect (Edmondson, 1999; Edmondson and Lei, 2014). It promotes an environment where communication flows freely between the team members because *'everyone is listened to'* (ATM5) which endorses respect amongst the team members. The study shows that for the four observed PBO teams, two relationship types prevailed amongst team members: strong, close relationship for Team A and Team B and a cordial relationship for Team C and Team D.

Team A and Team B members displayed familiarity and closeness. Most of them had previously worked on other projects together within the same organisation. From this shared experience, the team members gained an in-depth understanding of other members' preferences and opinions. They had witnessed each other's abilities and competencies and knew what each was *'capable of'* (ATM8). Furthermore, the team members talked about *'knowing how each other thinks'* (ATM8) and were thereby able to predict each other's behaviour. This suggests that, from prior shared experiences, a strong relationship had been established amongst the team members. This finding is consistent with other scholarly work on team relationships. Such studies (Granovetter, 1983; Hansen, 1999; Reagans and McEvily, 2003) show that relationship strength between team members is based on communication frequency. Therefore, the more team members interact with each other, the stronger the relationship ties. Hence, strong team relationships develop over time (Granovetter, 1983; Hansen, 1999; Reagans and McEvily, 2003). The findings indicate that

members of Team A and Team B were willing to help other team members through knowledge articulation because there was a common understanding that the project's success was their objective and that by working together, and articulating knowledge, would help avoid the need to redo or correct work performed. These team members seem to be at ease with each other and are comfortable expressing their ideas and opinions to other team members. The knowledge receiver trusts the knowledge holder's advice because their articulated knowledge has proven reliable over time.

A cordial relationship existed between members of Team C and Team D where team member behaviours seemed to be slightly more formal or structured. Members of Team C and Team D were relatively new to the organisation and had little or no prior history of working together. Where team members have had little or no communication with each other prior to working on a project, weak relationship ties may exist among the team members (Granovetter, 1983). However, Team C and Team D displayed respect toward each other and were equally as willing, as Team A and Team B, to articulate their knowledge to help others, and displayed an eagerness and willingness to help others in their team. The findings also show that members of Team C and Team D interacted as if trust exists. Although trust was not empirically examined in this research it has emerged as a concept of relevance. The apparent presence of trust among members of Team C and Team D is surprising, considering that literature suggests that the development of conventional trust would not have had time to develop (Rousseau *et al*., 1998). It seems that trust existed, based on the team member's defined role. Each team member assumes that other team members are experienced and knowledgeable in their specialised domain. This type of trust is consistent with Meyerson *et al.'*s (1996) definition of swift trust. They argued that swift trust is a presumed form of trust, which team members who have had limited encounters, have confidence in and therefore trust other team members based on their capabilities. Similar to Team A and Team B, there is common motivation between members of Team C and Team D to *"get the job done right"* (DTM5) to avoid the redoing of works.

Prior studies (Hansen, 1999; Reagans and McEvily, 2003; Swift and Hwang, 2013), posit that the stronger the relationship between the team members the more willing they are to

invest time and effort into making sure the receiver fully understands the conveyed knowledge. However, the findings from this study suggest that the members of Team C and Team D, who signify weak relationship ties, are equally as willing as Team A and Team B, who show strong relationship ties, to dedicate time and effort into articulating their knowledge to others. The members of the four teams seemed genuinely interested in helping each other and use varied articulation mechanism (discussed later in Section 2.3), to ensure that the knowledge they communicated to the knowledge receiver was clearly understood. Confirming the knowledge receivers' understanding of the articulated knowledge is important within the PBO context. These findings highlight that the team members adopt a distinct approach to articulate their personal tacit knowledge. They prioritise a result-oriented approach over a personal approach. A PBO context operates under stringent time constraints, leaving no room for errors, and team members go to great lengths to avoid and prevent project delays. Such findings are significant to PBOs because of the structural and temporal nature of project teams, which literature suggest would impact negatively on the development of strong team connections.

Research on team relationship ties has shown that team members with strong relationship ties share complex knowledge, such as tacit knowledge, and team members with weak relationship ties share information or explicit knowledge, such as policies and procedures (Hansen, 1999). An important discovery in this study shows that the team members who were considered to have weak relationship ties (Team C and Team D), were willing to articulate and share both complex (tacit knowledge) knowledge and information (explicit knowledge) with other team members. This was also relevant to the team members with strong relationship ties (Team A and Team B). Therefore, within this PBO context, the strength of the relationship ties between the team members does not appear to influence the type of knowledge articulated to other team members.

2.2.3 The articulation process

This section details the articulation process where tacit knowledge is converted to an explicit form. This process takes place within the context surrounding the sharing of tacit knowledge as outlined in Section 2.1.2. In discussing the articulation process, consideration is given to

articulation in the context of: (i) high-low experienced team members, and (ii) high-high experienced team members.

2.2.3.1 High-low knowledge articulation

In the interviews experienced team members explained that if they by chance, observed the likelihood of a familiar problem occurring, they reacted quickly and spontaneously to avert it. Specifically, if the situation involved a less experienced team member for example, senior to junior. More senior members of the project team also recognised that they needed to take time when articulating their knowledge to less experienced team members. They described how they would *"... jump in and try and guide them (less experienced team members) in the right direction"* and explain *"...why don't you do this, prioritise this one, over that?"* (ATM7). In such situations, the more experienced team member is essentially '*thinking on their feet*' (ATM7), whereby they are reflecting while simultaneously articulating their knowledge. In the context of PBOs, where circumstances are constantly evolving and time is critical with no room for mistakes or problems, the ability to think on one's feet becomes a vital skill. This skill calls for quick decision making, whereby the more experienced team members adeptly respond to real-time challenges. Such responsiveness enhances our understanding of the articulation process, within this context, by highlighting the significance of the experienced team members in effectively conveying their personal tacit knowledge to others.

Furthermore, the team members explained that they thought about the problem (i.e., self-reflected), to comprehend and make sense of what was taking place, and how they intended to address it, based on the knowledge they already held. From this the findings suggest that the knowledge holder self-reflects prior to articulating their knowledge to other team members. This insight conforms with Hakanson's (2007) articulation model, which highlights that knowledge articulation relies on an individual's experience. Hakanson (2007) argues that for an individual to articulate their tacit knowledge, they must have three elements: a frame of reference (i.e., theory) to give meaning to the tacit knowledge; a broad range of context dependent physical artefacts (i.e., tools); and methods used to express meaning (i.e., codes). For Hakanson (2007) knowledge articulation depends on an

individual's existing frame of reference because knowledge articulated, to others, develops meaning based on previously acquired knowledge. Team members engage in self-reflection prior to articulating their tacit knowledge (i.e., skills, expertise and/or insights), gained from previous experience. That said self-reflection initiates the articulation process.

The findings show that the high experienced team members (i.e., knowledge holders) articulate their specialised knowledge to the less experienced team members (i.e., knowledge receiver), using different mechanisms such as verbal explanation and debate, sketching and/or demonstration. Once the less experienced team member receives the knowledge they engage in an internal, self-reflection process, whereby they compare the new knowledge received with their existing perspectives. The findings indicate that if needed, the less experienced team member will question the high experienced team member about the articulated knowledge. This is to clarify and ensure their understanding of the conveyed tacit knowledge. The findings indicate that questioning and inquiry, from the knowledge receiver, are essential to the articulation process. Questioning and inquiry causes the high experienced team member to reflect further. This type of reflection differs from the reflection which initiates the articulation process, in that the high experienced team member redirects their thinking from the perspective of the less experienced team member. They try to understand the receiver's understanding of their articulated knowledge at which point the high experienced team member, using either the same method or a different method, articulates additional knowledge, to the less experienced team member. This is a gradual process which continues until an understanding is developed collectively between the knowledge holder and the knowledge receiver.

2.2.3.2. High-high knowledge articulation

High-high knowledge articulation focuses on an issue which involves several skilled specialists combined knowledge. This observation maybe more pronounced within the PBO context given the interdependent nature of project tasks. Evidence of high-high knowledge articulation is most commonly found in an unplanned informal meeting setting, between the team members, primarily at the location of the issue. Here the skilled team members work together to formulate the best solution to solve the problem, based on the resources available

(e.g., time and cost). This is a collaborative decision-making process where each team member views or approaches the issue or problem from their specific knowledge field. This unstructured turn-taking process occurs naturally as the team members take part when something pertinent to their skill domain triggers their attention (see Appendix C, which illustrates the collective unstructured articulation of the team members' personal tacit knowledge using sketching). The collaborative decision-making process is essentially a trial-and-error task, to find the best solution to the problem. In explaining this process, interviewees describe the pride in their own skill domain while respecting the other team members' skills. The findings indicate that as the team members actively engaged in this unstructured turn taking process, where they articulate their ideas, creative thought is spurred in other team members which in turn generates new ideas. *"I've had people come up with a solution, by just listening to some of the others' (team members), ideas. Adapting it (the idea).. it becomes sort of the perfect solution."* (ATM8).

