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A Cognitive Method for Comparing and Elaborating on Technology Frames

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From employees' varied interpretations of software efficacy to consumers' diverse beliefs about data privacy, technology frames refer to cognitive interpretations, assumptions and expectations that people use to comprehend the essence of information technology within a particular context. These frames differ across groups with different values, interests, experiences and expertise, having critical implications for researchers, managers and organizations. Despite theoretical enthusiasm to understand technology frames, limited methodological insights exist on how to systematically explore and compare technology frames. This gap impedes researchers from exploring novel questions related to technology frames, their variations and how they can be managed effectively. This paper proposes a cognitive method for comparing and elaborating on technology frames. Building on causal mapping and empirical studies, the method formulates steps to plan, elicit, compare and elaborate on the relationships that underlie framing differences. The method offers detailed recommendations and templates for effectively organizing and communicating diverse manifestations of framing differences and their implications. The paper concludes by highlighting the method's practical implications and encouraging research to advance extant knowledge of technology frames in the rapidly changing digital world.

Introduction

Information technology (IT) is at the core of digital products, services, platforms and experiences (Fang, Wu and Clough, 2021; He *et al.*, 2020; Sørensen, 2016; Wilkinson *et al.*, 2021), and researchers are increasingly exploring ways to manage its impacts on organizations and individuals (Balta *et al.*, 2022; Colbert, Yee and George, 2016; He *et al.*, 2020). The design and functionality of IT are shaped by the values, interests and expertise of those who create it (Chen, Richter and Patel, 2021; Duxbury *et al.*, 2014; Orlikowski and Scott, 2008), and IT also influences and transforms the way people, organizations and society perceive and interact with technology (Califf, Sarker and Sarker, 2020; D'Arcy *et al.*, 2014; B. Wang, Liu and Parker, 2020). This social construction of IT has led to discussions about how different social groups have distinct patterns of interactions with technology (Berger and Luckmann, 2016; Davidson, 2002; Giorgi, 2017; Kyriakidou and Olivas Osuna, 2017; Orlikowski and Gash, 1994; Spieth *et al.*, 2021). Framing differences stem from groups' diverse values, interests, experiences and expertise, creating distinct 'technology frames' within various contexts.[1] For example, stakeholders with different roles (Linberg, 1999; Lundberg, Nylén and

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[1]Technology frames are mental frameworks that people use to interpret, assume and anticipate the impact of information technology (IT) in a particular context. The term 'IT-related phenomena' encompasses a broad range of initiatives, including the development, implementation and use of IT products and services. Hence, this term emphasizes the complexity and diversity of IT-related activities that influence our understanding and experience of technology.

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Sandberg, 2021) and user groups with diverse past experiences (Mazmanian, 2013) may have different expectations and perceptions of IT impacts, struggles and the roles people play in managing them.

Understanding groups' technology frames is crucial for researchers, since incongruent frames can lead to conflicting choices and reactions to IT-related phenomena, causing communication and behaviour problems during IT development, implementation and use (Linderoth and Pellegrino, 2005; Luo *et al.*, 2018; Murungi and Hirschheim, 2022). This issue is especially pertinent in newly emerging technologies, such as collaborative tools, given their interactive and socially embedded nature, which allows for multiple interpretations (Nardon and Aten, 2012; Wilkinson *et al.*, 2021). Despite the significant impacts of technology frame differences on social practices and outcomes, the methodology used to explore and compare them has received insufficient attention (Spieth *et al.*, 2021). Although researchers have made valuable theoretical contributions in this area (Elbanna and Linderoth, 2015; Giorgi, 2017; Murungi and Hirschheim, 2022; Nardon and Aten, 2012), many studies tend to rely on pre-existing concepts, such as the nature of technology, technology strategy and technology in use (Orlikowski and Gash, 1994). As a result, they often fail to systematically capture the broader concepts and relationships that shape framing differences. This methodological void hampers the current understanding of diverse technology frames and their numerous implications in rapidly changing digital societies and workplaces.

Against this backdrop, this study presents a method for comparing and elaborating on technology frames as a crucial step towards theorizing about IT–people relationships. More formally, the study asks: *How can researchers effectively compare and elaborate on technology frames?*

Building on comparative causal mapping (Laukkanen, 1994; Laukkanen and Päivi, 2013) and methodological insights from empirical research, the paper proposes a structured perspective for comparing and elaborating on technology frames, while also providing flexibility to explore diverse framings and the relationships that underlie their differences. The perspective is offered as a method, with detailed recommendations and templates for organizing comparative findings and improving researchers' sensemaking, brainstorming and analytical transparency (Heinz and Rice, 2009). By revealing people's reasoning and the sources of difference, the method enhances organizational empathy and enables researchers and practitioners to discuss comparative insights (Leonardi, 2011). The study highlights avenues for how the proposed method can advance current understanding of the impact of diverse technology frames on social interactions, practices and outcomes. The paper concludes by discussing practical implications and opportunities for expanding the method.

Method background

Comparison in technology frame studies

The notion of 'technology frames' is rooted in the premise that people attach cognitive meanings to their experiences with IT, which subsequently shape their attitudes, actions and decisions towards IT. This idea has been explored in seminal studies, such as those by Orlikowski and Gash (1994) and Davidson (2002), as well as in recent works by Spieth *et al.* (2021) and Murungi and Hirschheim (2022). While most research focuses on the social dimension of technology frames, examining how stakeholders with different roles hold divergent framings (Chakraborty and Sarker, 2010; Lundberg, Nylén and Sandberg, 2021; C. Wang, Medaglia and Jensen, 2021), some studies adopt a process view that emphasizes the role of IT as an artefact in shaping technology frames (Linderoth and Pellegrino, 2005). IT-enabled projects offer opportunities to investigate how a specific technology, such as a collaborative tool for knowledge transfer, can gradually change individuals' technology frames. Moreover, a few studies have explored the longer-term effects of IT on technology frames (Ghobadi and Mathiassen, 2020; Niederman, Ferratt and Trauth, 2016), revealing that, for example, growing up with newer generations of social networking can lead to distinct expectations about digital products and processes.

Understanding differences in technology frames is critical, regardless of how they are approached in a study. The literature suggests that people hold similar values and interests to those with similar experiences and expertise (Berger and Luckmann, 2016; Giorgi, 2017; Kyriakidou and Olivas Osuna, 2017; Spieth *et al.*, 2021). These people belong to 'groups' with meaningful similarities

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in technology frames, such as role-based groups within organizations. Similar technology frames can lead to homogenous patterns of behaviour, which can drive positive outcomes and facilitate organizational change. In contrast, misalignments in technology frames can lead to challenging outcomes, such as misunderstanding, conflict and contradictory actions (Azad and Faraj, 2008; Lin and Silva, 2005; Yeow and Sia, 2008). Some studies, however, suggest that frame incongruences can be rewarding if managers distance themselves from political contests (Azad and Faraj, 2011; Cornelissen and Werner, 2014; Hsu, Huang and Galliers, 2014; Olesen, 2014; Spieth *et al.*, 2021). Differences can also encourage creative exploration, facilitate cross-functional collaboration and attract prospective funders (Anthony, 2018; Seidel, Hannigan and Phillips, 2020).

