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Abstract

Purpose: This paper focuses on knowledge storage, knowledge accessibility, and the associated challenges with these processes in an interorganizational project. For this purpose, the context of the Orange Line metro train project in Pakistan is examined, where multiple organizations were involved.

Design/methodology/approach: This study adopts an exploratory single case study approach. The empirical data comprises semi-structured interviews and archival documents. Thematic analysis is used for analyzing the data.

Findings: The distinct findings include (i) the use of knowledge storage systems, such as manual storage systems, electronic storage systems, and assigning a dedicated resource; (ii) that knowledge accessibility occurs at different levels within the organization (including intradepartmental and interdepartmental levels) as well as at interorganizational levels; and (iii) the challenges, such as misuse of knowledge, time pressures, confidentiality of sensitive knowledge, government regulations, and the reliance on human memory, associated with knowledge storage and knowledge accessibility. Based on the findings, an integrative framework of the interplay between knowledge storage, knowledge accessibility, and challenges is proposed.

Originality: This paper contributes to the literature on resource-based theory by examining knowledge storage and accessibility in an interorganizational project.

Keywords: Knowledge storage, Knowledge accessibility, Interorganizational project.

Introduction

Knowledge is considered to be a complex, cross-functional, and multifaceted concept with multilayered meanings (Nonaka, 1994; Alavi and Leidner, 2001; Lee and Choi, 2003). It is often 'sticky', difficult to codify and share (Von Hippel, 1994; Szulanski, 1996; Inkpen, 2000), and is made up of experiences, information, values, and systematic attitudes that provide a proper framework for the evaluation of information and experience (Xue, 2017), which can be used in making decisions and informing actions (Chang and Lin, 2015). Knowledge can be defined as information stored in people's minds, experience, or understanding (Alavi *et al*., 2005; Anand and Walsh, 2016). It has become the central part of an organization's activities as all rely on knowledge: the input and output of organizations is knowledge. The essence of an organization is its ability to create, share, and store knowledge assets – a process that has come to be known as knowledge management (Inkpen, 2000). Knowledge management is an organizational discipline that aims to acquire, share, store, use, and discard knowledge and is recognized as being important in generating value for organizations (Easterby-Smith *et al*., 2008; Oliva, 2014). An efficient knowledge management system in an organization serves to minimize the dependency on experienced employees through efficient knowledge storage, access, sharing, and the use of such knowledge in tasks (Ganapathy *et al*., 2021).

Researchers have investigated knowledge management factors such as enablers, processes, and performance in isolation (Szulanski, 1996; Syed-Ikhsan and Rowland, 2004). Prior

research has mostly been concerned with the storage, sharing, and creation of knowledge (Argote *et al*., 2003; Shujahat *et al*., 2017), knowledge application (Alavi and Leidner, 2001), knowledge integration and acquisition (Grant, 1996), knowledge management barriers (Oliva, 2014; Oliva and Kotabe, 2019), and investigating the role of knowledge management and its key drivers in organizational performance (Hogan and Coote, 2014). In addition, recent research on projects has mainly focused on interorganizational projects (Braun, 2018; Lumineau and Oliveira, 2018), megaproject collaborations and governance (Brunet, 2021; Galvin *et al*., 2021; Ruijter *et al*., 2021), and project decision-making (Killen *et al*., 2020; Turner, 2020). Despite the growing interest in projects, little research has tried to combine both fields of research by focusing on knowledge management in cross-functional and international project teams (Love *et al*., 2005), the role and implications of tacit and explicit knowledge management in project contexts (Koskinen, 2004; Teerajetgul and Chareonngam, 2008), the success factors for knowledge management in projects (Adenfelt and Lagerström, 2006), the knowledge sharing process in interorganizational projects (Iftikhar and Ahola, 2020), and the challenges of knowledge management in temporary organizations (Demarest, 1997; DeFillippi and Arthur, 1998; Brookes *et al*., 2006).

Interorganizational projects are temporary and complex, involve interdependent tasks (Lundin and Söderholm, 1995; Jones and Lichtenstein, 2008), and typically involve several organizations (Manning, 2017). Due to complex and temporal settings, projects face particular obstacles in knowledge management. After a project is finished, the constellation of people working together is resolved, fragmenting the project knowledge (Hanisch *et al*., 2009; Linder and Wald, 2011), and no institution remains where existing knowledge can be accessed. In temporary organizations, successful knowledge management becomes even more difficult due to the specific traits, such as that (i) projects are unique and temporary undertakings with a changing workforce, (ii) projects are often short-term oriented and integrate internal and external experts, and (iii) project participants have to adapt quickly to new conditions and contents of work (Hanisch *et al*., 2009). In addition, it is often difficult to identify which employees worked on a recently finished project, who was responsible for specific tasks, and where these employees are now working within the organization. In most cases, even the place where the documentation of a specific project is stored is unknown (Disterer, 2002). Obviously, these kinds of problems will increase with the number of projects running in parallel. Projects often develop through interactions between different organizations, such as the client's needs and the individual consultant's knowledge and expertise; therefore, the capacity to store both past expertise and knowledge about who did what, as well as make this expertise and knowledge easily accessible to other employees, is crucial to the individual, project, and organization (Mariano and Casey, 2007). It is evident that knowledge accessibility increases individual, project, and organizational performance (Cross and Cummings, 2004; Haas, 2006). As such, the knowledge and experiences have to be stored and made accessible to bridge the boundaries between projects and organizations (Disterer, 2002).

The current research available consists of (i) the critical role of organizational memory as a central system in the storage of knowledge produced by individuals (Walsh and Ungson, 1991; Kim, 1993); (ii) organizational learning processes (Casey, 1997; DeFillippi and Ornstein, 2003), (iii) retention structures (i.e., books, databases, and minds) (Walsh and Ungson, 1991; Gherardi *et al*., 1998), and (iv) processes such as acquisition (Shrivastava and Schneider,

1984), retention (Gioia and Poole, 1984; Spender, 1996), and updating of memory (Argote *et al*., 1990; Orlikowski, 1996; Goodman and Darr, 1998). Despite the interest, few empirical studies on knowledge storage and accessibility have been developed, and most studies have made only theoretical contributions (Walsh and Ungson, 1991; Stein, 1995; Olivera, 2000; Carlile and Rebentisch, 2003; Casey and Olivera, 2011). This suggests a need to (i) study knowledge storage and accessibility processes in interorganizational projects; (ii) conduct empirical research to address the role and influence of individuals, projects, and organizations in knowledge storage and accessibility; and (iii) discuss the challenges in the knowledge storage and accessibility processes. This paper explores knowledge storage and accessibility in an interorganizational project by answering the following research questions:

1. *How do organizations store knowledge in an interorganizational project?*
2. *How is stored knowledge made accessible in an interorganizational project?*
3. *What are the challenges in storing and accessing knowledge in an interorganizational project?*

Our study makes a number of contributions. First, it explores knowledge storage and knowledge accessibility processes. Second, it pinpoints key challenges in knowledge storage and knowledge accessibility. Third, it provides empirical evidence from an interorganizational project that has been largely ignored. Fourth, it highlights the role of individuals, teams, organizations, and networks in knowledge storage and knowledge accessibility. Finally, it provides an integrative model for interorganizational knowledge storage and accessibility processes along with their key challenges.