Regarding the process where specialised knowledge has been articulated, the findings show that collective reflection takes place between the team members in that they examine their own beliefs to understand the new knowledge, while considering other skills and resources. This is consistent with Nonaka's (1994) externalisation phase of the knowledge creation theory who posit that during externalisation individuals reflect to understand and articulate the world that surrounds them (Nonaka and Toyama, 2003). The findings disclose that the knowledge receivers may challenge the knowledge holders, through questioning and inquiry, through which further explanation and justification of the articulated knowledge is sought. In this way, the team members collectively create new knowledge. The interviewees referred to a variety of articulation methods such as verbal explanation and debate, sketching and demonstration that may be employed during the turn-taking process. The use of such methods allows the team members to build on each other's different options and expertise, interacting to synthesise a new approach or idea to solve a problem. In essence, willing team members collectively reflect on current or future actions to take, while merging their ideas from their skilled perspectives, with that of others in the team, to form a solution to a problem. Therefore, transitioning from an individual team member's subjective tacit knowledge to a collective and objective form. The findings indicate that this collective

articulation process is conducted slowly. The team members think first from their own skilled perspective and then from the perspective of the other skilled team members. This is on account of the interdependency of the task/problem at hand, in that the team members consider the resources available and the sequence of works to be followed to prevent project delays.

Within this PBO context, questioning and querying is encouraged and considered highly important. It is recognised as a fundamental way to draw knowledge from the individual team members. The findings also acknowledge that many team members understand the impossibility of articulating every minute detail of a task. Therefore, the knowledge receiver's questions are of the utmost importance. The knowledge holders' articulations and the knowledge receivers' questions and inquiries involve back-and-forth processes that continue until a collective understanding is achieved (Nonaka, 1994; Nonaka and Takeuchi, 1995; Nonaka and von Krogh, 2009). The setting supports the conversion of tacit knowledge into an explicit form through the combined efforts of each team member. The findings from this study strengthen the assertion that the articulation process takes place in a context where knowledge is articulated to enhance an individual's learning and new knowledge is created collectively to solve problems (Argyris and Schon, 1996; Nonaka and Konno, 1998; Senge, 2006).

Within the rich research context of PBOs, a team member's willingness to articulate personal tacit knowledge to other team members has proven to be very important. It initiates the articulation process, where tacit knowledge is converted into an understandable explicit form. The team members showed real interest in helping other team members through knowledge articulation. An organisational structure, such as PBOs, depends on knowledge articulation to complete tasks and prevent and solve problems (Mueller, 2014). Any unwillingness of team members to articulate their knowledge to others prevents the articulation process from taking place and is a barrier in the knowledge articulation process. During the articulation process reflection takes place individually and collectively, both of which aid in the creation of a new concept. High-low knowledge articulation involves individual self-reflection. High-high knowledge articulation involves collective-reflection.

2.3 Mechanisms used to articulate knowledge (RQ3)

Previous reference was made to the mechanisms used to articulate knowledge. These act as the medium for transferring and converting personal tacit knowledge into an understandable explicit form. The use of such mechanisms determines the quality and richness of the knowledge being communicated, thereby aiding the knowledge receiver's understanding.

The findings suggest that the mechanisms used to articulate knowledge require face-to-face interaction and the synchronised presence of both knowledge holders and receivers in person. Face-to-face interaction has been recognised as the most prominent approach for articulating tacit knowledge (Nonaka and Takeuchi, 1995; Teece *et al*., 1997). The use of face-to-face interaction in this PBO project team's context takes place naturally as a routinised type of behaviour or activity. This is not unusual given that the context of this research study was one where complex and unique problems are common and need to be dealt with quickly on-site. These problems most often require the problem-solving skills of multiple team members.

An insight of this study is that knowledge holders adaptively shift between different articulation mechanisms (e.g., verbal explanation and debate, sketching and demonstration) according to the receivers' perceived understanding of the communicated knowledge and their existing knowledge. Interestingly, the findings reveal that the type of mechanisms used by the team members vary according to the circumstance. The knowledge holder will select mechanisms which are convenient to them at that point in time, at the location where knowledge is being articulated. In essence the knowledge holder will use the mechanism/s *"whichever is handiest"* (ATM5) to them. For example, the knowledge holder, articulating their knowledge onsite, may use demonstration as a mechanism to convey their knowledge to the receiver. The use of varied mechanisms by team members, according to the circumstances, is understandable within a PBO context, considering that it is a context inherent in constant change. The findings show that if the knowledge holder acknowledges that a specific articulation mechanism would be more effective in conveying their knowledge to the knowledge receiver, but the necessary resources are unavailable, they improvise.

Knowledge holders adapt the resources, available from their surroundings, to fit the chosen mechanism, rather than relying on a specific type of resources. For example, if the knowledge holder, considers sketching as the most suitable mechanism for articulating their knowledge onsite, but they do not have access to a whiteboard, they look for an alternative resource such as *"...the back of a cigarette box or a piece of drywall."* DTM5, to sketch their idea. The team members act as bricoleurs (Levi-Strauss, 1967) in that they are adept at using whatever resources are available to the mechanism they feel are most suitable for articulating their knowledge. The finding offers novel insights on the mechanisms used to articulate knowledge.

Furthermore, the findings show that once the knowledge holder has exhausted all of the mechanisms available at that time and place, and if the knowledge receiver still does not fully comprehend the conveyed knowledge, they will turn to alternative mechanisms at a different location. The knowledge receiver's understanding of the articulated knowledge is constructed from a diverse range of mechanisms, from the resources available. Each mechanism used adds to the knowledge receiver's understanding. Hence a bricolage approach (Levi-Strauss, 1967; Baker and Nelson, 2005) is followed in developing the knowledge receiver's understanding of the articulated knowledge. The level of adaptability and importance given to communicating knowledge that is understandable and cohesive in the project team, cannot be underestimated given time and financial constraints to effective project delivery.

This research noted how team members used different mechanisms to articulate their knowledge for example verbal explanation and debate, sketching, and demonstration. This took place in an informal setting (e.g., on-site meetings and tea-break chats as detailed in Section 2.1.2). However, it is of particular interest to note the prevalent use of sketching during discussions to explicate personal tacit knowledge. As a discussion unfolded, team members employed sketching to aid in communicating their knowledge. The discussion focused around the sketch, with knowledge articulation being assisted using verbal communication. The findings suggest that, amongst the four teams, sketching is one of the most prominent and prevalent mechanisms for articulating personal tacit knowledge.

Sketching is primarily used in high-high knowledge articulation, where team members collectively come together to solve a problem (see Section 2.2.3.2). To a lesser extent, sketching is also used in a high-low knowledge articulation (see Section 2.2.3.1). In a PBO context team members have different skills and expertise; each communicate using discipline-specific terminology. This can lead to misinterpretation causing on-the-job problems impacting the project timeline. In this context, sketching is a universal language that bridges the language gap between the different skill domains. This helps reduce confusion and misunderstanding among the team members, which significantly reduces on-site errors (Nonaka and Takeuchi, 1995).

Another finding was that each team member, freely and when they felt they could do so, took turns adding their contribution to a sketch, which was captured primarily on a whiteboard. The sketch developed as each team member articulated their ideas. This interactive process helps stimulate the creation and refinement of new ideas (Ferguson, 1992; von Krogh *et al*., 2000). At the same time, it allows for the interpretation of other ideas (Nonaka and Takeuchi, 1995; von Krogh *et al.,* 2000) where team members learn how other specialised knowledge operates in conjunction with their specialised knowledge. Adding knowledge to a sketch parallels team members' thinking, steadily crystallising a collective concept and making it more understandable. This unstructured turn taking process acts as the solution to or prevention of a problem. It is essential to recognise that the interviewees acknowledged that many whiteboards were readily accessible to team members throughout each of the four sites. This prop aided the use of sketching and facilitated the knowledge articulation process.

The articulation process takes time. However, the findings show that team members who feel acute time pressures, are more likely to speed up or rush the knowledge articulation process when communicating their personal tacit knowledge to other team members. This acceleration of the process can harm the quality of the communicated knowledge because time limits prevent the knowledge holder from devoting the time needed to ensure the knowledge receiver fully understands the articulated knowledge. Hence, time pressures can prevent and negatively impact personal tacit knowledge articulation between the project

team members. This finding is in line with Connelly *et al*. (2014), who found that time pressures impact an individual's likelihood of engaging in knowledge articulation (sharing) behaviours. However, Connelly *et al*.'s (2014) research concentrated specifically on knowledge that is more aligned with explicit than tacit knowledge.