In response to these diverse outcomes related to technology frames, researchers advocate for socio-cognitive comparisons of technology frames to explore different viewpoints and identify strategies to reconcile framing differences (Linberg, 1999; Lundberg, Nylén and Sandberg, 2021; Mazmanian, 2013). These scholars have noted that technology frames are compared in the context of IT development, implementation and use. A literature review was conducted to explore studies that focused on this comparison to enhance further understanding of how researchers compare technology frames. The review began by examining classic papers on the topic (Davidson, 2002, 2006; Davidson and Pai, 2004; Orlikowski and Gash, 1994), extracting the list of papers that cited them. From this list, studies whose core research goal was to compare technology frames were identified, categorizing them based on the context in which frames were being compared. The findings confirmed the earlier suggestions. Specifically, some studies tend to focus on IT development, which involves the creation of new IT systems (Chakraborty and Sarker, 2010; Leonardi, 2011; Yeow and Sia, 2008). These studies examine how stakeholders involved in the development process – such as engineers, designers, business analysts and end-users – frame, and how these frames affect the development process (e.g. requirement gathering) and outcomes (e.g. collaborative behaviours). Other studies focus on IT implementation within organizations, which involves installing and configuring an existing IT system and training people to use it effectively (Barrett, 1999; Hsu, Huang and Galliers, 2014; Lundberg, Nylén and Sandberg, 2021). These studies examine how organizational groups frame the implementation process, including corporate culture, power dynamics and resistance to change. Finally, some studies also focus on user adoption of technology, examining how different user groups adopt an existing technology (Mazmanian, 2013; C. Wang, Medaglia and Jensen, 2021). These studies differ from implementation studies in that their prime focus is on adopting an existing technology that does not require new development or implementation – such as a digital tool like WeChat. It is important to note that these studies are not mutually exclusive and can overlap. For example, a study may examine the development and implementation of a new IT system or the implementation and use of an existing one. However, by categorizing studies, one can understand better how researchers compare technology frames and derive practical implications. The Appendix provides a summary table of these studies.[2] While empirical works highlight sustained interest in advancing theoretical knowledge, studies tend to apply prescribed approaches and overlook individuals' causal logic and assertions (Spieth *et al.*, 2021). Furthermore, researchers seldom utilize systematic comparisons to unlock innovative insights and implications. These challenges contradict the spirit of technology frames (Orlikowski and Gash, 1994), which emphasizes examining individuals' mental models and cognitive processes (Weick, 1979, 1996; Weick and Bougon, 1986).

Alas, neglecting the methodological primacy of exploring and comparing diverse framings hinders fresh explorations in studies of technology frames (Spieth *et al.*, 2021). This paper contributes to addressing these issues by presenting a method to effectively compare and elaborate on the causal network of concepts and relationships underlying technology frames. The method draws on cognitive mapping techniques, while also acknowledging their limitations.

[2]The aim of this review is not to provide an exhaustive literature summary of technology frames or offer categorizations. Instead, the primary objective is to develop an understanding of how researchers have compared technology frames in different contexts, such as through the use of interviews that elicit participants' technology frames along predefined dimensions.

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Comparison in cognitive mapping studies

Cognitions refer to the belief systems people use to perceive, construct and make sense of their world and decide what actions to take (Axelrod, 1976; Swan, 1997; Weick, 1979, 1996). Since cognitive models are central to organizational phenomena, researchers have explored ways to elicit and understand them (Bougon, 1983; Carley and Palmquist, 1992; Oliver and Montgomery, 2008; Siau and Tan, 2008; Sperry and Jetter, 2019; Swan, 1997; Weick and Bougon, 1986). Causal mapping has emerged as a prominent approach to understanding how people explain a phenomenon by mapping concepts and their causal relationships (Armstrong, 2005; Hodgkinson, Maule and Bown, 2004; Narayanan and Fahey, 1990). Through interviews and focus groups, participants reveal concepts and relationships, and various techniques such as Self-Q and repertory grid are used to capture individuals' subjective sense-making processes (Ananth, Nazareth and Ramamurthy, 2011; Bougon, 1983; Tan and Hunter, 2002). Sorting techniques provide a list of concepts to participants, who then choose and sort the relevant concepts on a blank sheet of paper and draw arrows to indicate relationships (Carrington, Combe and Mumford, 2019; Markíczy and Goldberg, 1995). After data collection, researchers code causal relationships and use matrices (Bougon, Weick and Binkhorst, 1977) and other techniques such as t-tests and cluster analysis to examine causal relationships among the identified concepts (Eden and Ackermann, 2004; Eden, Ackermann and Cropper, 1992).

Scholars agree that causal mapping helps explore and elaborate on cognitive models crucial to management issues like strategic decision making, collaboration, innovation and organizational change (Gary and Wood, 2011; Konlechner and Ambrosini, 2019). One application of causal mapping is *comparative causal mapping*, which enables researchers to explore and elaborate on in-depth comparisons of groups' interpretations, assumptions and expectations (Kiss and Barr, 2017; Kun-Chang and Soon-Jae, 2006; Nadkarni and Barr, 2008; Tyler and Gnyawali, 2009). Over time, comparative causal mapping has emerged as an insightful stream of research that sheds light on various research topics. Most studies using causal mapping have employed it to test existing propositions or theories (Carrington, Combe and Mumford, 2019; Clarke and Mackaness, 2001; Jenkins and Johnson, 1997). In the seminal work by Jenkins and Johnson (1997), the authors compared the causal maps of owners of retail stores who achieved sustained growth with those who did not. Although the causal maps did not show significant cognitive differences between the two groups initially, the authors later discovered that those who achieved entrepreneurial growth emphasized internal efficiencies more than competitive issues, which supported the belief that intuitive thinking is crucial to entrepreneurial success. Some studies have used more exploratory causal mapping, such as constructing and comparing groups' causal maps (Armstrong *et al.*, 2012; Ghobadi and Ghobadi, 2015; Ghobadi and Mathiassen, 2015, 2020; Nelson, Armstrong and Nelson, 2009; Riemenschneider and Armstrong, 2021; Riemenschneider, Buche and Armstrong, 2019). These studies examine how people reason about a phenomenon using concepts and the relationships between them. While some studies propose single measures, such as the distance ratio, to compare maps (Carrington, Combe and Mumford, 2019; Langfield-Smith and Wirth, 1992; Markíczy and Goldberg, 1995), the majority of studies suggest multi-dimensional measures that consider a map's content and structure (Laukkanen, 1994, 1998; Laukkanen and Päivi, 2013). For example, *map density* determines the extent of information captured in each map, *concept centrality* identifies the most important concepts in a map based on their frequency or perceived importance, and *relationship reachability* assesses the prominence of different types of linkages in a map's structure based on their frequency or correlation.