Literature review

Knowledge storage

Knowledge storage involves storing and organizing information to provide a better understanding of knowledge through obtaining different types of knowledge from internal and/or external sources and coding and indexing the knowledge for later retrieval. It serves as a storage mechanism for the knowledge collected in the past. Knowledge storage involves embedding knowledge in a repository such as a database or portal (Argote *et al*., 2003), which is viewed as organizational memory and retention of knowledge assets (Hung *et al*., 2007). Studies have shown that while organizations create knowledge, they also forget (i.e., do not remember or lose track of the acquired knowledge) (Argote *et al*., 1990; Darr *et al*., 1995). Thus, the storage, organization, and retrieval of organizational knowledge – also referred to as organizational memory (Walsh and Ungson, 1991; Stein and Zwass, 1995) – constitute an important aspect of effective organizational knowledge management (Alavi and Leidner, 2001). Based on the nature of knowledge, the process of acquiring, decoding, and storing knowledge is pivotal in knowledge management, and it becomes crucial in context of organizations where knowledge is based on past learnings and experiences and depends upon the perceptions and understanding of diverse-natured people or organizations (Kivrak *et al*., 2008). Organizational memory includes knowledge residing in various component forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures and processes, and tacit knowledge acquired by individuals and networks of individuals (Tan *et al*., 1998). As per Robinson *et al*. (2005), for knowledge management, it is essential to

acquire knowledge through complex resources, anchor it to the system so that it becomes an organizational asset and relates to unlocking and leveraging different types of knowledge so that it becomes available as an organizational asset. Knowledge must be assembled from all the participants or stakeholders participating in the project; moreover, efficient knowledge storage also requires filtering out unnecessary and non-useful knowledge to create the best knowledge database (Kanapeckiene *et al*., 2010).

Knowledge accessibility

Knowledge accessibility is the process by which individuals, projects, and organizations access knowledge from knowledge storage. Individuals in the organization (to the extent that their security system privileges permit) may have access to the repository (Gasik, 2011). Knowledge access means identifying and utilizing knowledge for influencing the decision-making capabilities of individuals or organizations in terms of needs or problem solutions (Mahdiraji *et al*., 2021). This involves two iterative steps. The first step involves the search for knowledge sources that may be useful. In a project setting, it is vital to establish whether it is worth gaining knowledge from an organization's own memory or grasping it from other organizations (Loon, 2019). The second involves determining the relevancy of the specific knowledge source for handling tasks and assessing the worth of acquired knowledge (Carlile and Rebentisch, 2003) and defines the pathway for knowledge sharing between the source and the recipient of the knowledge (Mahdiraji *et al*., 2021). Knowledge accessibility is defined as the effort that one takes to request knowledge from another individual or organization (Woudstra *et al*., 2012). Teece (2001, p. 128) notes that "knowledge, which is trapped inside the minds of key employees, in filing drawers and databases, is of little value if it is not supplied to the right people at the right time."

Woudstra *et al*. (2012) propose three dimensions of knowledge accessibility sources: social, cognitive, and physical accessibility. Social effort represents the perceived social risks (such as a knowledge seeker's image being threatened) when seeking knowledge. Research has shown that individuals engage in discussion and knowledge sharing to enhance their reputations (Wasko and Faraj, 2005). In the process of knowledge seeking, knowledge seekers' reputations may suffer if they appear unknowledgeable on a topic. They may feel indebted to the knowledge provider if the knowledge seeking is not reciprocal (Borgatti and Cross, 2003). Such feelings may prevent knowledge seekers from reaching out to potential knowledge providers and accessing the needed knowledge. Cognitive effort represents the mental effort to understand the knowledge and information that is provided to knowledge seekers. An increase in cognitive effort means that the knowledge cannot be easily comprehended and thus requires additional effort to interpret. Cognitive effort depends on the level of "shared representations, interpretations, and systems of meaning among parties" (Nahapiet and Ghoshal, 1998, p. 244). Common culture, backgrounds, and technical language help reduce the mental effort required when seeking knowledge (Easterby-Smith and Lyles, 2011; Woudstra *et al*., 2012). Finally, physical effort represents the time and ease that results from the effort required to reach knowledge providers or sources (Fidel and Green, 2004; Woudstra and van den Hooff, 2008). In other words, it represents accessibility in terms of potential inconvenience faced in accessing knowledge from people who are in different locations or time zones and not directly accessible. For instance, individuals may have to adjust their schedule or require more formal and less ad

hoc scheduling to communicate with others, which can be more time-consuming (Woudstra *et al*., 2012).

Interorganizational projects

An interorganizational project is defined as a project in which multiple organizations temporarily work together on a shared activity to coordinate and realize complex products and services (DeFillippi and Arthur, 1998; Jones and Lichtenstein, 2008) that could not have been achieved by individual organizations on their own (Schulz and Geithner, 2010). It involves multiple legally independent yet functionally interdependent constellations of different organizations to work together to pool various resources and expertise to complete complex products and services successfully (Jones and Lichtenstein, 2008; Oliveira and Lumineau, 2017; Lumineau and Oliveira, 2018). Each organization focuses on its own distinctive competency, leaving others to specialize in complementary activities in an integrated effort to produce a product or service (Barringer and Harrison, 2000). Recent research strongly advocates the importance of collaboration among organizations as it enhances knowledge through collaborative sources, and sharing of knowledge helps organizations to advance in innovations (Faccin *et al*., 2019).

In interorganizational projects, temporality is a key feature, as projects have a specific life span for which different organizations come together (Lundin and Söderholm, 1995; DeFillippi and Arthur, 1998); these interorganizational collaborations are temporarily embedded (Jones and Lichtenstein, 2008). Flexibility is another important feature of interorganizational projects as lead organizations create and recreate new organizational structures around project demands or client needs. Lead organizations can select partner organizations that they perceive to be best suited to perform the task at hand, and these partner organizations can adapt their involvement in different projects to suit their capacities (Ligthart *et al*., 2016). Since projects are *temporary* organizational settings, organizing through projects is thus inherently flexible and reconfigurable (Bechky, 2006).