3.0 Frameworks of knowledge sharing in project teams in a PBO

This section presents two final frameworks: 1) knowledge sharing in project teams in a PBO within a formal setting; and 2) knowledge sharing in project teams in a PBO within an informal setting. Both frameworks were informed initially from the preliminary conceptual framework presented in Paper 1, Section 5, along with a comprehensive analysis of the data collected for this research study.

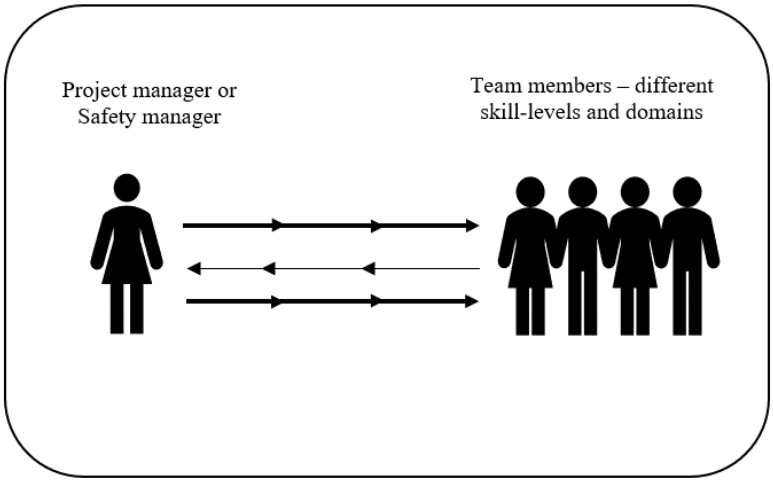
As outlined in the key findings, knowledge sharing, and articulation, is a deeply embedded organisational process. Through detailed analysis of team member perspectives, the researcher peeled back the layers and exposed the subtleties of the articulation process: an under-explored phenomenon. The analysis identified several themes from the data. However, after deep thinking and reflection, the researcher recognised further meaning and understanding of the themes. Figure 1 presents a depiction of knowledge sharing in project teams in a PBO within a formal setting. Figure 2 presents a depiction of knowledge sharing in project teams in a PBO within an informal setting. The frameworks show the different contexts surrounding the sharing of explicit and tacit knowledge, and the intricacies of the articulation process in project teams in a PBO.

3.1 Explicit knowledge sharing in project teams in a PBO

The findings show explicit knowledge (i.e., information) is shared in a structured and organised manner in a formal setting. The formal setting is a single location such as an onsite meeting room. The meetings are pre-planned and are led by a team leader, such as the project manager or the safety manager (knowledge holder). During these meetings, information tends to be predominantly shared in one direction, with the team leader (knowledge holder) passing information to the other team members. Although there is an element of information flowing back to team leader, this is mostly limited to other team members seeking or offering

clarification on specific points. In Figure 1, the weight of information flow is signified by the arrowed lines. The thick arrowed lines represent the information flows from the team leader to the team members with different skill levels and domains, and the thin arrowed line represents information passed from the team member/s to the team leader. This process is quick and efficient, ensuring that team members are kept updated on what is taking place on site.

Figure 1: Knowledge sharing in project teams in a PBO: formal setting



Key:

Predominant information flow from the team leader to the team members

Information returned from the team members

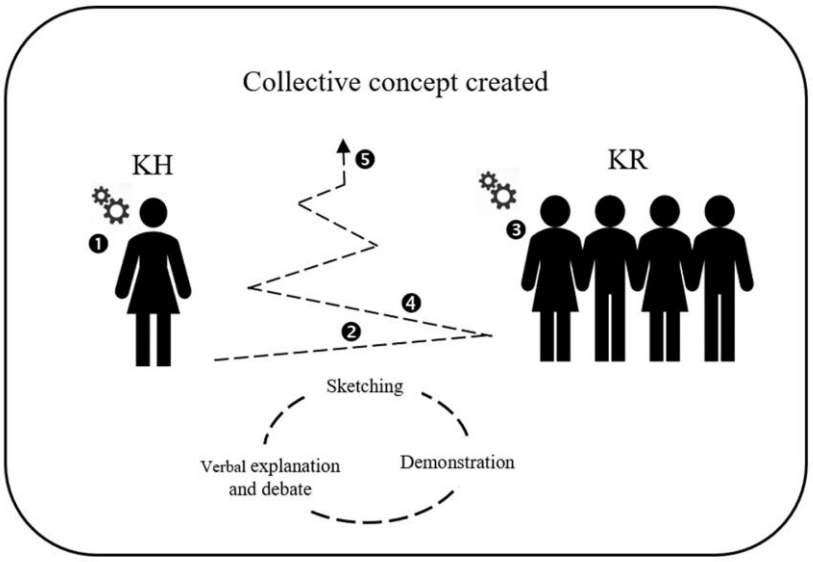
3.2 Tacit knowledge sharing in project teams in a PBO

The findings show that tacit knowledge is shared in an informal setting and does not follow any predefined format. The informal setting is usually onsite, at the problem location, but may transition to another location, such as a site office. During tacit knowledge sharing, a collective understanding between the team members is created through bi-directional communication, where the knowledge flows back and forth between the knowledge holder and the knowledge receiver. Figure 2 illustrates the informal context surrounding the sharing of tacit knowledge. It is within this context that the articulation process takes place.

In Figure 2, numbers ❶ - ❺ capture the knowledge articulation process. The broken line represents the back-and-forth movement of exchanges between the knowledge holder and the knowledge receiver. As the articulated knowledge gradually becomes clearer to the knowledge receiver, the broken line, becomes smaller, indicating a progression towards a collective understanding between the knowledge holder and the knowledge receiver (i.e., shifting from tacit to explicit knowledge). This process can extend over a lengthy period of time as time is needed to ensure the knowledge receiver understands and comprehends the articulated knowledge.

Figure 2, Number ❶ indicates the starting point, of the articulation process, where the knowledge holder, a team member with high experience, self-reflects to make sense of a situation and to decide on how they intend to address it. Number ❷ represents the knowledge holder articulating their personal tacit knowledge to the knowledge receiver/s using available mechanisms such as verbal explanation and debate, sketching, and demonstration, which are available at the problem location. The knowledge receiver/s may have a different skill domain but the same level of experience as the knowledge holder, or they may be less experienced in the same skill domain. The knowledge receiver reflects on the articulated knowledge, trying to understand its meaning, this is indicated by number ❸. If further clarification is needed from the knowledge holder, questioning and inquiry takes place, this is represented by number ❹. Numbers ❶ - ❹ are an iterative process, which continues until a collective understanding is developed between the knowledge holder and receiver/s (signified by number ❺).

Figure 2: Knowledge sharing in project teams in a PBO: informal setting



Note: The numbers ❶ ❷ ❸ ❹ ❺ represent the articulation process where tacit knowledge is converted into an explicit form between project team members.

❶ Knowledge holder/s self-reflect to understand the problem.
❷ Knowledge holder/s articulates their personal tacit knowledge to the other team member/s using different mechanisms (e.g., verbal explanation and debate, sketching, and demonstration).
❸ Knowledge receiver/s self-reflect.
❹ Questioning and inquiry by the knowledge receiver/s as they seek deeper understanding.
❺ A collective explicit concept is created.
❶❷❸❹An iterative process which continues until a collective understanding is developed between the knowledge holder/s and receiver/s.

In some instances, a collective understanding between the knowledge holder and the knowledge receiver/s is not attained at the problem location. Therefore, if further clarification is needed, from the knowledge holder the articulation process may transition to another location, where new articulation mechanisms are available (e.g., if a demonstration is deemed necessary the knowledge holder and knowledge receiver/s may move to a location to facilitate the demonstration). This illustrates the willingness of the knowledge holder going to great lengths ensuring their articulated knowledge is thoroughly understood by the knowledge receiver. Indeed, the willingness of the knowledge holder to give other team members access to their personal tacit knowledge initiates the articulation process, without this the articulation process would not commence. Furthermore, the articulation process is

facilitated by the supportive relationships that exists between the team members i.e., strong team relationship and a cordial team relationship.

4.0 Contributions to practice and literature

This study explored the articulation process within a project team environment, specifically, through the lens of Nonaka's (1994) externalisation mode of the knowledge creation theory, where tacit knowledge is converted into an explicit form. From this study the intricacies of this underexplored phenomenon were revealed. From these subtleties and nuances valuable contributions to practice and literature are identified.