Despite these advancements, there are some limitations to using causal mapping for comparative analysis of technology frames, and three key issues need to be addressed. First, current research has focused on the analytical aspects of comparing causal maps, neglecting the unique challenges associated with studying technology frames. Specifically, technology frames are deeply ingrained in individuals' thinking and behaviours and can change in response to their experiences and expertise. Researchers must carefully plan and design data collection techniques to elicit individuals' beliefs and assumptions without imposing their own views and assumptions. Unfortunately, existing methods do not provide adequate guidance on these matters, which can challenge the

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validity and reliability of findings from comparative studies of technology frames. Second, existing studies typically report how researchers compared maps against high-level measures, such as map comprehensiveness, density and centrality. However, they lack systematic guidance for conducting comparisons beyond those measures. Researchers interested in comparative studies of technology frames must rely on trial-and-error efforts to design effective research protocols. Finally, comparative causal mapping offers valuable opportunities for elaborating on the relationships between concepts, observing similarities and differences and leveraging them for theorizing. However, existing methods do not provide sufficient guidance on conducting comprehensive comparisons and building theories based on them. This gap has led to critiques of high subjectivity in people's causal assertions and the need for mid-range theories or complementary methods (Bellini, de Faria Pereira and Becker, 2016; Deng and Chi, 2013).

Comparing and elaborating on technology frames

This section presents the methodological approach for comparing and elaborating on technology frames. Informed by comparative causal mapping and empirical research insights, the method summarized in Table 1 is divided into five stages: research planning, data collection, constructing maps, empirical analysis and theoretical elaborations. The recommendations are flexible and can be tailored to suit researchers' specific contexts and research questions.

Research planning

Effective research planning is crucial for comparing technology frames. The process starts by formulating 'research questions' that align with the research approach. In studying generational differences (Ghobadi and Mathiassen, 2020),[3] the question was how developers – who have been early adopters of social networking technology – contribute unique goals to software development. Depending on the research perspective, a process-oriented study may examine how individuals' perceptions of a new technology evolve with repeated use, while a variance-focused study may aim to uncover how attitudes towards technology in the workplace vary across different age groups. Regardless of the chosen research approach, it is essential to clearly define the research questions to compare groups' technology frames.

Next, researchers pay close attention to the groups they are comparing and the data collection techniques they will use to address research questions. Since people's experiences with technology are complex and personal and can change over time (Greenfield, 2010; Kuniavsky, 2010), assigning respondents to appropriate groups can be challenging. In the research on technology-based generations, it was difficult to categorize individuals as digital natives or immigrants based solely on their birth year. It was essential to create a robust definition for the concept of nativity and prepare a list of questions to determine whether informants qualify for the digital native/immigrant groups based on their early experiences with social networking. It was also critical to take measures to prevent bias in the informants' responses, as a pilot study suggested that younger and older developers tended to hold different perceptions of each other's technology experiences. Therefore, the interviews did not highlight the comparative nature of the research and instead presented the research goal as exploring developers' general experiences in building software applications. In summary, researchers must plan their words to avoid unintentionally biasing their data collection methods. For example, as researchers investigate technology frames regarding events that threaten employees' well-being, labelling events as a crisis may trigger sensitivity and lead to biased responses from leaders (Carrington, Combe and Mumford, 2019).

Once researchers have outlined the groups they will compare, they identify data collection techniques that can effectively address research questions. Ideally, researchers plan to use a combination of research methods such as interviews, observations and archival resources. For instance, in a study exploring how groups react to emerging technology, collecting data from potential participants at different periods would be valuable to enable longitudinal analysis. This allows for examining technological frame changes, providing

[3]Throughout the paper, the research citations on knowledge-sharing barriers and generational differences are Ghobadi and Mathiassen (2015, 2020), respectively, but they are not always cited when the context is obvious and to avoid repetitive citations.

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Table 1. Method process for comparing and elaborating on technology frames

Research planning

1.1. Begin with **formulating clear research questions** that focus on comparing technology frames across groups.
1.2. Develop a thorough **understanding of the groups whose technology frames will be compared**.
1.3. **Develop a grouping strategy** that establishes groups with distinct technology frames.
Consider how to inquire about people's IT-related experiences (e.g. avoiding leading questions that assign informants to a specific group and not revealing the comparative nature of the research).
1.4. Identify a **range of data collection tools** to address the research questions (e.g. interviews, surveys, archives).
Consider whether the research questions require paying attention to how IT (e.g. a newly implemented system) shapes groups' technology frames and ensure that data collection methods capture this.
1.5. Prepare a **set of open-ended questions** to explore how different groups reason about the IT-related phenomenon.
Consult existing theories and frameworks in relation to the research question, if necessary, to develop the questions.
If the research involves interviewing or surveying informants, develop a strategy to **prevent demand characteristics** that may lead people to report biased opinions.

Data collection

2.1. **Contact potential informants** and, upon their consent, **create a more comprehensive list of participants** for the study.
2.2. Based on the grouping strategy developed in the previous stage, **establish groups that represent distinct technology-related experiences**.
Before collecting primary data, approach potential informants and inquire about their IT-related experiences (as outlined in the research planning) and use this information to shape the groups.
Check the demographic characteristics of the participants within each group, identify important demographics that should be controlled (e.g. age, education) and explore ways to control those demographics (e.g. defining subgroups).
2.3. Use pre-identified methods, such as focus groups, interviews and surveys, to **collect empirical data about people's technology frames**.
Consider using archival data, such as news articles, public hearings, online comments and organizational reports, whenever possible. If necessary, consider collecting longitudinal data, such as conducting interviews at different time points, to gain a comprehensive understanding of the changing technology frames. This is particularly useful if the study aims to explore the role of IT in shaping technology frames (as outlined in the research planning).

Map construction

Code data:
3.1. **Consolidate the data collected from each group** into a single file.
3.2. **Identify causal statements** using keywords like because, so, since and if–then, and distinguish between causes and effects. Assign higher-level labels to causes and effects to create constructs. Consider using existing frameworks and theories to assist with these assignments if feasible.
3.3. Develop a **list of constructs, concepts and relationships** for each group and summarize the primary results using the method's templates (Tables 2 and 3).

Build maps:
3.4. **Visualize each group's causal map of technology frames** by drawing a network of interrelated constructs.
Use software such as Decision Explorer, Dialogue Mapping or CMAP2 to draw maps and facilitate their analysis if necessary. Software can be beneficial for real-time data collection and map building, that is, researchers can host a workshop where participants can contribute by improving, assessing and validating the maps. Compare the maps independently.
If possible, use intercoder reliability measures (e.g. research assistants) to resolve any disagreements. Disagreements help address significant issues and improve shared understanding. Ask experts from the empirical study (e.g. key informants) to verify the research findings (e.g. maps, tables) to strengthen the study's validity.