Based on the above discussion, knowledge management in an interorganizational context is not an easy task. It is significantly impacted by various factors like the nature of relationships and interactions between organizations, knowledge traits, etc. (Meier, 2011; Battistella *et al*., 2016). Milagres and Burcharth (2019) explain the important role knowledge attributes play in grasping, storing, and sharing knowledge among partners. The more complex the knowledge, the greater the challenges in storing and accessing it at the right time, in the right capacity. Knowledge is classified into (i) tacit knowledge (soft, sticky and experience-based knowledge which is undocumented and difficult to express (Nonaka, 1994) such as an individual experience, skills, insights, etc. of the project (Iftikhar and Ahola, 2020), and (ii) explicit knowledge (hard knowledge and can be documented (Nonaka and Von Krogh, 2009) such as design, drawings, reports, etc. of the project (Iftikhar and Ahola, 2020). Both are important for interorganizational project.

Resource-based theory

According to the resource-based view, organizations' performance differences are based on their resources (Peteraf, 1993). Organizations may differ in their resources, and these resources may not be transferred across the organization (Barney, 1991). However, organizations do have

different resources, and that is how organizations maintain a unique and sustainable position in the competitive environment (Hoopes *et al*., 2003). The central idea in resource-based theory is that organizations compete against other organizations based on their resources (Wernerflet, 1984; Barney, 1991). A resource (including tangible and intangible assets) is defined as anything that could be thought of as a strength (Wernerflet, 1984) that helps the organization to compete. In the strategic management literature, knowledge is emerging as the most strategically significant resource for organizations (Inkpen, 2000; Zack *et al*., 2009). Knowledge is defined as a resource that is valuable, rare, difficult to imitate, and non-substitutable (Thornhill, 2006). In this sense, knowledge management can be seen as consistent with resource-based theories of the organization (Grant, 1996), as competing on knowledge as a single resource could be quite difficult for others to imitate (Earl, 2001). In this study, we considered knowledge as a resource for organizations, as relevant knowledge is stored at the organizational level and there are certain protocols and restrictions for knowledge access which makes it difficult to transfer; in turn, this provides a desirable position for an organization to have unique and valuable knowledge that can produce a competitive advantage.

Methodology

Research design

We conducted a single case study to understand knowledge storage and knowledge access in an interorganizational project. The case study method is particularly suited to addressing research questions that require detailed understanding; this is because of the richness of data that can be collected in a case study context (Hartley, 2004). Our study focuses on the Orange Line (OL) metro train project in Lahore, Pakistan. We selected this particular case to explore and understand knowledge storage and accessibility in an interorganizational project, focusing on how different organizations involved in interorganizational projects store knowledge and can access that stored knowledge and the key challenges in doing so. We addressed our research questions through an inductive and in-depth study.

Case description: The Lahore Orange Line Metro Train

The OL commences in Lahore. The OL's main line is about 27.1 km long in total. A total of 26 stations were designed along the whole line, including 24 elevated and two underground stations. The speed of the train is 70 km/hr with a passenger capacity of 1000 passengers per hour in each direction. In April 2015, administrative approval was given for an amount of Rs: 162.628 billion (USD 1.626 billion). The planned duration of the project was 27 months. The OL offers a well-organized, effective form of transportation to the public, providing a high-quality transportation service and improving job access. The OL also improves the efficiency and effectiveness of the region's current transit system, reducing the traffic load on adjacent main roads and reducing traffic jams and noise and air pollution. The design capacity of the system was 245,000 per day.

The project was divided into (i) civil works and (ii) electrical and mechanical (E&M) works. The civil works were further divided into four packages (sub-projects) assigned to four different contractors. Civil works started in October 2015 for packages 1 and 2, and in January 2016 for packages 3 and 4. The E&M works were assigned to a foreign organization. The OL became operational in October 2020 (Archival data).

Data collection

We collected data using interviews and archival documents. We relied on interviews as the primary source of data. The archival data served as an important source for building the case background. We conducted 11 interviews with 11 participants, ranging from 52 minutes to 164 minutes in length (details are provided in Table I). We conducted interviews with project directors, project managers, general managers, and other team members (deputy project manager, planning engineer, technical advisor, and quantity surveyor). Informants included members of the client team, the design consultant, contractors, and the executing agency. The interviews were semi-structured. Informants were asked a core set of structured questions and open-ended probes. We also encouraged informants to use their own terminology and to steer the interview toward issues and concepts that they felt best represented their own experiences. Initially, we utilized a snowball technique, asking each informant who they believed could help us to understand knowledge storage and access on the project. The interviews were recorded and transcribed. We also utilized archival sources of data provided by informants. The archival data consisted of 185 internal and publicly available documents, including PowerPoint presentations, an environmental impact assessment report, design details (layout and drawings), monthly and weekly progress reports, a project feasibility report, and a planning commission (PC-1) document. We asked the client, contractors, and design consultant to provide the necessary documents. Archival data was useful in developing a better background understanding of the case context.

Insert Table I about here

Data analysis

For data analysis, we used thematic analysis. Thematic analysis systematically identifies, organizes, and offers insights into meaningful patterns (themes) (Braun and Clarke, 2012). The thematic analysis in this study was highly inductive (Howitt and Cramer, 2007) and was driven by what is in the data, meaning that the themes identified emerged from the content of the data (Braun and Clarke, 2012). We followed Braun and Clarke's (2012) practical guide for applying thematic analysis. First, the transcriptions were read and explored inductively to identify knowledge storage and accessibility processes and related challenges. Second, subthemes of manual storage, electronic storage, assigning a dedicated resource, knowledge accessibility within the organization, knowledge accessibility across organizations, misuse of knowledge, time pressures, confidentiality of sensitive knowledge, government regulations, and reliance on human memory were developed. Third, by reviewing the subthemes, the main themes were defined. Table II illustrates how the subthemes are derived from the interview transcriptions and how these subthemes then lead to themes.

Insert Table II about here

Findings

We found different subthemes for knowledge storage and accessibility. For knowledge storage, we found subthemes of manual storage, electronic storage, and assigning a dedicated resource. For knowledge accessibility, our findings support various degrees of knowledge accessibility within the organization (such as within the department and across departments) and knowledge accessibility across organizations. We also found challenges in knowledge storage and

accessibility with subthemes of misuse of knowledge, time pressures, confidentiality of sensitive knowledge, government regulations, and reliance on human memory.