4.1 Contributions to practice

The frameworks (Figures 1 and 2) inform the context surrounding the sharing of tacit and explicit knowledge and the articulation process. The frameworks will serve practitioners, by identifying the type of knowledge shared and explaining how and where solutions to real-world problems are identified. This research develops awareness of how knowledge articulation takes place in an unstructured, informal context, indicating that it occurs naturally rather than being forced. To gain the most from this process it usually requires the synchronous face-to-face presence of both the knowledge holder and receiver. This allows the knowledge to flow back and forth between the knowledge holder and receiver through the practice of asking questions and seeking clarification. PBOs can benefit from recognising the value of informal knowledge articulation practices, as such practices help to identify solutions to undefined and ad hoc problems that occur commonly on project sites. For practitioners working under these conditions, tacit knowledge sharing is fundamental to collective understanding and teamwork on project sites as discovered in this study. The research shows as tacit knowledge is articulated and collective understanding develops, collective knowledge gradually develops, and explicit information is produced through the articulation process.

Figure 2 contributes to practice by unpacking the nuances of the knowledge articulation process. The research reveals the importance of the team members willingness to give others access to their personal tacit knowledge. It shows that willingness initiates the articulation

process. Organisations can support and practise this type of behaviour to promote an environment where, communication flows freely. In practice, knowledge articulation flows horizontally rather than vertically amongst the team members. That said, the articulation of personal tacit knowledge is based on the level of knowledge the team members have pertaining to the topic rather than based on seniority. Recognising and acknowledging that junior team members also carry valuable knowledge is important for practice. This is an important finding for new team members joining project-based teams and PBOs more generally. Junior and/or new team members should be encouraged to and willing to contribute to articulating their knowledge with others.

Furthermore, the findings demonstrate that the team members use the mechanisms which are most convenient to them, at that point in time, rather than the most appropriate mechanisms, to articulate their personal tacit knowledge. Organisations could benefit from ensuring that the right mechanisms are in the right place at the right time. Using the most appropriate mechanism, rather than the most convenient, will enhance the articulation and knowledge sharing process, and thereby reduce the time needed to understand the conveyed tacit knowledge. This is fundamental to solving complex problems and in developing the capabilities of project team members which is essential in PBOs where problems are a common occurrence within this context (Stark *et al*., 2014).

4.2 Contributions to literature

This research set out to understand the phenomenon of articulation in knowledge sharing by delving into the knowledge sharing practices of team members working in PBOs. In doing so, a number of contributions to literature can be gleaned from this study, this includes extending Nonaka's model of tacit and explicit knowledge particularly the externalisation phase and unearthing the complexities that occur during articulation processes between knowledge holders and knowledge receivers. By exploring and highlighting the intricate, multifaceted nature of knowledge articulation, the study delves deeper into the finer nuances of the externalisation phase of Nonaka's (1994) knowledge creation theory, illuminating its complexities and revealing new insights.

Seminal research by Polanyi (1966) and later Nonaka (1994) explored how explicit and tacit knowledge are shared in organisational settings. Tacit knowledge is often described as opaque and complex, and barriers such as language and context can interfere in the meaning and sense-making for the knowledge receivers. This study discovers that articulation is indeed a complex process, particularly in project team environments. The findings reveal that the opaque nature of tacit knowledge can be reduced with articulation mechanisms central to the deconstruction, construction, and delivery of meaning and understanding. This research reveals the nature of articulation is a bi-directional process between knowledge holder and knowledge receiver and through various mechanisms, but particularly sketching in this case study, tacit knowledge transforms into explicit information.

Contrary to some existing research (e.g., Ractham and Srisamran, 2018; Furlan *et al*., 2019), articulation plays much more than a supporting role in the sharing of knowledge. Rather it is the articulation process and use of mechanisms that reinforce and enable the knowledge receiver to gain greater comprehension of knowledge holders' tacit knowledge. This discovery is significant as it places articulation as a crucial step between tacit and explicit knowledge sharing (Hakanson, 2007; Ractham and Srisamran, 2018) and critically, the mechanisms used in articulating tacit knowledge in a PBO settings.

Furthermore, this research reveals that knowledge receivers are not passive receptors in knowledge articulation. Rather, knowledge receivers articulate responses which indicates to the knowledge holder that their tacit knowledge is not yet externalised, and this can lead to the knowledge holder engaging other mechanisms (improvised or structured) in the articulation process. The role of the knowledge receiver in the articulation process has not featured in any significant way in literature yet without bi-directional communication, meaning and sense-making cannot be achieved. This is an important contribution to the field of knowledge articulation in organisational research indicating that knowledge articulation should not focus solely on the message and the knowledge holder, but rather there are layers to interpretation that ultimately affects how jobs and tasks are undertaken and executed. In understanding the bi-directional nature of articulation, researchers and practitioners can gain

greater insights on the need to adopt and develop mechanisms in knowledge sharing practices.

The study illustrates the nuances of formal and informal contexts that surround the sharing of tacit and explicit knowledge, among team members within a PBO. Intricate details are revealed that aids in understanding the structure of formal and informal contexts. Prior research has not sufficiently researched these contexts to appreciate their relevance to knowledge sharing (Mueller, 2014; Bell *et al*. 2016; Butt *et al*., 2016; Wen and Wang, 2022). Therefore, the subtle details highlighted in this study (summarised in Table 1), of informal and formal contexts, surrounding the sharing of explicit and tacit knowledge in PBO project teams are new to knowledge sharing research and therefore adds to literature and understanding relevant to knowledge sharing.

5.0 Recommendations

From the findings of this research there are several recommendations, for professional practitioners specific to a PBO. Practitioners seeking to improve the practice of knowledge articulation, among team members, should model the behaviour they want to see in their team members. Professional practitioners should articulate and share their expertise with other team members and encourage team members, in particular new team members and junior team members, to share their ideas and opinions also. This creates an environment where team members feel safe and comfortable at being themselves and they feel their knowledge is of value. Team members who feel their knowledge is of value, are more willing to articulate their knowledge with their other team members. This, enhances knowledge articulation among team members, leading to improved problem-solving skills.

The process of articulation centres on the mechanisms employed to convey personal tacit knowledge. The mechanism chosen is crucial in shaping the team members' understanding of the tacit knowledge being communicated. However, not all mechanisms may be suitable for every team member, and/or specific circumstances. Therefore, while one mechanism may effectively work for one team member, it may not be suitable for another. To ensure effective knowledge articulation within a team, it is recommended that practitioners have a

range of mechanisms available, for the knowledge holder to use as needed, to accommodate the diverse styles of the team members and the knowledge being articulated. This will enhance the articulation process by reducing the time needed to understand the articulated tacit knowledge.

6.0 Research limitations

The focus of this study was to explore how knowledge is shared and articulated within project teams, concentrating on the mechanisms used to articulate knowledge, within a PBO. It is necessary to recognise that this study has some limitations. The PBO context is one which the researcher is unfamiliar with therefore the researcher is considered an outsider to the study (Adler and Adler, 1987; Dwyer and Buckle, 2009). This may have had some bearing on how open and forthcoming the interview participants were in answering the interview questions. However, this does not seem to be the case considering the richness of the data collected. Furthermore, the likelihood of researcher bias was reduced as the researcher was detached from the phenomena of study, additionally the researcher kept reflective logs as a way to identify potential bias.

The researcher's intention was to conduct in person, face-to-face interviews with the research participants however this was not possible due to the global pandemic, COVID 19, restrictions (Dodds and Hess, 2020). Therefore, all interviews were conducted online, via Microsoft Teams, with the participants at their place of work. Interviewing the participants at their place of work may have presented potential limitations in that the interviewees may have restricted their answers because of other individuals being nearby. This was addressed through member-checking (Guba and Lincoln, 1982) whereby the recorded interviews were transcribed and emailed to the interviewees for review. This allowed the interviewees the opportunity to clarify, retract and add to, any information they provided while further ensuring the rigour of the data collected. Appendix D illustrates feedback received via email from an interview participant. Conducting the interviews online meant that the participants were very succinct and adhered to the interview agenda.

This study was undertaken in one PBO within the EPC sector: this may be considered a limitation as the findings cannot be generalised to other setting. However, the intention of this research was not to generalise the findings but to explore an under-explored phenomenon and the findings are presented to facilitate transferability (Lincoln and Guba, 1986) to other setting. The final sampling size of 26 participants might be viewed as small, however this did not compromise the richness of the data collected from the participants interviewed. The depth and breadth of the data collected is evident in the diverse roles performed by participants, i.e., project managers, safety managers, design coordinators, contract surveyors, and engineers, and their duration of employment with the organisation, i.e., from six weeks to over 16 years. Although many perspectives were collected the opinions of other members such as junior members, and operatives may have benefitted this research study.