Empirical analysis

4.1. Explore the **content and structure of the maps** to compare the technology frames of different groups.
Content comparison involves comparing the constructs and relationships in the maps to identify interesting findings, such as constructs and relationships that are highlighted only by certain groups or constructs and relationships that only a few people within some maps point to. Structure comparison involves using established measures for (1) maps, such as comprehensiveness, density, cluster index, average chain length and feedback analysis; (2) constructs, such as centrality measures; and (3) relationships, such as reachability measures.
4.2. **Organize the key findings** from the causal maps and analyses (Tables 4–6).

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Table 1. (Continued)

Theoretical elaborations
5.1. **Revisit the comparative findings** presented in the earlier templates to deepen your understanding of the empirical findings. The goal is to refresh your memory about the most notable empirical findings. If possible, use additional datasets (e.g. re-approach the informants to triangulate, challenge and enrich research interpretations).
5.2. **Consult existing theories and evolving business and social trends** to make greater sense of the empirical findings. Extant theories can provide additional insights to enrich emerging theory. Concepts such as abduction and retroduction (and associated steps) are helpful in moving towards theoretical elaborations.
5.3. **Formulate theoretical elaborations** in the form of conceptual models, frameworks, perspectives or propositions. Develop explanations for the findings and identify relationships between the constructs, relationships and empirical results.
5.4. **Discuss emerging theories with research colleagues** not involved in the study to enhance their underlying ideas and presentations. This can lead to repeating any of the steps above (e.g. consulting new theory, looking further at the data).

a complete understanding of the phenomenon. Researchers could also capitalize on archival data to corroborate emerging findings. Analysing past communication patterns or decision-making processes provides insights into how technology frames have shifted or remained consistent. These processes involve discussing data collection requirements with site managers or stakeholders to identify relevant data sources.

Furthermore, triangulation strategies should be considered to access complementary data sources and cross-validate emerging themes. In studying technology-based generations, young developers preferred experimenting with new tools. This critical finding highlighted the need for leveraging archival data to better understand the history of experimentations and identify the initiators of those processes. By triangulating data sources, it was possible to revisit and confirm the validity of the emerging finding.

Finally, researchers develop a list of open-ended questions to understand the reasoning behind different groups' technology frames. Researchers consult existing theories and frameworks to structure the questions while remaining open to emergent ideas (Spieth *et al.*, 2021). It is crucial to prevent demand characteristics from affecting the study's results (Hall *et al.*, 2021; Young, Adelstein and Ellis, 2007). To achieve this, researchers should avoid signalling their associations or preferences towards a particular group, particularly in studying technology frames, where human experiences with IT can be controversial and a source of competitive advantage. In the study on generational differences, objectivity was maintained by refraining from implying any intention to explore generational characteristics and focusing on each developer's experiences with social networking technology. These strategies enhance the robustness of empirical findings while avoiding the limitations associated with demand characteristics.

Data collection

Once researchers obtain informed consent from their participants, they carefully plan how to approach different individuals and assign them to appropriate groups based on relevant technology frames. This may involve reconsidering criteria for group assignments (inclusion/exclusion criteria). In the research on generations, phone calls or quick in-person visits confirmed developers' early experiences with social networking applications. Researchers should also consider separating group members with similar IT-related experiences, based on important characteristics such as demographics, to ensure that the finalized groups represent distinct categories of people. This strategy enhances the validity and reliability of empirical findings. For example, in a study on the effects of a new digital app on the performance of recent graduates in the organization, researchers may initially create two groups of employees based on their employment history. However, further analysis may reveal that recent graduates vary significantly in their technology adoption history. It is helpful to separate recent graduates into two subgroups based on the influential characteristic. Similarly, in studying generations, two groups were initially created: Group 1 for precocious users (before age 11) and Group 2 for non-precocious users (after age 13). However, further analysis revealed that people in Group 2 differed significantly in age and experience. To ensure the findings' validity, Group 2 was divided into two subgroups based

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on age and experience: younger, less experienced people in Group 2a and older, more experienced people in Group 2b.

Once researchers have planned their study and gained agreement from participants, they collect the data using the planned methods. Collecting data for causal analysis is time consuming and has practical implications (Eden, Ackermann and Cropper, 1992). While some studies demand in-depth interviews, others might allow for creating a list of concepts where participants quickly choose and draw their causal maps. Researchers can enhance productivity by holding workshops and applying online tools to interact with participants and produce practical outcomes (Paroutis, Franco and Papadopoulos, 2015). Conducting focus groups with experts can gather relevant ideas on technology frames, which can then be presented to primary participants to explore relationships between constructs and determine causal relationships. To track changes in technology frames longitudinally, researchers could use interviews or surveys administered via mobile apps at regular intervals over time. Surveys, for instance, can be given to participants before and after using a new technology, and then at regular intervals to measure changes in their technology frames and overall satisfaction.

Constructing maps

Code data. To create causal maps, researchers use keywords to identify causal statements in collected data, such as 'caused by', 'leads to', 'influences' and 'results in'. The identified statements are then distilled into higher-level concepts and underlying constructs, using content analysis techniques (Laukkanen, 1994, 1998; Swan, 1997). In the study of generational differences, some causal statements revealed developers' concerns with user satisfaction and the ecosystem surrounding software. A coding table is then created to organize concepts, constructs and sample quotes, along with a table summarizing the relationships between the concepts (e.g. Tables 2 and 3). To ensure the quality and consistency of the coding process, researchers use data validation, reliability and language standardization techniques, as well as consulting with industry experts. The majority rule and discussions among coders are used to resolve coding discrepancies.

Build maps. After obtaining coding results, researchers create causal maps for each group by visualizing the concepts using circles and the relationships using arrows. Figure 1 provides an example to demonstrate diverse perspectives on effective software development. Different types of arrows can distinguish between different types of relationships. For example, bold lines represent relationships between concepts and the core phenomenon of interest, standard lines represent relationships between concepts and dashed lines represent relationships emphasized in other maps.[4] Microsoft packages like PowerPoint and Excel can be used to create small maps. If the number of concepts is significant, researchers use software such as Decision Explorer, Dialogue Mapping and CMAP2 (Ackermann and Alexander, 2016; Sperry and Jetter, 2019). It is essential to consult with key informants such as managers or user representatives to evaluate the maps' content and structures.

Empirical analysis

Once researchers create causal maps of technology frames for each group, they analyse the maps. First, the content analysis of a map involves paying attention to the concepts and relationships that shape a group's technology frames, as well as the underlying constructs. In the study on knowledge-sharing barriers, causal maps were constructed to understand how different stakeholder groups perceive barriers to effective knowledge sharing (Ghobadi and Mathiassen, 2015). Initial analysis suggested stakeholder groups' differences in emphasizing various barriers, but a deeper analysis revealed that each group also elaborated on different aspects of the same concepts, such as different aspects of team capabilities for effective knowledge sharing. During maps' content analysis, researchers should actively seek findings that challenge their understanding of the groups' technology frames, as this can provide a deeper insight into technology frames. For example, inconsistencies within groups, that is, differing

[4]The study focused on exploring generational differences in technology frames related to software development goals. As such, the causal maps are not as dense as those in studies focused on different research questions. It is important for researchers to adapt their approach to their specific objectives to ensure that the resulting maps accurately reflect the phenomena being studied.