Knowledge storage

Knowledge storage is important; however, its importance increased when organizations were working in an interorganizational project. One of the informants mentioned that "usually, it is a part of the contract, that organizations need to keep records. If they do not keep a record, they won't be able to fulfill the project requirement at a later stage." This practice has been quoted by Milagres and Burcharth (2019) as a supporting factor in maintaining a knowledge repository where the parties are enabled through formal contracts to share their part of knowledge. The findings indicate that organizations of the OL project kept documents both in manual and electronic systems. Manual systems can be in the form of manual documentation, such as record keeping, papers, files, and hard documents (El-Gohary *et al*., 2006). Electronic storage techniques such as email, Intranet, query language, multimedia databases, expert systems, and database management systems can be effective tools in enhancing knowledge storage. These tools can help an individual to retrieve and categorize useful information (Chou, 2005). Through our findings, it was evident that a manual system is a physical form of storage, such as a register and traditional file folder, while an electronic system is a computerized form, using different tools such as mobile, WhatsApp, email, Excel, Systems Applications and Products (SAP), etc. This is illustrated in the following comment by a contractor:

> Documents that we receive, they are in the hard form, and we enter them in the computer as well. We give numbers to every document, after numbering it we do its filing and enter it in the computer as well … We use Excel, and that is a very good software, as it efficiently absorbs things in a very broader view … We scan the documents too, and they are stored in hard form as well … We used to keep project documents in physical form, in the computer and also saved them in Google drive and hard drives, etc., so, this is how the record is kept for every project. (Deputy Project Manager, Contractor 1)

Moreover, a few organizations assign a dedicated and separate resource to handle the storage and management of data. Assigning a dedicated resource enables high performance in terms of the efficient utilization of storage space and material handling times (Fumi *et al*., 2013), as illustrated by one informant:

> We have record keepers, those who take care of records and have placed everything systematically. So, you will go to them and tell them that this is what I need, and they will take it out for you. The person who needs the help will go and ask for it, and that thing will be provided. (Deputy Director 1, Executing agency)

The abovementioned tools and technologies can serve a variety of functions, such as storing large amounts of information, making information accessible to individuals, providing means for communication, generating records of interactions and transactions, and automating processes (Olivera, 2000). However, due to certain issues of misuse and inadmissibility of electronic system-generated outcomes (Yang *et al*., 2015) in a court of law, organizations need to store knowledge using both manual and electronic systems, as explained by one contractor:

> In the law, in the government, we do need the documents with the signature. We maintain its hard copy. If you go downward, you will find 150 cupboards, which contain records. But it is not like

> that; I simply go and pick out a certain file. We have a computer trainer, and servers are installed there, contains all the data, i.e., drawings and others … When the government would ask us, as per the law, you cannot present photographs, videos, or audios as a witness … I used to say that this doubled our work, as we have to maintain in both hard and soft forms. (Technical Advisor, Contractor 3)

Knowledge accessibility

The benefits of storing and providing access to knowledge are particularly relevant for multi-project organizations where knowledge acquired at one site can be beneficial to other sites (Goodman and Darr, 1998). Providing access to dispersed knowledge can reduce the organizational costs of repeatedly developing solutions to common problems and reducing the burden on employees for extracting relevant knowledge (Olivera, 2000; Ganapathy *et al*., 2021). Accessibility refers not only to having physical access to a source but also to the perceived costs (e.g., time and effort) involved in retrieving information from the source (Carlson and Davis, 1998). We can say that an important step after knowledge storage is to make it accessible to others. We found subthemes of knowledge accessibility within the organization and across organizations. Knowledge accessibility within the organization contains two dimensions: accessibility within departments and accessibility across departments. Accessing data within departments is a smooth process; however, if data accessibility is needed across departments, then formal approval is required, as illustrated in the following quote:

> The record of all written communication is available all the time, and everyone working in the organization has access to them … So, even though we are working for Orange Line, but we can ask about the document of any project of the organization ... If we have to ask someone from outside our unit, then we have to write letters. When they are asking from outside the unit, then there is also a hierarchy, and we cannot give any information to another department without the prior approval of [the] chief engineer, even within [the] organization. (Deputy Director 2, Executing agency)

Effective knowledge access demands social interaction (Berchicci *et al*., 2016), where individuals from different backgrounds (culture, organizational experience, disciplinary training) draw upon their pools of knowledge (Jones *et al*., 2006). Organizational workers frequently consult domain experts to acquire the knowledge necessary to undertake their duties (Lee *et al*., 2007). Since knowledge is department- and unit-specific, if another department and unit want to access the specialized knowledge, they need to get approval for that, for example:

> Not every employee can access stored data. There are specific individuals who are given access. We have data for files and plots. We have scanned all files and placed the documents in one place, but the access is given only to those people who are working in those areas. Other than them, no one has access. If it is something which is a concern of the unit, but they need access to it, they place the request and provide the reason why they want it. (Project Director, Executing agency)

In an interorganizational project, competing organizations often cooperate closely to produce complex, high-value technologies or products. This collaborative relationship among competitors is known as "coopetition" (Fang *et al*., 2013; Gast *et al*., 2019). It can be understood as simultaneous cooperation and competition between organizations (Bengtsson and Kock, 2014). Since knowledge is considered as an organizational resource – based on which organizations can gain a competitive advantage (Thornhill, 2006), knowledge

accessibility across organizations is a matter of concern. As explained by one interviewee, a proper request for information is made and is then scrutinized by the organization, considering why other organizations need that knowledge and what they will do with such a type of knowledge (e.g., would that cause any harm to a knowledge providing organization?):

> Outside this organization, like some other contractor or consultant needs any of our data … They cannot access that data directly. They can access through people in the head office or the people in the team. And it is first assessed as to whether it is against the organization's policy to share that data with them, whether it will cause any harm to the organization or the project, or that the information is not being used for some malicious purpose … if they need it, they will write a proper application as to why they need it, what purpose would it serve, and then it will be seen in the approval process if it can be granted to you or not. (Deputy Project Manager, Contractor 1)

Challenges

There are a few challenges related to storing and accessing knowledge. We found subthemes of misuse of knowledge, time pressures, confidentiality of sensitive knowledge, government regulations, and reliance on human memory. It is important to not just create advanced electronic systems but also provide opportunities for organizations to prevent misuse of valuable knowledge assets (Jennex and Zyngier, 2007). Misuse of knowledge not only restricts people from knowledge accessibility but prevents organizations from keeping data in electronic form as it can cause damage and harm to the organization, as explained by one informant:

> My brother-in-law is having a store, I installed a computer in his store, and I appoint a person. My brother-in-law does not know much about the computer. The boy who used to work on [the] computer played the game. He was in need of money; he copied the data on a hard disk and argued that you do not fully deposit the tax returns, so give me four lac rupees or I will give this data to the taxations department … In our system, anyone [can] copy the data and provide it to others, so we do not keep such things. (Technical Advisor, Contractor 3)

In an interorganizational project, multiple organizations are working, and individuals are under pressure to complete quality work within a certain time frame. Time pressures are a continuous and obvious feature of project work. So, priority is given to task completion as it is one of the most frequently used measurements of project success (Nordqvist *et al*., 2004), rather than keeping records and making them accessible to others. Khedhaouria *et al*. (2017) suggest that time pressures limit creativity by preventing team members from engaging in knowledge sourcing activities and by tempting them to fall back on familiar routines rather than looking for and applying new knowledge, as illustrated in the following quote:

> These are all the methods, and we need to make them efficient; things should be recorded more because sometimes there are a lot of communications, and we remain unable to record some of them because of pressure and time or because of other things being [a] priority. And then later we realize[d] that this communication happened verbally, and we could not document it, and now we are facing a problem because of that. All the documents need to be maintained. It is important when we deal with other organizations, with [our] own team as well. Internal and external – both communications are important. (General Manager, Client)