7.0 Future research

This research highlights the intricate details of the knowledge articulation process, building on this study future research could explore the concept of trust specifically swift trust (Meyerson *et al.,* 1996) as this has emerged as a concept from the findings. This would give insights into the development of trust among team members who have little or no prior working history and also new entrants to the organisation. Reciprocity was as a concept that surfaced in the findings, serving as a facilitator in the knowledge articulation process. Further research, through the lens of social exchange theory (Homans, 1958), could explore the nuanced ways in which reciprocity influences knowledge articulation and its role in shaping team collaboration. Researchers could further explore how knowledge articulation occurs among team members from diverse nationalities, where one common spoken language does not exit. Language was hinted at in this research as a potential barrier to knowledge articulation. This line of inquiry would provide an opportunity to understand how knowledge is articulated between individuals of diverse nationalities and what mechanism are used to clearly communicate the articulated knowledge. The framework ‘knowledge sharing in project teams in a PBO: informal setting’ could potentially be applied to other contexts that future research could explore. Existing research in knowledge sharing and articulation has predominately been quantitative in nature (Kipkosgei *et al*, 2020; Hu and

Randel, 2014). This study followed a qualitative approach which allowed the researcher to gain a deeper understanding of the perspectives of individuals during knowledge sharing and articulation. Further qualitative research is needed to deepen our understanding of the articulation process as articulation remains an under-explored phenomenon. Finally, this study was conducted within an Irish PBO in the engineering, procurement, and construction sector, a sector which relies heavily on knowledge sharing and articulation. There is an opportunity to extend this research into other sectors which are dependent on knowledge sharing and articulation practices, such as, educational institutions.

8.0 Conclusion

This research study addresses the research objective and research questions, detailing new insights into the context surrounding the sharing of both tacit knowledge and explicit knowledge in project teams in a PBO. The study sheds light on the subtle intricacies of the knowledge articulation process and the different types of mechanisms used to articulate tacit knowledge are acknowledged. Two frameworks are presented illustrating how knowledge is shared in project teams, formally and how knowledge is shared in project teams, informally. The nature of this study and the research aims pursued revealed new insights and the findings that have both impact for and make contributions to practice and literature.

References

Adler, P. A., and Adler, P. (1987) *Membership Roles in Field Research*, Newbury Park, CA: Sage.

Ambrosini and Bowman's (2001) 'Tacit knowledge: Some suggestions for organisations', *Journal of Management Studies*, Vol. 38, No. 6, pp. 811-829.

Ansari Moghaddam, S., Hoon, T.B. and Yong, M.F. (2017) 'Collaboratively composing an argumentative essay: Wiki versus face-to-face Interactions', *Journal of Language Studies*, Vol. 17, No. 2, pp. 33–53.

Argyris, C. and Schon, D. A. (1996) *Organisational Learning II Theory, Method, and Practice*, USA: Addison-Wesley publishing company.

Baker T., Nelson R. (2005). 'Creating something from nothing: Resource construction through entrepreneurial bricolage', *Administrative Science Quarterly*, Vol. 50, No. 3, pp. 329–366.

Bell, L. van Waveren, C. C. and Steyn, H. (2016) 'Knowledge-sharing within the project-based organizsation: a knowledge-pull framework', *African Journal of Industrial Engineering* Vol, 27, No. 4. pp. 18-33.

Bilginoglu, E. and Yozgat, U. (2018) 'Perceived training intensity and knowledge sharing among banking sector employees in Turkey: examining the moderating role of intrinsic motivation and self-efficacy', *Life Skills Journal of Psychology*, Vol. 2, No. 4, pp. 361-371.

Butt, A., Naaranoja, M. and Savolainen, J. (2016) 'Project change stakeholder communication', *International Journal of Project Management* Vol. 34, pp. 1579–1595.

Bock, G.-W., Zmud, R. W., Kim, Y.-G., and Lee, J. N. (2005). 'Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate', *MIS Quarterly*, Vol. 29, No. 1, pp. 87–111.

Connelly, E. C., Ford, P. D., Turel, O., Gallupe, B. and Zweig, D. (2014) 'I'm busy (and competitive)! Antecedents of knowledge sharing under pressure', *Knowledge Management Research & Practice*, Vol. 12, pp. 74–85.

de Vries E. R., van den Hooff, B. and de Ridder, A. J. (2006) 'Explaining knowledge sharing: The role of team communication styles, job satisfaction, and performance beliefs', *Communication Research*, Vol. 33, No. 2, pp. 115-135.

Dodds, S. and Hess, A. C. (2020) 'Adapting research methodology during COVID-19: lessons for transformative service research', *Journal of Service Management*, Vol. 32, No. 2, pp. 203-217.

Dwyer, S. C. and Buckle, L. J. (2009) 'The Space Between: On Being an Insider-Outsider in Qualitative Research', *International Journal of Qualitative Methods*, Vol. 8, No. 1, pp. 54-63.

Edmondson, A. C. (1999) 'Psychological safety and learning behavior in work teams', *Administrative Science Quarterly,* Vol. 44, pp. 350–383.

Edmondson, A. C., and Lei, Z. (2014) 'Psychological safety: The history, renaissance, and future of an interpersonal construct, *Annual Review of Organizational Psychology and Organizational Behavior*, Vol. 1, pp. 23–43.

Ferguson, E. S. (1992) *Engineering and the Mind's Eye,* Cambridge Mass. and London: MIT Press.

Furlan, A., Galeazzo, A. and Paggiaro, A. (2019) 'Organizational and perceived learning in the workplace: A multilevel perspective on employees' problem solving', *Organization Science,* Vol. 30, No. 2, pp. 280-297.

Granovetter, M. (1983) 'The strength of weak ties: A network theory revisited', *Sociological Theory,* Vol. 1, pp. 201-233.

Guba, E. G. and Lincoln, Y., S. (1982) 'Epistemological and methodological bases of naturalistic inquiry', *Educational Communications and Technology Journal*, Vol. 30, No. 4, pp. 363-381.

Hansen, T., M. (1999) 'The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits', *Administrative Science Quarterly*, Vol. 44, pp. 82-111.

Hariharan, A. (2005), 'Implementing seven KM enablers at Bharti', *Knowledge Management Review,* Vol. 8, No. 3, pp. 8-9.

Hakanson, L. (2007) 'Creating knowledge: the power and logic of articulation', *Industrial and Corporate Change,* Vol. 16, No. 1, pp. 51–88.

Homans, C. G. (1958) 'Social Behaviour as Exchange', *American Journal of Sociology,* Vol. 63, No. 6, pp. 597-606.

Hu, L., and Randel, A., E. (2014). 'Knowledge sharing in teams: Social capital, extrinsic incentives, and team innovation', *Group and Organization Management*, Vol. 39, No. 2, pp. 213–243.

Kim, T., Lee, J., Chun, J. and Benbasat, I. (2014), 'Understanding the effect of knowledge management strategies on knowledge management performance: a contingency perspective', *Information & Management*, Vol. 51, No. 4, pp. 398-416.

Kipkosgei, F., Son, Y., S. and Seung-Wan Kang (2020) 'Coworker Trust and Knowledge Sharing among Public Sector Employees in Kenya', *International Journal of Environmental Research and Public Health,* Vol. 7, pp.1-17.

Levi-Strauss, C. (1967) *The Savage Mind*, Chicago: University of Chicago Press

Lincoln, Y. S. and Guba, E. G. (1986) 'But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation', *New Directions for Program Evaluation,* Vol. 30, pp. 73–84.

Meyerson, D., Weick, K. E., and Kramer, R. M. (1996) 'Swift trust and temporary groups', in R. M. Kramer & T. R. Tyler (eds.), *Trust in organisations: Frontiers of theory and research*: pp. 166-195. Thousand Oaks, CA: Sage

Mueller, J. (2014) 'A specific knowledge culture: Cultural antecedents for knowledge sharing between project teams', *European Management Journal*, Vol. 32, p. 190–202.

Nonaka, I. (1994) 'A dynamic theory of organisational knowledge creation', *Organisational Science*, Vol. 5, No. 1, pp. 14-37.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge Creating Company,* New York: Oxford University Press

Nonaka, I and Toyama, R. (2003) 'The knowledge-creating theory revisited: knowledge creation as a synthesising process', *Knowledge Management Research & Practice*, Vol. 1, pp. 2-10.

Nonaka, I. and Konno, N. (1998) 'The concept of 'Ba': Building a foundation for knowledge creation', *California Management Review,* Vol. 40, No. 3, pp. 40-54.

Nonaka, I. and von Krogh, G. (2009) 'Tacit knowledge and knowledge conversion: Controversy and advancement in organisational knowledge creation theory', *Organisation Science,* Vol. 20, No. 3, pp. 635-652.

O' Meara, M. and Kelliher, F. (2020) 'Exploring the process of articulating tacit knowledge in an organisational setting', Paper presented at the 34th *Annual British Academy of Management Conference*, 2-4 Sep, University of Manchester, Manchester.