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Table 2. Coding: Concepts and constructs

Concepts		Constructs	Sample quotes
Product expectations	**User satisfaction** refers to software that makes users feel that the software and the ecosystem around it meet their needs, requirements and expectations.	1. User satisfaction with software features and functionalities 2. User satisfaction with their perception of the software's usefulness 3. User satisfaction with the ecosystem around the software	'You can get all development aspects right, but if users aren't feeling the software is useful to them, the process is a waste. When users are convinced, they can make the whole business successful. This means fewer complaints, increased conversations, less frustration and fewer sleepless nights for developers' (Group 2a).
	User impact refers to improvements that the software can make to users' lives, such as improving users' health, well-being and productivity; transforming established ways that users interact with existing applications; and creating new career paths for users.	1. User productivity 2. User well-being 3. User career path 4. Challenging established norms	'The final software should help alleviate the pain points of users in some way. If we can make something that people can use to help them with one of their tasks, we have created something great, maybe by coming up with new product ideas, adding new features to a product, creating new tools to make work more efficient or easier to test' (Group 1).
	Software popularity refers to developing products that are used by as many users as possible and establishing long-term popularity among a selected group of users.	1. Widespread use 2. Long-term use	'More users mean more revenue for developers – but perhaps more importantly, popularity of the software sends a powerful signal to the market that we have developed a great software' (Group 1).
	Software maintainability refers to software with well-structured, elegant code with features and functionalities that are flexible and adaptable to change.	1. Code quality 2. Scalable software 3. Business maintainability	'Building strong community around the software is vital for long-term survival. When days come that we can no longer maintain the software, a supportive community can organize itself and make new contributions possible' (Group 2b).
	Social impact refers to software that relates to social causes to help address societal needs, enhance social capital and contribute to social ecosystems that are dynamic and growing.	1. Societal needs 2. Dynamic ecosystems	'Software industry should be mindful of the impact that it can make by designing and nurturing powerful ecosystems. This is because those ecosystems can grow into a vibrant ecosystem that connects millions of developers and users, creates jobs and enhances social capital' (Group 2b).

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Table 2. (Continued)

Concepts		Constructs	Sample quotes
Process expectations	**Development productivity** refers to processes that continuously stretch to reduce release time, costs and waste.	1. Time reduction 2. Cost reduction 3. Wasted-effort reduction	'Waste reduction should be a core part of development process to make it possible to spend more time doing what provides value to users… Because when developers focus on building unnecessary features, they can miss important development opportunities. The development team should always look for 20% of the code that can make the overall performance of the program' (Group 2b).
	Team satisfaction refers to development conditions that feature enjoyable and rewarding interactions between team members as well as reflect a sense of development achievement across team members.	1. Team morale 2. Team learning	'Development works should be designed to regularly look at team interactions to take the pulse of the team's morale. That way, development culture can be tracked and improved alongside the rest of the work… Developing software is not a short-term activity. It happens over multiple releases and enhancements over time. Team members must take pride in building a product together over this long-term' (Group 2b).
	Development contributions refer to methodological advancements that developers offer to the software community. They can include code contributions, technical advice or even new models that other development teams can use.	1. Code contributions 2. Contributing new models for organizing development works	'It would be optimal to contribute to the knowledge in the software community, either by contributing some of our code to open-source projects, distributing any useful toolkit we invented during the process, or even sharing some technical advice with similar projects' (Group 1).
	Development dynamism refers to the continuous practice of experimentation with existing technology and innovation in developing new tools and techniques.	1. Continuous experimentation in development 2. Continuous innovation in the use of development technologies	'Software is a competitive and fast-paced market… A software developer's nemesis is getting behind industry trends. I strongly believe that each project should challenge us to learn new things and stay on top of the profession' (Group 2a).

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Table 3. Causal relationships

Sample quotes	Concepts	Link
'Users must be happy that the software does what they pay for [user satisfaction] because meeting the demands of the target audience is a big tick against development goals [effective software development]'.	1. User satisfaction 2. Effective software development	User satisfaction → Effective software development
'The final software should help alleviate the pain points of users in some way [user impact]. If we can make something that people can use to help them with one of their tasks, we have created something great [effective software development]'.	1. User impact 2. Effective software development	User impact → Effective software development
'Team members must take pride in building a product together over this long-term [team satisfaction]. That is the only way to build high-quality products that the team will be proud to stand behind [effective software development]'.	1. Team satisfaction 2. Effective software development	Team satisfaction → Effective software development
'By encouraging developers to experiment with and use the new competences [development dynamism], software organizations can release true open-source projects and even make code contributions to nonprofit software bodies [development contributions]'.	1. Development dynamism 2. Development contributions	Development dynamism → Development contributions

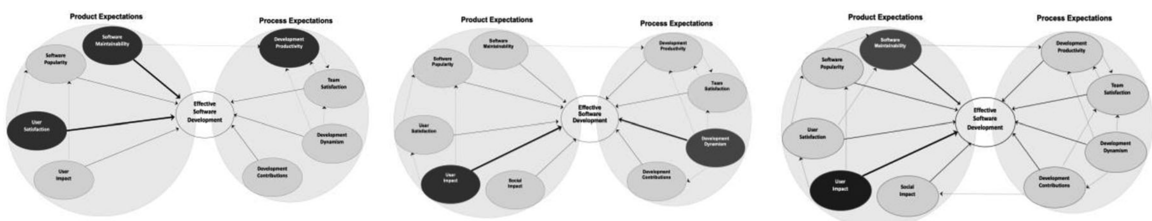

Figure 1. Causal maps

priorities among individuals, should be explored to better understand the sources of framing differences. In a study on user perceptions about ethical digital applications, a few users in the same group may prioritize the underlying cloud computing options, and additional interviews or focus groups can provide a deeper understanding of the factors influencing within-group differences.

Second, the structure analysis benefits from established approaches. In analysing each map, researchers typically begin by measuring its density to gauge the level of interconnectivity among concepts. Density is calculated by dividing the number of links (L) expressed in the data by the map's total number of concepts (N). A high density suggests a better understanding of the phenomena, while a low density indicates a less understood phenomenon. To understand the concepts that dominate the relationships in the map, researchers measure their centrality. In-degree centrality refers to the number of direct links going into a concept and indicates the degree to which other concepts influence the concept. Out-degree centrality refers to the number of links going out of a concept and indicates how the concept influences other concepts in the map. Researchers also measure the 'reachability' of each linkage in the map to understand the strength of relationships. Reachability is calculated by adding the number of direct and indirect linkages between two concepts and dividing it by the total number of expressed linkages in the map. For example, in a study on generational differences, the reachability between development dynamism and effective development was measured by summing up 19 direct statements and 6, 5 and 6 indirect statements, and dividing the result by the total number of expressed linkages (236). This gave a reachability score of 0.15. Figure 2 provides an example of analysed causal maps, where the numbers in the concept boxes indicate their centrality and the numbers on the arrows represent reachability measures.