Organizations often conduct operations involving highly sensitive, proprietary information from a variety of locations; doing so poses several challenges to the maintenance of information security, including having to cross geographic, institutional, and cultural boundaries (Massimino *et al*., 2013). As a result, the significant sharing and access of knowledge at

different levels of organizations make it difficult to reconcile the confidentiality of knowledge with its availability (Ahmad *et al*., 2014). Most of the time, organizations' knowledge is sensitive and is only accessible to certain staff members. Again, the risk of data misuse makes it difficult for organizations to provide data access to others, for example:

> There are certain things that are confidential. Even there are things that are not in my access, and I am unable to access them myself. There are things that are extremely confidential. (Deputy Project Manager, Contractor 1)

We found that storing knowledge in a manual system, such as keeping files and folders, is an orthodox approach. The public sector cannot automate and switch to electronic systems until there are clear rules and regulations from the government to do so. The public sector is used in this paper to refer to institutions and organizations under state control. It is also important that knowledge in the custody of the public sector is not only available but should also be made accessible. It is, therefore, the government's responsibility to put in place effective national and institutional frameworks, including adequate capacity to facilitate and enhance information capture, organization, maintenance, and use (Mutula and Wamukoya, 2009). The major reason for using manual systems is that electronic systems are disregarded as evidence in a court of law, as explained by one Project Director:

> A centralized database can be used, but these instructions have to come from the government. You cannot do it within departments. We don't just have to get our work done on the project; we are answerable for things as well. So, when you will be asked for something, they will ask for [the] record and you cannot say that we WhatsApp or emailed it because currently these things are not accepted by the government, organizations … There is no clear government policy regarding this because, in our country, we are always careful about sharing our records. (Project Director, Executing agency)

The current system of knowledge storage and access is not up to standard, which, in turn, means relying on human memory for knowledge storage and access. Human memory has long been used as an important tool in helping people effectively perform tasks. However, the capacity of the human memory is limited (Dingler *et al*., 2016). As such, people tend to forget, which makes things difficult to recall. As one participant explained:

> Let's say you are making a budget and that numbers get lost in the files. And then nobody knows what they mean. Similarly, letters get lost in the files. They just sink. And once they sink, and if you forget about them, they are useless. I think with the absence of anybody with a photographic memory, some software would be a great help to bring all the knowledge back into [the] business for future mega projects … There should be a system which could play a role of bridge and without this bridge, who did what and what they did, if that cannot be recalled, the knowledge is lost. (Managing Director, Client)

Discussion

This paper explored knowledge storage, knowledge accessibility, and the associated challenges in an interorganizational project, on the basis of which an integrative model (Figure 1) was developed. This model represents (i) the knowledge storage process, which involves manual storage, electronic storage, and assigning a dedicated resource; (ii) knowledge accessibility within the organization (intradepartmental and interdepartmental) and across organizations; and (iii) the challenges involved in knowledge storage and accessibility.

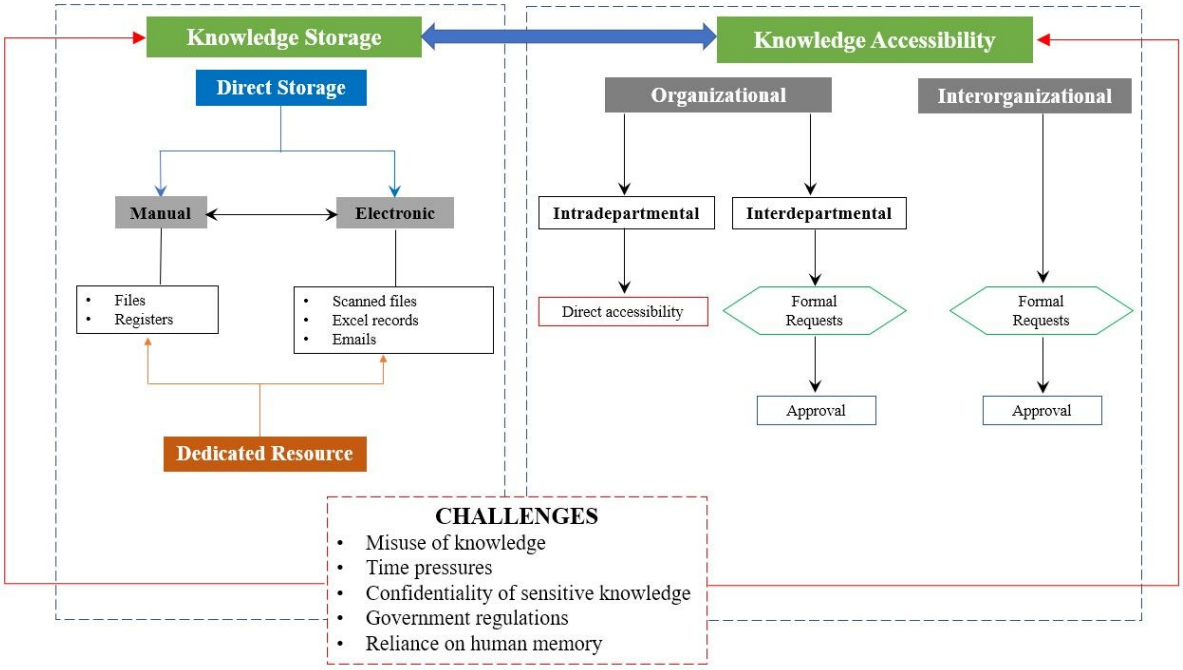

Figure 1: Knowledge storage and accessibility model in interorganizational projects

In knowledge management, one of the vital steps is knowledge storage. Knowledge storage is about storing and organizing information that can be used later (Argote *et al*., 2003). The emerging knowledge is an organizational asset that needs to be stored and maintained in organizational memory, embedded in line with the organization's goals and objectives, and is ready for future use (Pinho *et al*., 2012). The findings of this study reveal that knowledge is stored mainly in (i) documented form, such as in file folders and records that are kept in registers by assigning a number to each file; and (ii) soft form, such as in databases, emails, and computer drives (Obeso *et al*., 2020). In these different arrangements, knowledge is directly stored and managed by the relevant team members. However, one of the interesting findings is that a dedicated resource, such as a document controller or documents coordinator, is assigned to maintain and store knowledge (Mahdi *et al*., 2019); this person knows a significant amount about the knowledge storage system used.