Polanyi, M. (1966) 'The logic of tacit inference', *The Journal of the Royal Institute of Philosophy,* Vol. 41, No. 155, pp. 1-18.

Ractham, V. V. and Srisamran, P. (2018) 'Effects of knowledge articulation and self-reflection on team performance', *Knowledge Management & E-Learning,* Vol. 10, No. 2. pp. 177–195.

Reagans, R. and McEvily, B. (2003) 'Network Structure and Knowledge Transfer: The Effects of Cohesion and Range', *Administrative Science Quarterly,* Vol. 48, pp. 240-267.

Rousseau, M. D., Sitkin, B. S., Burt, S. R. and Camerer, C. (1998) 'Not so different after all: A cross-discipline view on trust', *Academy of Management Review*, Vol. 23, No. 3, pp. 393-404.

Sanchez, R., (2005) 'Tacit knowledge versus explicit knowledge approaches to knowledge management practice' in D. Rooney, G. Hearn and A. Ninan, (eds) *Handbook on the Knowledge Economy* Cheltenham: Edward Elgar Publishing, pp. 191-203.

Senge, P. (2006) *The Fifth Discipline The Art & Practice of The Learning Organisation,* United Kingdom: Random House Business Books.

Stark, E., Bierly, P., Harper, S.R., (2014) 'The interactive influences of conflict, task interdependence and cooperation on perceptions of virtualness in co-located teams', *Team Performance Management,* Vol. 20, p. 221–241.

Swift, E. P. and Hwang, A. (2013) 'The impact of affective and cognitive trust on knowledge sharing and organizational learning', *The Learning Organization* Vol. 20, No. 1, pp. 20-37.

Teece, J. D., Pisano, G. and Shuen A. (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal,* Vol. 18, No. 7, pp.509–533.

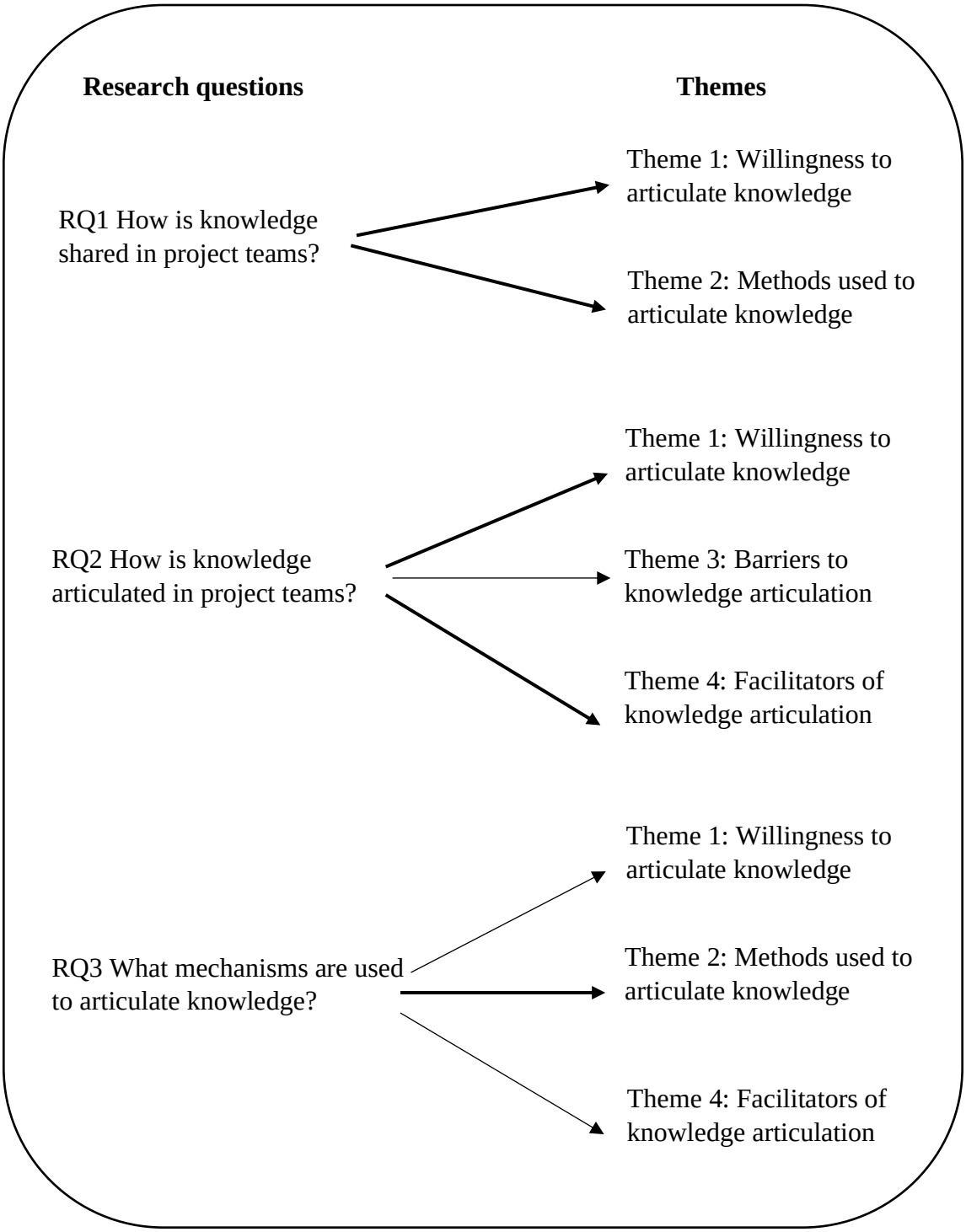
Tsoukas, H. (2009) 'A dialogical approach to the creation of new knowledge in organizations', *Organisational Science,* Vol. 20, No. 6, pp. 941–957.

von Krogh, G., Ichijo, K. and Nonaka, I. (2000) *Enabling Knowledge Creation,* Oxford University Press: Published New York.

Wen, P. and Wang, R. (2022) 'Does knowledge structure matter? Key factors influencing formal and informal knowledge sharing in manufacturing', *Journal of Knowledge Management,* Vol. 26, No. 9, pp. 2275-2305.

Wu, W., Lin, C., Hsu, B., and Yeh, R. (2009) 'Interpersonal trust and knowledge sharing: moderating effects of individual altruism and a social interaction environment', S*ocial Behavior and Personality,* Vol. 37, No. 1, pp. 83-94.

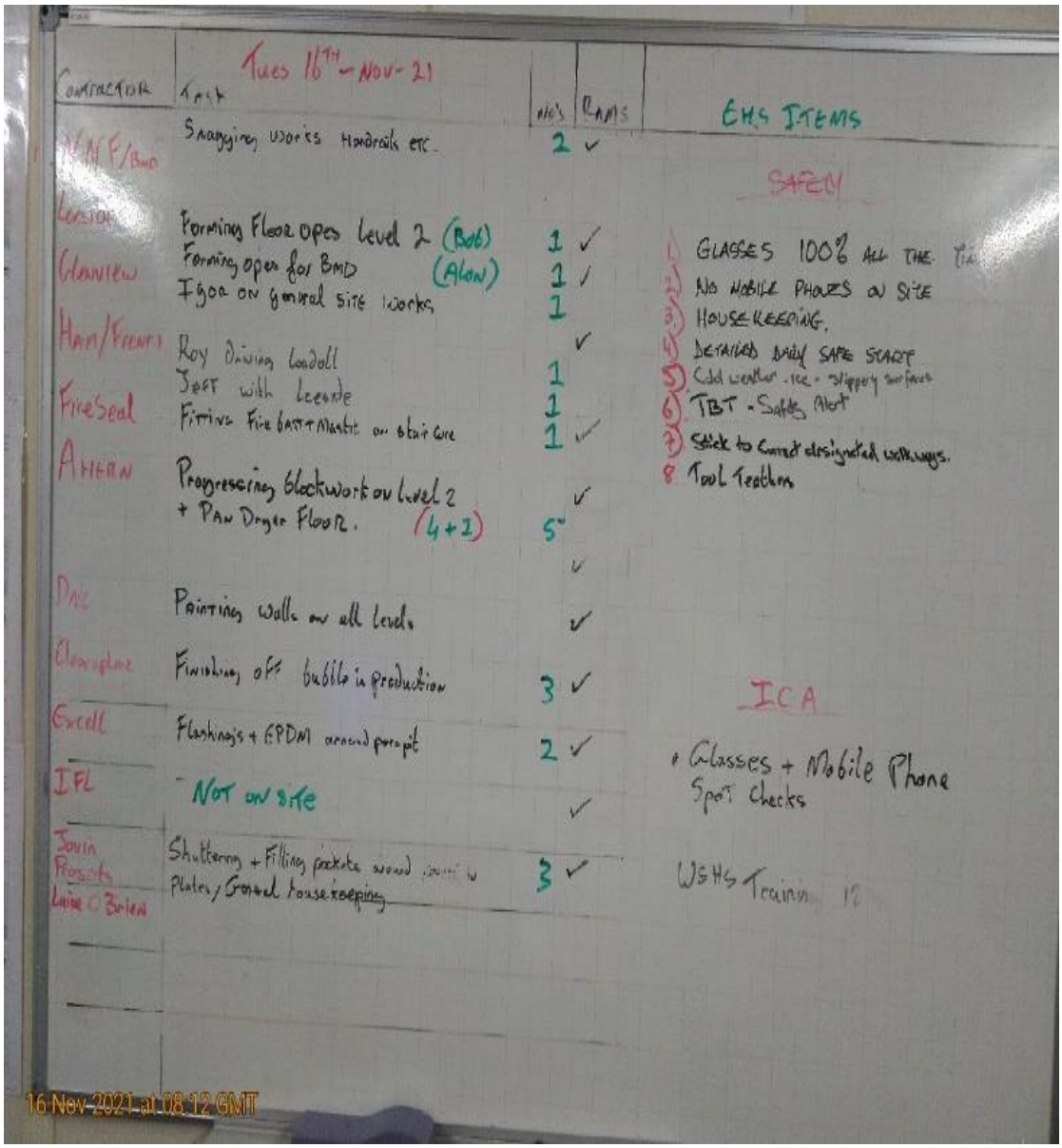
Appendix A: Linking the research questions with the relevant themes