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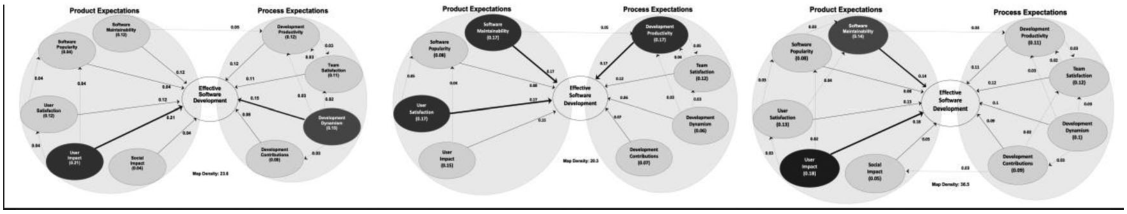

Figure 2. Analysed causal maps

Table 4. Articulation of expectations across groups' maps

Concepts and constructs			Group		
			1	2a	2b
Product expectations	User satisfaction	1. Satisfaction with software features and functionalities	X	X	X
		2. Satisfaction with their perception of the software's usefulness	X	X	X
		3. Satisfaction with the ecosystem around the software			X
	User impact	4. User productivity	X	X	X
		5. User well-being	X	X	X
		6. User career path			X
		7. Challenging established norms	**X**		
	Software popularity	8. Widespread use	X	X	X
		9. Long-term use		X	X
	Software maintainability	10. Code quality	X	X	X
		11. Scalable software	X	X	X
		12. Business maintainability			X
	Social impact	13. Societal needs	X		X
		14. Dynamic ecosystems	X		X
Process expectations	Development productivity	15. Time reduction	X	X	X
		16. Cost reduction	X	X	X
		17. Wasted-effort reduction			X
	Team satisfaction	18. Team morale	X	X	X
		19. Team learning	X	X	X
	Development contributions	20. Code contributions	X	X	X
		21. Contributing new models for organizing development works	X		
	Development dynamism	22. Continuous experimentation in development	X	X	X
		23. Continuous innovation in the use of development tools	**X**		

Crafting maps along with analysing the underlying data is crucial as the foundation for comparing and elaborating on diverse technology frames. Tables 4–6 serve as organizing templates to extract insights from the maps and analyses, illuminating key findings such as similarities, differences and unique perspectives among groups. Table 4 summarizes how concepts and underlying constructs are emphasized across groups, highlighting conceptual differences. In Figure 2, Group 2 developers did not highlight social impact as a concept, while Group 1 developers were the only group to express concerns about challenging established norms and process dynamism as development goals.

Table 5 has a similar nature to Table 4 but deals with organizing the findings related to the groups' elaborations on the relationships. Figure 2 illustrates an instance where Group 3, which comprises experienced developers, emphasized several relationships that were not given much weightage by other developers, indicating their richer understanding of development goals based on their experience.

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Table 5. Maps' relations

Linkages			Group 1	Group 2a	Group 2b
Product–product linkages					
1	**Product–product**	User satisfaction → Software popularity	X	X	X
2		**User satisfaction → Software maintainability**			**X**
3		User impact → User satisfaction	X		X
4		User impact → Software popularity	X	X	X
5		**Software popularity → Software maintainability**			**X**
Process–process linkages					
6	**Process–process**	Development productivity → Team satisfaction	X	X	X
7		Team satisfaction → Development productivity	X	X	X
8		Development dynamism → Development productivity	X	X	X
9		Development dynamism → Team satisfaction	X	X	X
10		Development dynamism → Development contributions	X		X
11		**Development contributions → Team satisfaction**			**X**
Process–product/product–process linkages					
12	**Product–process**	Software popularity → Development productivity	X	X	X
13		**Development contributions → Social impact**			**X**
Total			**9**	**7**	**13**

Table 6 organizes the core summary of the insights gained from the comparisons. Its goal is to shine a spotlight on unexpected findings for further theorizing. Researchers extract and note the density of each map, the most central concepts, linkages with the highest reachability, concepts or linkages highlighted only by specific groups and notable inconsistencies in the data related to each group, among others. This process helps to highlight key similarities and differences between the groups' technology frames, leading to a more nuanced understanding of framing issues.

Theoretical elaborations

Once comparative findings are organized and outlined, researchers elaborate on them. This stage involves challenging researchers' mental models of technology frames and developing novel explanations that expand existing theories. For example, the study on technology-driven generations revealed that precocious users of social networking technology were the only group to emphasize critical assessment of software usability and the development of intuitive solutions. This finding shaped the basis for the first proposition, suggesting that involving these users in such activities can advance the development of intuitive technologies. Hence, although the study initially focused on comparing how different groups perceive development goals, the comparative findings illuminated the potential to theorize how generational differences can be leveraged to advance technology development.

Similarly, to leverage the method for building process theories (Langley, 1999; Rowe, Ngwenyama and Richet, 2020), researchers could have conducted a longitudinal case study of a software development project, collecting data on the technology frames of different stakeholders at different stages of the project, and analysing how these frames evolve. The comparative insights can pinpoint meaningful changes in groups' perspectives that may have contributed to project success or failure. Researchers can then develop process theories explaining how changing stakeholders' technology frames affect project outcomes. In

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Table 6. Comparative findings

Group 1 map	Group 2 map	Group 3 map
Notable insights about: **Map** 1. Density 2. Feedback analysis **Constructs/concepts (based on centrality insights)** 1. Constructs/concepts only emphasized by this group. 2. Constructs/concepts emphasized by all groups except this group. 3. Constructs/concepts emphasized by a higher proportion of people within this group. 4. Constructs/concepts emphasized by a lower proportion of people within this group. 5. Notable inconsistencies with the group. **Relationships (based on reachability insights)** 1. Linkages only emphasized by this group. 2. Linkages emphasized by all groups except this group. 3. Linkages emphasized by a higher proportion of people within this group. 4. Linkages emphasized by a lower proportion of people within this group. 5. Notable inconsistencies with the group.	*Notable insights about:* **Map** 1. Density 2. Feedback analysis **Constructs/concepts (based on centrality insights)** 1. Constructs/concepts only emphasized by this group. 2. Constructs/concepts emphasized by all groups except this group. 3. Constructs/concepts emphasized by a higher proportion of people within this group. 4. Constructs/concepts emphasized by a lower proportion of people within this group. 5. Notable inconsistencies with the group. **Relationships (based on reachability insights)** 1. Linkages only emphasized by this group. 2. Linkages emphasized by all groups except this group. 3. Linkages emphasized by a higher proportion of people within this group. 4. Linkages emphasized by a lower proportion of people within this group. 5. Notable inconsistencies with the group.	*Notable insights about:* **Map** 1. Density 2. Feedback analysis **Constructs/concepts (based on centrality insights)** 1. Constructs/concepts only emphasized by this group. 2. Constructs/concepts emphasized by all groups except this group. 3. Constructs/concepts emphasized by a higher proportion of people within this group. 4. Constructs/concepts emphasized by a lower proportion of people within this group. 5. Notable inconsistencies with the group. **Relationships (based on reachability insights)** 1. Linkages only emphasized by this group. 2. Linkages emphasized by all groups except this group. 3. Linkages emphasized by a higher proportion of people within this group. 4. Linkages emphasized by a lower proportion of people within this group. 5. Notable inconsistencies with the group.