Our model in Figure 1 also incorporates knowledge accessibility, which is an integral and subsequent element of knowledge storage, without which there is no positive outcome of storing knowledge (Teece, 2001). The findings provide interesting evidence that knowledge in an interorganizational project could be accessible at different levels; that is, at the organizational level (including intradepartmental and interdepartmental levels) and at the interorganizational level (Inkpen, 1998). At the organizational level, particularly in the intradepartmental context, knowledge is accessible to employees of the same department and team members working on the same project as their work is majorly interlinked; therefore, access to the knowledge storage is direct and does not require a formal request process. However, when the data are to be accessed by another department within an organization, this requires a formal request, and the data are only shared after formal approval. Knowledge accessibility at the interorganizational level also requires formal requests. The reasons are quite apparent as in the interorganizational project, multiple and competing organizations (such as suppliers, clients, and customers) as a source of knowledge and competitiveness (Feng *et al*.,

2010; Manning, 2017) are cooperating to produce complex products and services (DeFillippi and Arthur, 1998; Gast *et al*., 2019). Therefore, the organizations involved in interorganizational projects are cooperating and competing with each other simultaneously (Bengtsson and Kock, 2014). Formal approval is only given if the purpose and reasons behind having the knowledge are stated, as the diversity of departments and organizations may have different interests, utilization, or further sharing intentions (Hu *et al*., 2019). The formal process of knowledge accessibility within an organization's departments or between organizations is integrally linked to having a common aim for using the information (Boamah *et al*., 2021). Knowledge can be accessed both through formal procedures and indirect informal procedures depending on the nature of knowledge accessor and provider relation (Ali *et al*., 2018).

Knowledge storage and accessibility processes are accompanied by various challenges that arise in each of these processes separately and in the interactive link (also seen in Figure 1). One of the significant challenges faced is the possibility of knowledge seekers misusing the knowledge as their intent may not be in line with the organization or the collaboration of organizations' objectives (Mahdiraji *et al*., 2021). This fear of misuse of knowledge brings into consideration the nature of knowledge in terms of its sensitivity, which is a vital challenge inherent in the knowledge management process. Another main challenge faced by organizations is the time consumption in storing knowledge that exists in the form of experience, and that lies with internal or external sources. One possible reason is that usually interorganizational projects are temporary and time-constrained (Lundin and Söderholm, 1995; Jones and Lichtenstein, 2008), so teams and organizations are under pressure to finish tasks on time (Schindler and Eppler, 2003); as such, they don't have time to bring knowledge to the project in a retrievable form. In addition, there are time implications in terms of accessing the stored knowledge through formal processes and utilizing it in the performance of projects (Karamitri *et al*., 2017; Karamat *et al*., 2019). Moreover, the confidentiality of sensitive knowledge is the main reason that knowledge storage and accessibility need to be well-managed in order to minimize any knowledge breaches or leak issues (Maleki and Rosiello, 2019) – open knowledge accessibility without any formal requests would compromise the confidentiality of knowledge (Ahmad *et al*., 2014). Another challenge is that the choice of storage is impacted by the local government regulations regarding the knowledge source media, particularly for public projects where reporting methods and documentation are a major part of project management and forensics for analyzing projects after closure (Karamat *et al*., 2019). According to Karamat *et al*. (2019), government regulations are considered one of the barriers in knowledge accessibility as most knowledge is maintained in document form, making it very difficult to access. Last but not least, most project knowledge exists in the form of experience, which makes it difficult to convert to document form (Iftikhar and Ahola, 2020; Terhorst *et al*., 2018); as such, people must rely on their memories. However, people tend to forget things, and the implication of time to effectively codify, store, and further share tacit knowledge is also greatly affected by the volatility of human memory. As the storage process becomes complex or time-consuming, the loss of information or data is inevitable due to human memory (Dingler *et al*., 2016).

Conclusion

This paper provides answers to the research questions: "How do organizations store knowledge in an interorganizational project?", "How is stored knowledge made accessible in an interorganizational project?" and "What are the challenges in storing and accessing knowledge in an interorganizational project?" In this study, we present that knowledge is stored in manual storage systems, electronic storage systems, and by assigning a dedicated resource. Knowledge accessibility occurs at the organizational (including intradepartmental and interdepartmental levels) and interorganizational levels. Moreover, this study identified five challenges that could hinder the process of knowledge storage and accessibility: misuse of knowledge, time pressures, the confidentiality of sensitive knowledge, government regulations, and reliance on human memory.

This paper contributes to the resource-based theory, which considers knowledge as an essential resource in the complex interorganizational project literature. First, this study extends the dimensions that describe knowledge storage and accessibility in general and the associated challenges in particular. Second, key findings relate to the relationship between knowledge storage and knowledge accessibility and challenges in ~~an interorganizational~~a complex multi-organizational project. Third, the identified knowledge storage systems from an interorganizational project could increase the robustness of an upcoming project. Fourth, our findings demonstrate knowledge accessibility at multiple levels, such as organizational (intradepartmental and interdepartmental) and interorganizational levels. Fifth, this study identified the challenges for knowledge storage and accessibility from interorganizational projects that could hinder knowledge storage and accessibility. Finally, we believe that the knowledge storage and accessibility model in Figure 1 can serve as a basis for refining further research concerning some of the distinctive features of knowledge storage and accessibility in interorganizational projects. The model is findings driven from different organizations with different sets of roles, objectives, terms and policies, therefore, it provides approaches of knowledge storage and accessibility among different types of organizations in a multi-organizational project.

Regarding the practical implications, this research can assist managers in preparing knowledge storage systems in which they can store useful knowledge, which could also be beneficial for organizations in later stages when employees want to access such knowledge. The study findings also provide better insights for senior management, managers, and organizations about the procedures and practices required for knowledge accessibility considering both internal and external knowledge sources. An interorganizational setting is common in projects where knowledge is exchanged between different organizations within the project network, therefore the proposed model can help practitioners to lay basis for effective and smooth knowledge management in a complex multi-organizational setup. Moreover, the identified challenges in knowledge storage and knowledge accessibility provide a valuable guideline to practitioners who wish to optimize the effectiveness of knowledge storage and accessibility in interorganizational projects. In an integrated manner, the model provides a roadmap for project participants and organizations to store and access knowledge and address the existing challenges. In doing so, practitioners will develop an understanding of knowledge storage systems, accessibility procedures, and the challenges related to them.

Our study opens up several new avenues for further research. First, we examined an interorganizational project – a unit of analysis in which multiple organizations engaged simultaneously in knowledge storage and accessibility – at an aggregate level. Future research might consider the organization as a unit of analysis and compare the knowledge storage and accessibility within different organizations (client, contractors, sub-contractors, and consultants) in an interorganizational project. Second, the knowledge management process is often concurrent and does not represent a monolithic set of activities but an interconnected and intertwined set of activities (not always in a linear sequence) (Alavi and Leidner, 2001). For example, for an organization to access knowledge, the knowledge must be stored. However, we tried to address both storage and accessibility, which might undervalue or overvalue one of the concepts; as such, future researchers should give separate and due attention to them. Third, we did not consider how different types of knowledge would be stored and accessed; this is a good candidate for future research. Fourth, the research is cross-sectional, with interviews conducted at one point in time; however, to see how knowledge storage and accessibility processes evolve over a project's duration, we recommend undertaking a longitudinal study. Fifth, we identified the challenges in storage and accessibility; future research should consider facilitators for knowledge storage and accessibility. Finally, we believe that the OL metro train project is an excellent example of an interorganizational project. However, it raises questions about the transferability of our theory. While caution is always necessary with single case studies, we believe that our framework is transferable beyond interorganizational projects as our data were collected from a heterogeneous set of organizations~~.~~ such as designers, consultants, contractors, executing agency and client.