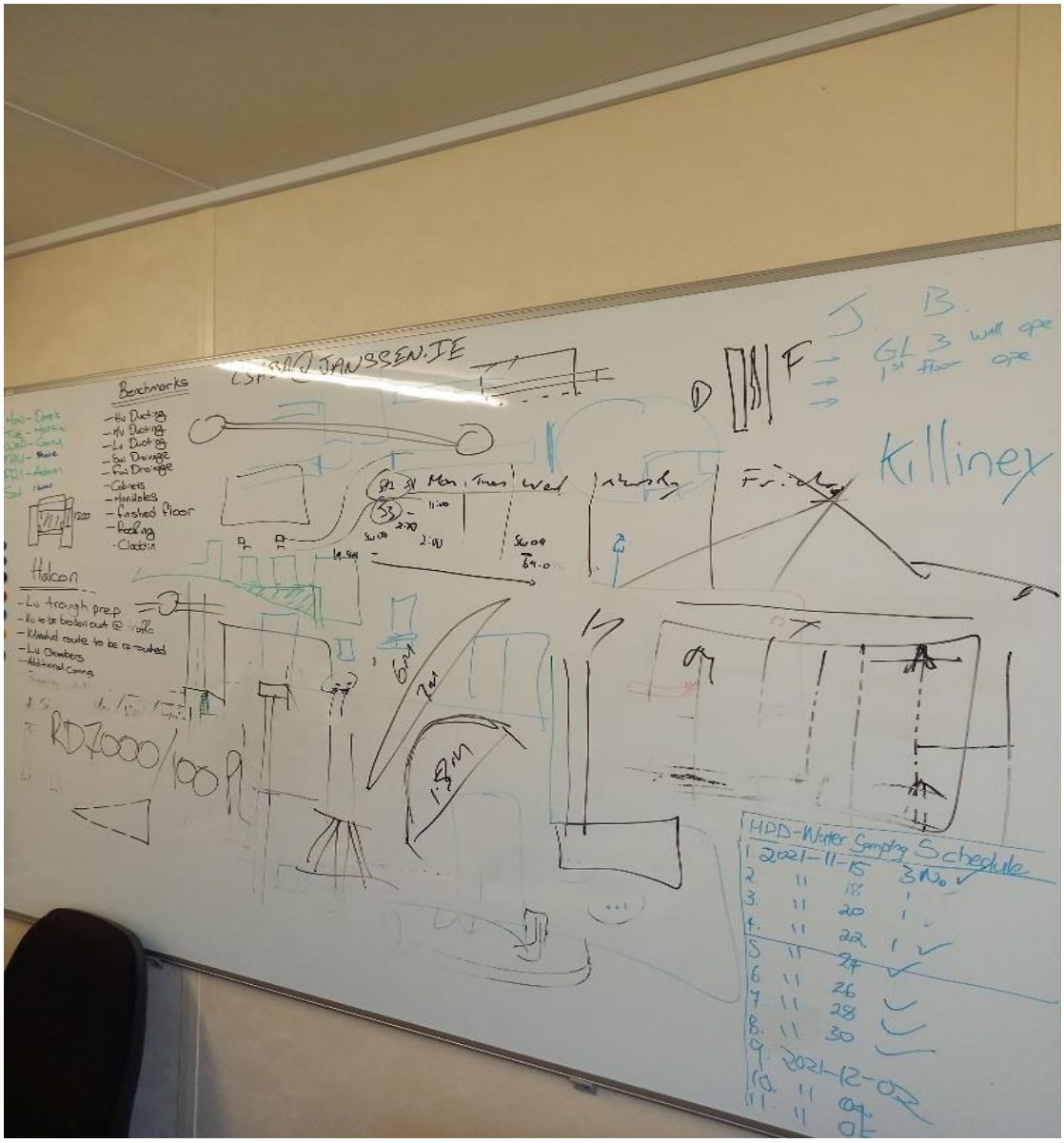
Note: The thick arrow ⟶ signifies a strong prominent connection between the research question and the theme.

The thin arrow ⟶ signifies a less prominent connection between the research question and the theme.

Appendix B: The structured sharing of explicit knowledge



Appendix C: The unstructured articulation of tacit knowledge



Appendix D: Information received via email from an interview participant

"With regards to one item on my transcript where I mentioned about giving information from a different angle. Examples I have used in the past include using diagrams or drawings where somebody hasn't fully understood the verbal communication. Sometimes a pictorial view is easier for them.

Also, I said that I enjoyed offering information and advice to my work colleague that shares the office with me. One reason for this is because he is the same age thereabouts as my own children and I see the enthusiasm that that age group have."

SECTION FOUR: REFLECTIVE LOG EXTRACTS

Introduction

Maintaining a reflective journal was strongly recommended during the first DBA professional development workshop. The purpose of the reflective journal is to record learnings, difficulties and achievements encountered throughout the DBA journey. Although reflective journalling was not something I was comfortable undertaking, from the beginning of the DBA I pushed myself to diligently notate my experiences. Some of the earlier entries may not be considered "reflective" as they simply describe what I was doing or feeling at particular stages of the DBA. However, as I engaged more with the literature and after completing Workshop 5 assignments my reflective skills developed, and my diary entries evidenced a deeper thought process of my past experiences. Therefore, some of my diary entries detail patterns of behaviour I displayed during particularly stages of the DBA (e.g., feedback from the examiners). The next section details samples of my thoughts throughout the DBA journey, these samples are categorised into two areas 1. Personal development and 2. Academic development.

Personal development

This section details log extracts which reflects my personal development throughout the DBA journey.

September 2018

The day has arrived. Waterford the heart of where it begins, the journey of my DBA. I'm armed with greetings of success; however, I'm still suffering with a lack of confidence. My husband Ed is on the phone giving me my pep talk, helping to put my head in the right place. My mind wonders back to my son; Gearoid his last statement to me was "*Mum you can do this*". So here I am "*doing this*".