another example, researchers may have used the method to compare groups' technology frames across a sample of organizations implementing similar technologies. If the comparison has yielded insights into framing patterns associated with different organizations, researchers could consider developing configurational theories that explain how different combinations of technology frames affect adoption patterns and organizational performance (Fiss, Marx and Cambré, 2013; Meyer, Tsui and Hinings, 1993). Another possibility is combining the method with other data collection techniques to shape multi-method studies and gain a more comprehensive understanding of diverse technology frames (Venkatesh, Brown and Sullivan, 2016). For example, researchers might use the method as a starting point to analyse data from social media platforms where users discuss their experiences with different technologies. They can build on the comparative insights into diverse frames through additional interviews or surveys to examine the factors that shape them. Table 7 provides a sample of theorizing possibilities.

Additionally, researchers can incorporate complementary data from secondary archives or conduct additional interviews with key informants to re-examine their interpretation logic. This step helps to enhance further the credibility of the emerging theoretical account. For example, to strengthen the proposition that developers who were precocious users of newer forms of social networking applications were more likely to experiment with development technologies, it was helpful to return to the company, examine available developers' meeting notes and conduct additional interviews with development managers. These efforts helped gather more evidence about the roles

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played by precocious users in experimentation processes, which further strengthened the proposition.

Consultation of existing theories and evolving trends in business and society allows researchers to critically examine and validate the credibility of the emerging theoretical account (Sarker *et al.*, 2018; Walsham, 2005). By reflecting on these sources, researchers can go beyond the available evidence and develop propositions that extend beyond empirical data.

In studying the generations, social impact theory provided a framework for understanding why Group 1 and Group 3 developers expressed concerns about broader societal goals. This theoretical lens was instrumental in developing the proposition that these developers should be encouraged to collaborate to advance the trend of creating socially impactful software. By leveraging existing theory, the study could move beyond a simple description of the groups' perspectives and generate actionable recommendations for the industry (Ghobadi and Mathiassen, 2020).

It is crucial for researchers to carefully engage with empirical findings and consider insights from additional sources, as their ontological stance influences the methods employed (Archer, 1995). This consideration can impact the overall approach to elaborating on technology frames. For instance, researchers may aim to move from available evidence to potential underlying causes of diverse technology frames. The method supports practices such as identifying inconsistencies and contradictions (e.g. refer to Table 6 and related text). Researchers should further challenge their theoretical elaborations by incorporating relevant concepts like abduction and retroduction. Researchers can draw upon anomalies in empirical and social trends to generate hunches that explain these anomalies (Sætre and Van de Ven, 2021). Additionally, they can utilize the steps proposed by Iannacci *et al.* (2022) to craft plausible explanations based on the evidence obtained from Table 6, eliminate competing hypotheses, identify the most likely mechanism and refine their theoretical understanding.

Finally, researchers discuss emerging theories with academic colleagues to enhance theoretical insights for better arguments and proposition development. For example, the theoretical perspective about evolving generations was discussed with colleagues not involved in the study, and that led to significant benefits, such as highlighting the

Table 7. Research avenues for applying the method

Paradigm	Proposition	Possible questions
Process research	Apply the method to investigate the evolution of diverse technology frames in different social contexts and their impact on technology development, adoption and use over time.	1. How do technology frames of employees evolve during the implementation of a social intranet system, and how do these changes influence their sense of belonging to the company? 2. How do emerging technologies, such as AI chatbots, influence the technology frames of different user groups in online platforms and how do these changes impact user satisfaction over time? 3. What role do changes in the technology frames of stakeholders play in the success or failure of IT development projects?
Configurational research	Apply the method to identify patterns of different combinations of technological frames associated with outcomes, such as consumer satisfaction, talent acquisition and organizational agility.	1. What are the unique configurations of employees' technology frames about video conferencing tools associated with effective collaboration in different organizations? 2. How do these configurations vary across industries, regions and cultural contexts?
Mixed-method research	Leverage comparative analysis of diverse technology frames to explore and understand technology adoption and use and leverage the insights gained to inform further investigations into technology frames and their consequences.	1. How can a comparative study of designers' beliefs about the effectiveness of AI in a specific industry inform the investigation of the impact of AI-related change on organizational performance across multiple industries? 2. In what ways can comparative insights from a study of software developers' technology frames inform action research recommendations for resolving team conflicts?

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need to return to the data, collect new data and explore new theories and social trends.

Discussion

Research implications

Scholars have extensively researched the collaborative applications of IT, such as online platforms, virtual reality and distributed workspaces (Colbert, Yee and George, 2016; Nardon and Aten, 2012; Rothbard *et al.*, 2022; Wilkinson *et al.*, 2021). A growing literature on 'technology frames' has highlighted the diverse patterns of interactions that different groups may have with IT based on their values, interests, experiences and expertise (Giorgi, 2017; Leonardi, 2011; Orlikowski and Gash, 1994; Spieth *et al.*, 2021; Steffen *et al.*, 2019). Although such diversity can severely affect societies and organizations (Berger and Luckmann, 2016; Giorgi, 2017; Kyriakidou and Olivas Osuna, 2017; Murungi and Hirschheim, 2022), the literature has been criticized for lacking a focus on systematically comparing and elaborating on technology frames (Spieth *et al.*, 2021).

This study contributes to the literature on technology frames by addressing the challenges of studying diverse framings and proposing a comprehensive methodological approach for comparing and elaborating on technology frames. The method builds on cognitive mapping (Laukkanen, 1994; Laukkanen and Päivi, 2013) and draws on empirical lessons from studying technology frames (Ghobadi and Mathiassen, 2015, 2020). The method's core strength is guiding studies through the comprehensive spectrum of research planning and data collection to map construction, analyses and theoretical elaborations. It includes examples and templates for eliciting, analysing and organizing comparative insights, offering a better understanding of why and how different groups hold diverse technology frames and their implications.

Furthermore, the method offers opportunities to grasp the underlying mechanisms behind diverse technology frames. The notion of 'mechanism' can be complex to define, as it is crucial to consider the ontological stance from which these interpretations are made (Gerring, 2008; Mingers and Standing, 2017). Nevertheless, researchers can gain insights into groups' belief systems and how these systems shape their technology frames by exploring causal relationships. This understanding paves the way for theoretical elaborations, including developing conceptual models and propositions, which explain how diverse framings can be leveraged to foster positive outcomes for organizations and society.