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Reviewer(s)' Comments to Author:

Reviewer: 1

Recommendation: Major Revision

Comments:
This study tries to explore the knowledge storage and accessibility in an interorganizational project.

1. The documents generated from a project are mostly data not knowledge, not even information, because many of then are not analyzed yet. Therefore, it is a research about data storage and accessibility, rather than knowledge storage and accessibility.
2. The storage and accessibility of data relies heavily on the policy and infrastructure of the organization, therefore, experiences from a case company may not be applied to other organizations.
3. If authors can apply grounded theory to analyze the data, and produce a theory, which may increase the contribution of the study.

Our response: Thank you for your comments and feedback. We are grateful for your insightful comments and recommendations that helped us improve the paper. Below we explain how we addressed each comment.

Additional Questions:
1. Originality: Does the paper contain new and significant information adequate to justify publication?: This study tries to explore the knowledge storage and accessibility in an interorganizational project.

1. The documents generated from a project are mostly data not knowledge, not even information, because many of then are not analyzed yet. Therefore, it is a research about data storage and accessibility, rather than knowledge storage and accessibility.
2. The storage and accessibility of data relies heavily on the policy and infrastructure of the organization, therefore, experiences from a case company may not be applied to other organizations.
3. If authors can apply grounded theory to analyze the data, and produce a theory, which may increase the contribution of the study.

Our response: Thank you for your comment. Knowledge is classified into tacit and explicit knowledge. Tacit knowledge is known as soft, sticky and experience-based knowledge which is undocumented and difficult to express (Nonaka, 1994) such as an individual experience, skills, insights, etc. of the project (Iftikhar and Ahola, 2020). In contrast, explicit knowledge is known as hard knowledge and can be documented (Nonaka and Von Krogh, 2009) such as design, drawings, reports, etc. of the project (Iftikhar and Ahola, 2020). For this study, we are considering documents as explicit knowledge and developing insights about their storage and accessibility; we agree that documents would be generated from data (facts and unfiltered information) and information (filtered data). However, the study is not about exploring the documents preparation process.

Iftikhar, R. and Ahola, T. (2020), "Knowledge sharing in an interorganizational setting: empirical evidence from the Orange Line metro train project", *Journal of Knowledge Management*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JKM-06-2020-0485.

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We agree that the knowledge storage and accessibility rely on the policy and infrastructure of the organization, however, the study is from viewpoint of multiple organizations working in an interorganizational project. The finding section also present the evidence of knowledge storage and accessibility from interorganizational project where multiple organizations are working together. We are not considering any single organization perspective but project. Subsequently, the discussion section is depicting that "knowledge is an organizational asset that needs to be stored and maintained in organizational memory, embedded in line with the organization's goals and objectives, and is ready for future use (Pinho et al., 2012)." Moreover, if stored knowledge is not made accessible within organization or across organizations then there is no use of it as stated: "knowledge accessibility, is an integral and subsequent element of knowledge storage, without which there is no positive outcome of storing knowledge (Teece, 2001)." Hence, it is pivotal that knowledge would be made accessible as presented in discussion section.

Pinho, I., Rego, A. and Cunha, M. (2012), "Improving knowledge management processes: a hybrid positive approach", *Journal of Knowledge Management*, Vol. 16 No. 2, pp. 215-242.

Teece, D.J. (2001). "Strategies for managing knowledge assets: the role of firm structure and industrial context", In Nonaka, I. and Teece, D.J. (Eds), *Managing Industrial Knowledge: Creation, Transfer and Utilization*, Sage Publications, London, pp. 125-144.

According to Glaser and Strauss (1967) and Strauss and Corbin (1998) grounded theory principal aim is to generate theory. However, this study is extending already existing theory of resource-based in interorganizational project, stated in theoretical contribution of revised manuscript. We are not constructing a new theory but extend the established theory. Which is common practice in project management research. Thereby, keeping this in view, we did not find grounded theory to be relevant.

Strauss, A. and Corbin, J. (1998), *Basics of qualitative research*. Beverly Hills, CA: Sage.

Glaser, B.G. and Strauss, A.L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Transaction.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: yes

Our response: Thank you so much for your positive feedback.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: This paper uses semi-structured interviews to collect data, and uses sematic analysis to analyze the data.

It is not a research based on grounded theory, thus, the paper does not produce an useful theory.

Our response: As stated earlier, this paper extends the resource-based theory in the conclusion section of revised manuscript: "This paper contributes to the resource-based theory, which considers knowledge as an essential resource in the complex interorganizational project literature. First, this study extends the dimensions that describe knowledge storage and accessibility in general and the associated challenges in particular. Second, key findings relate to the relationship between knowledge storage and knowledge accessibility and challenges in an interorganizational project. Third, the identified knowledge storage systems from an interorganizational project could increase the robustness of an upcoming project. Fourth, our findings demonstrate knowledge accessibility at multiple levels, such as organizational (intradepartmental and interdepartmental) and interorganizational levels. Fifth, this study identified the challenges for knowledge storage and accessibility from interorganizational projects that could hinder knowledge storage and accessibility. Finally, we believe that the knowledge storage and accessibility model in Figure 1 can serve as a basis for refining further research concerning some of the distinctive features of knowledge storage and accessibility in interorganizational projects."

We are not producing or constructing a new theory, which is purpose of grounded theory (Glaser and Strauss, 1967; Strauss and Corbin, 1998). Hence, we did not find ground theory suitable for our study.

Strauss, A. and Corbin, J. (1998), *Basics of qualitative research*. Beverly Hills, CA: Sage.
Glaser, B.G. and Strauss, A.L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Transaction.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Result are clearly analyzed, but authors need to improve the contributions to make it publishable.

Our response: Thank you for your comment. We have made changes in the contributions.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The data storage and accessibility are tied strongly to the project environment, therefore, results are not universally applicable.

Our response: In the conclusion section we stated that "we believe that our framework is transferable beyond interorganizational projects as our data were collected from a heterogeneous set of organizations." To support this claim, we refer to Table I which provide interview participants details, but also contain information regarding role of the organizations, particularly mentioning client, consultant, designer, executing agency and contractors. Each of these organizations are in different business and performing different roles in project. Hence, we believe that the study is not only applicable to projects but other contexts as well.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: yes

Our response: Thank you for your positive review.