Workshop 1 Day 1: I left feeling exasperated at myself I totally misinterpreted what was required of the assignment, I need to be more careful when reading instructions, I can't afford to be making such trivial mistakes which could potentially have great implications. (September 2018**)**

I'm finding the 'Professional Skills Audit' assignment detailed and challenging to complete. There are so many subsections which I don't understand. It is a very thought provoking, task. To help me manage the workload for this assignment I list three goals, on a flash card, to be completed per day. I find using the flash cards very useful as they are easy to carry and easy to retrieve. This has really helped me from feeling overwhelmed. (October 2018)

I am facing the study, family, work life challenge. I was under the illusion my 'study life' could replace my 'physical training life' what I did not take into consideration is time. My training sessions had a fixed time. While studying hours can go by in a blink of an eye. (December 2018)

I recognise a pattern in my behaviour. Whenever I have to complete an assignment, I go through a cycle. Firstly, I stress out at the number of words I have to write for the assignments. I then set goals that are unachievable which results in me consistently feeling low as I can never achieve what I set out to achieve. This behaviour usually lasts a few days. Then I suddenly get a new lease of life and I decompartmentalise the work, breaking it down into small manageable pieces. For example, instead of trying to write 8000 words in a day (which is impossible for me) I aim to write 200 words a day, which is very doable. (October 2019)

The grades have been released for Workshop 3 assignment. I can't believe it. I truly did not expect that grade, far better than I expected. I'm so happy. (Jan 2020)

When I reflect on my experience throughout the writing of Paper 1, I have come to believe I was actually 'burnt out'. I feel I put too much time and effort (if that is possible) into the first draft of Paper 1. In fact, I don't recall ever taking a day off while writing Paper 1. Sometimes too much of something can cause more harm than good. The importance of taking time away from studying cannot be understated it helps clear your mind and refresh your focus, which can lead to more efficient studying. Taking breaks is something I intend to practice. (June 2020)

This journey is an emotional rollercoaster. (July 2020)

I am now in the mist of writing Paper 3 which is due at the end of the month. I must say there is a lot of managing involved with this paper. Months prior to the actual writing of the Paper 3, I was in communication, via MS Teams and email, with the gatekeeper (B) selecting the teams for the initial interviews. Once the teams were selected interviews were organised, but this needs to be managed well and requires a lot of time. Several interviews had to be rescheduled due to the interviewee's work commitments. Although you are doing lots of work behind the scenes there is actually very little writing going on. Also, the transcribing of the interviews takes an extremely long time (approx. 10 hours per transcript). At times I felt the transcribing was a cumbersome and boring task. However, I did find it really helped me become familiar with the data. (September 2021)

Although I am keen to complete the thesis my enthusiasm seems to have dwindled. I am finding it very difficult to keep going. (January 2023)

Academic development

The following reflective log extracts detail the researcher's academic development throughout the DBA journey.

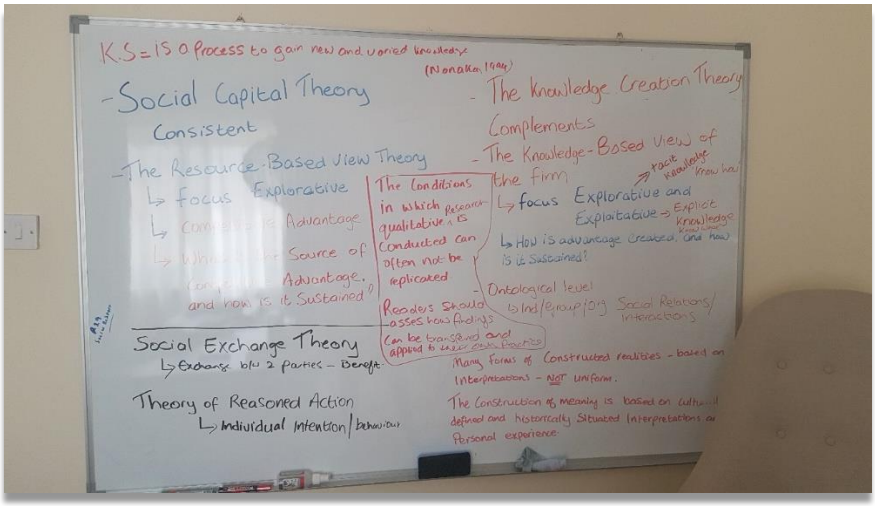
I wonder if I am the only DBA candidate taking hours to read and understand academic journals with a dictionary and thesaurus beside me. (November 2018)

The more I read the more I realise how little I know. There is so much knowledge which I have been completely unaware about such as the different methods of learning, perspectives of learning, the influence of learning, and what triggers learning. This is all truly fascinating to me. How naïve I was to think there was a possibility I would struggle to find information pertaining to lessons learned. (December 2018)

I was beginning to think taking two weeks off work, to study, was all in vain. The task of identifying theories, applicable to my research question, was proving somewhat impossible.

Then the eureka moment, happened. Everything seemed to fall into place. Sense and meaning appeared. I could clearly see the theories. Such a euphoric feeling. I want to tell the world I can actually see the theories. Image 1 below details several theories identified applicable to my research question. (February 2019)

Image 1: Theories associated with the knowledge sharing



Well, I have truly surprised myself. Yes, as always, I am confused however, it is a good confused, if that is possible. I am loving philosophy; it is fascinating and so interesting. I find it such a rewarding experience exploring the ideas of the great minds that have shaped our world. Philosophy has really helped me better understand the world and the people around me. I actually went into the bookstore, on shop street, today and purchased books about philosophy. I felt smart (intellectually) and educated, a really good feeling. There was a moment when another part of my mind was saying 'wake up, get a grip of yourself'. I proudly put that little demon away and relished the moment of feeling 'smart'. (July 2019)

I've just returned from workshop 3, well now what an adventure and experience. Brain fried. So much information is shared during the workshop that it's almost impossible to grasp. Three days was really not enough however I'm not sure I would have been able for another day. On a positive note, I feel really good about my presentation, it seemed to go well. I

enjoyed the feedback from the Workshop facilitators as it helped me question my research ideas and techniques. (October 2019)

My head is wrecked from reading so many academic journals. However, I'm actually starting to recognise there are different types of journals, some are empirical, some are conceptual, some are theoretical. So, I've decided it's time to organise all of the various printed academic papers, to do this my husband he has come up with an ingenious way for organising the papers. He simply put a large piece of plywood on my study room. Nails are strategically applied to the plywood to hold each journal. This allows me to visually see the papers as well as access them quickly. Image 2 below shows the organised academic papers. (November 2019)

Image 2: Organised academic journals

Well now I'm smiling like a Cheshire cat, the supervisors have just been allocated and I am seriously ecstatic. Truly delighted. Based on the time I have encountered and engaged with both of my allocated supervisors they know their stuff, true professionals. These guys are sharp as knives and will have very high expectations. (Jan 2020)

It would seem that my Paper 1 is full of flaws, and I now need to rewrite the entire paper. I feel so deflated and exhausted. I'm questioning whether I really want to continue this journey. (May 2020)

Reflecting on the past several days, I realise I cannot keep doing this to myself. The level of stress I put myself under is not healthy— physically or mentally. I am aware due to the current environment (Covid pandemic) there is less distractions in my life which has unfortunately provided me with the opportunity to obsess more about the examiners' comments on Paper 1 (which by the way I still have not read completely). The impact of added stress caused me to sleep for a very long time and has left me in a low state. All of which does not just impact me but my entire family. Some major decisions are needed to be made. (June 2020)

After speaking to my supervisors, I have a renewed faith in myself however, I still question whether I want to contend with the process of pursuing the DBA. The issue is not whether I am capable of completing the course, the issue is stopping, slowing down, walking away and taking a break. I need to stop myself from letting the course dominant my life and instead embraced it as an addition to my life.

I commend my supervisors they are in constant contact with me and are continuously reassuring me. Both supervisors really believe there is very little changes needed to be made to my paper. I'm a skeptic, so I beg to differ. (June 2020)

I have reviewed the majority of the examiners' comments on Paper 1 and yes there is a lot (46 comments in total) however, some of them are repeating. There is still a lot of work that needs to be completed, to help me manage the changes I am working on completing small sections at a time. (June 2020**)**

Writing Paper 2 is a dream to write. It's such an uplifting and enjoyable experience. This is because it is a more structured format than Paper 1, in that it outlines the research design,

data collection methods, and the technique used to analysis the data. This is in order, and I like order.

Data collection (for Paper 4) has been such a fulfilling and enlightening experience for me. Firstly, it brings meaning and life to the academic journals I have been reading. Secondly it has helped develop my interviewing skills, while also creating an understand of the different trades and skills needed to complete a project. (Nov 2021)

It's amazing the positive influence the DBA programme has had on me. Today a colleague was struggling using the NVivo application. I, without thought, stepped in, and helped guide them. This made me reflect and acknowledge how much I have gained throughout this DBA journey. (February 2022)

I am so delighted with myself. The presentation of Paper 4 went very well. It was recommended without changes by the examiners. This was the first time that I actually felt relaxed delivering my material. Fear was no longer present. I find the experience of presenting in person, rather than online, much more rewarding. I gained so much knowledge from the examiners' questions, which really helps broaden my perspective and understanding of knowledge sharing and articulation. (May 2022)

It is amazing how the knowledge gained from the DBA programme has influenced my work life. Today I was teaching, third level students, project management, specifically project teams and (if I must say so myself) I was amazing. I truly surprised myself on the amount of knowledge I had. Any questions asked, by the students, were answered with depth. This is due to the knowledge gained from the DBA programme.

Conclusion

The DBA journey is close to an end. This has been a fascinating and incredible learning experience, personally and academically. This journey has afforded me the opportunity to develop and improve my knowledge base, and my presentation and research skills. While

also steering me to a life of continuous learning, through reflection. It has shown me that much is achievable through self-determination.