Reviewer: 2

Recommendation: Accept

Comments:
To author or authors: Continue research and find more cases in different types of business. Keep up the excellent writing and editing.

Our response: Thank you for your positive feedback and appreciation. We appreciate your time in reviewing our manuscript.

Additional Questions:
1. Originality: Does the paper contain new and significant information adequate to justify publication?: Yes. In our complex business world, interorganizational analysis is valuable especially in terms of knowledge storage and accessibility. The author(s) have made a special effort to investigate transient interorganizational project management and knowledge sharing. Storage and accessibility to knowledge need new ideas and empirical evidence. Well done. It builds on previous research well and explores more than indexing and coding by exploring organizational memory and tacit knowledge. Plus, authors know accessibility is social, cognitive, and physical, which is especially difficult with short-lived, interorganizational projects.

Our response: Thank you for your appreciation.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Strong bibliography and detailed literature review. Aspects of knowledge definitions, reality of social media threats, and the importance of resource theory are covered so well. There might be more about tacit knowledge for future study and applications of the framework presented.

Our response: Thank you for your comment.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: The research is limited to one case, but the analysis is well done and the challenges of storage and access in KM are illustrated in a useful framework model. Both background details on interview subjects and coding procedure for qualitative data are well documented. The proposed model could be part of robust growth in future studies of complex, interorganizational projects in areas such as healthcare and computer systems development.

Our response: Thank you for your positive review.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Participants in interviews described well. And the coding procedure for qualitative data was presented clearly and could be replicated using the three, useful themes: Knowledge of Storage, Knowledge of Accessibility, and Challenges faced by project team members. Useful results for real project managers in complex, stressful business environments.

Our response: Thank you. We appreciate that you find our paper useful for practitioners.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The proposed model could be part of robust growth in future studies of complex, interorganizational projects in areas such as healthcare and computer systems development.

Our response: Thank you for your positive feedback.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Well written. Beautifully organized. Clearly illustrated framework in figure.

Our response: Thank you for your appreciation.

Table I: Interview participants' details

Role	Designation	Education	Experience (years)	Interview duration (minutes)
Consultant and designer	Project Manager	MSc (UK)	30	61
	Planning Engineer	MSc (in progress)	4	164
Executing agency	Project Director	BSc	16	118
	Deputy Director 1	-	10	
	Deputy Director 2	MSc (in progress)	9	93
Client	Managing Director	-	45	56
	General Manager	MSc (US)	33	101
Contractor 1	Deputy Project Manager	BSc	14	74
Contractor 2	Project Manager	-	29	52
	Quantity Surveyor & Deputy Project Manager	Matric	15	92
Contractor 3	Technical Advisor	BSc	40	125

Archival data		
Type of archival data	***Detail of archival data***	***Quantity***
Project feasibility report	Project study report	23
Design details	Layout and drawings	102
Environmental impact report	Environmental effects of the project	19
Planning commission (PC-1) document	Summary Detailed document	10
Progress reports	Monthly progress reports	15
PowerPoint presentations	Project brief and details Project background Progress reports	16
Photos	Execution of the project	408

Table II: Example of the coding procedure

Themes	Subthemes	Illustrative quotes
Knowledge storage	Manual storage	Documents are in hard physical files. The files have numbers and names, issues, so these files are well maintained. We have proper registers for it so that you can look up a proper reference in it and take out the concerned file, like you can find that you sent an issue on 15th March, so you take [the] file number, trace it back, so you get to know where that file is stored. (Project Director, Executing agency)
	Electronic storage	We have the record in computerized form … Whenever [a] project finishes, we send all the data to our head office … We have hard drives, and we send all the data in them for the projects that we have done till today. (Quantity Surveyor & Deputy Project Manager, Contractor 2)
	Assigning a dedicated resource	We have junior clerks who are properly managing all the record[s] for every project. So, when we need anything, we just have to tell them that we need this document of this project, and they have maintained all the files for it, and they bring it to us, and we can pick whatever is required from it. (Deputy Director 2, Executing agency)
Knowledge accessibility	Knowledge accessibility within the organization	Not everyone can access the data storage … It cannot be shared with everyone … So, only the designated people can access [it]. Like, if it's accounts information, only people from [the] accounts department can access it, and no one else … it is specialized that a person who needs a particular kind of knowledge will update it and access it … If some other department needs it, then they would make a request through his in-charge, and then he will get the information as much as he requires. (Deputy Project Manager, Contractor 1) It is [the] company's documents, and they do not share them with anyone. Owners will keep it in their own custody … Let me explain you this: we can share the drawings after the owners give permission for that, but the matters of accounts cannot be shared with anyone … For instance, if I give the geogrid wall design to anyone, they will ask me why I have shared it. It's a new technology that came from China for the first time … Whosoever wants it will have to contact the owners. (Project Manager, Contractor 2)
	Knowledge accessibility across organizations	Knowledge accessibility across [the] organization will be a bit difficult because usually, knowledge is the organization's property, and it is the kind of information that we don't share with everybody. But if somebody needs it, we are ready to help… So, it depends upon the reason they give why they want that information. (Project Manager, Consultant, and Designer)
Challenges	Misuse of knowledge	[The] Right of Information Act says we don't share intellectual property. As data mining can give others [an] undue edge, so we don't give access to intricate information … [Name of document] can't be share[d] because anyone can copy that part, even someone very close to me ask if they misused it then government will ask from me why you provided them these documents? Let me give you an example. We did the [Name of document]. It is a very expensive document; if we provide access, anyone can cut paste from it and earn money through it, so it will have its issues … We don't. Because somebody can get [an] undue advantage. (Managing Director, Client)
	Time pressures	I have got a lot of things scattered in my system. I don't know if I miss a lot of things in my email or somewhere else. But these things are not properly documented, and records are not kept. Though things are there – but they are not documented. We did not have time for that. (Planning Engineer, Consultant, and Designer)

	Confidentiality of sensitive knowledge	Our record is quite a sensitive record. If some person goes and tampers with that record or deletes some of the document: that is why everyone can't be given access. In our organization, we have [a] files system. If someone else goes and takes out an ownership letter from someone's file, the owner of that file would be ruined. (Deputy Director 1, Executing agency)
	Government regulations	One thing that we are following in Orange Line to a great extent, but it's not there in other projects yet, all the records get scanned and get saved on the computer software properly, so that the access becomes a bit easier. Like any database that are usually used, there is no such database of records in government. As yet, there are people present who are managing the record manually, but there is no computerized database as yet, and there are no such instructions from government. (Deputy Director 2, Executing agency)
	Reliance on human memory	Files are there, but you just don't know what is inside that file. You forget, and the file cannot speak what does it have inside. It has just hidden the data inside it. Something needs to pop up, and it is very much required … No matter how experienced you are, you tend to forget things. Things get skipped from your mind; memory is limited. (General Manager, Client)