Practical implications

The method benefits practitioners in managing technology-related initiatives, such as implementing a new system, promoting existing technology or encouraging consumer engagement through social media. Managers can benefit from collaborating with technology and management studies experts to ensure that the method is well-positioned to address the requirements of research planning, data collection, map construction and analyses. The engaged scholarship approach fosters the co-production of insights by researchers and managers that can advance theory and practice simultaneously (Pascal, Thomas and Romme, 2013; Van de Ven, 2007). This approach is particularly relevant in the evolving context of technology frames, as it allows for the interaction and reflection of both groups to provide valuable perspectives and contributions (Wells and Nieuwenhuis, 2017).

During the research planning stage (Stage 1), managers collaborate with researchers to identify practical research questions that can help them better understand differences and work towards addressing existing challenges or unlocking unexplored opportunities. They also work together to identify relevant groups or stakeholders and discuss access to the research site. The engaged scholarship approach carries risks, such as potential conflicts of interest between the parties and power dynamics. Therefore, managers' commitment and trust in the process are crucial. Data collection (Stage 2) and map construction (Stage 3) can effectively use different techniques and sources. Clear protocols about how data will be used, and participants' rights, must be communicated. Open communication for feedback and critique is crucial in mitigating potential risks, such as breaches of confidentiality.

While most of the measurements and initial analyses (Stage 4) could be left to the researchers given their required expertise, managers should play an active role in overseeing the organizing templates to pinpoint comparative findings. Managers could give researchers autonomy to formulate final implications informed by existing

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knowledge and relevant academic insights (Stage 5). However, they must maintain active participation in brainstorming, meetings and potentially further access to the site to help researchers in the process of final elaborations. Ultimately, managers can use these insights to enhance their processes and promote awareness across the organization about framing differences, which is becoming increasingly important in today's environment, where there is a growing emphasis on inclusivity and diversity. For instance, they can create workshops to share with designers how different users perceived the new changes to the online platform and how those differences influenced users' wellbeing. Such training can be helpful in situations where people may be unaware of each other's technology frames (Leonardi, 2011), helping build empathy and understanding of different needs and disagreements.

Concluding points and future research directions

With the increasing integration of artificial intelligence and machine learning technologies, understanding the role of technology frames in shaping our perceptions and expectations of technology is more important than ever. It is crucial to better comprehend how these frames are constructed across various groups and how they can be effectively managed. The method presented in this study provides a valuable starting point for exploring technology frames and their underlying network of causal relationships in management and technology studies.

Future studies can further enhance and expand the method. First, the method highlights the possibility of exploring the changing nature of technology frames. One area for improvement is to use the method to conduct longitudinal studies that track technology frames' changing dynamics over time. By doing so, researchers can learn about additional methodological ideas that benefit process research studies.

Second, the method can be enhanced by providing more data collection and analysis planning considerations. This is critical for studying multiple groups or large datasets. Strategies such as the effective use of analytical software can be suggested to enhance researchers' productivity in constructing and analysing maps.

Third, future research can use the method in large projects that employ multiple interdependent causality studies to generate an empirically varied theory (Illari and Russo, 2014). By generating empirically varied theories, researchers bring us closer to testing and refinement through replication logic (Burton-Jones, McLean and Monod, 2015). During the process, researchers also learn and can contribute additional methodological guidance for future studies' benefits.

Finally, the proposed method aims to shed light on the technology frames held by different groups and assist researchers in interpreting the underlying mechanisms behind diverse framings. Additionally, the rapid evolution of AI chatbots is shaping cognitive powers that can impact human cognition (Loconte *et al.*, 2023). Exploring the technology frames associated with these emerging phenomena presents an exciting opportunity for future research to apply and expand upon the method. While the method has traditionally focused on stakeholder groups like users, developers and designers, it also points to emerging issues in these domains (see Table 7). Scholars can leverage the method's planning and data collection recommendations to explore how the behaviours exhibited by technologies such as ChatGPT influence human cognition.

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Appendix

Socio-cognitive studies comparing technology frames

Study	Groups	Technology frames	Outcomes
Barrett (1999)	While implementing an electronic trading system, the study explored the incongruence between **IT innovators'** frames and the frames of **insurance brokers**.	Groups' descriptions of the **nature of technology**, **technology strategy** and **technology-in-use**. These concepts are based on Orlikowski and Gash (1994).	Incongruences contributed to high levels of resistance to and non-use of the system.
Orlikowski and Gash (1994)	During the introduction of groupware technology in a consulting firm, the technology frames of **technologists** (those who introduced the new system) differed from those of **intended users**.	Groups' descriptions of the **nature of technology**, **technology strategy** and **technology-in-use**. These concepts are based on a **grounded analysis of empirical cases**.	Incongruences contributed to problematic organizational outcomes, such as insufficient training and support provided to users and users' limited adoption and use of the technology.
IT use (adoption)			
C. Wang, Medaglia and Jensen (2021)	During the collaborative use of technology (WeChat) for knowledge sharing, the study explored the technology frames of **three stakeholder groups** (**government**, **industry** and **university stakeholders**).	The groups had a congruent understanding of the **nature of technology** in enabling knowledge sharing (grouping, instant messaging, file transfer and preview, notification alert and mention). However, their motivation or **technology strategy** changed as the collaboration developed. All began by highlighting connectivity aspirations, but industry and university stakeholders shifted their strategy to effective task management. Finally, the groups differed in their **technology-in-use** patterns. In daily operations, government stakeholders mostly used WeChat for participatory task assignments. Other groups also used it for task division, task development, triggered attending and information protection.	Patterns of congruence and incongruence in the stakeholders' framings of technology for knowledge sharing lead to emergent adaptive governance practices characterized by selective participation, role and capability identification and ad-hoc decision making.
Mazmanian (2013)	During mobile technology appropriation in two organizational groups, the study explored how **two user groups** (with positive and negative past experiences) differed in their technology frames about using the system.	Groups' descriptions of how they perceive the new system as useful in their occupation (**occupational identity**), capable of being integrated into daily life (**materiality**), visible to explore other use cases (**visibility**) and capable of giving them a sense of agency in determining their use patterns (**vulnerability**). These concepts are based on a **grounded analysis of empirical cases**.	A technology with the capacity to increase connectivity was enacted differently in two occupational communities in the same organization.

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Study	Groups	Technology frames	Outcomes
IT development			
Chakraborty and Sarker (2010)	During requirement elicitation for a new system, the study explored the technology frames of **analysts** and **user representatives** and how their frames change over time to achieve a shared understanding.	The groups had a different understanding of the **nature of technology** (the requirements and features of the system) during the project's scoping. As knowledge transfer and the sensemaking process unfolds, groups develop a shared mental model regarding the system requirements.	The stakeholders apply the reasoning process to the sensory input received through knowledge transfer and social interaction and develop mutually shared technology frames (system requirements). This shared understanding contains elements that are initially unknown or not understood by the stakeholders; it is evolved through a process of making initial interpretive assumptions about the requirements that are modified and reformulated as further sensory input are received and processed.
Leonardi (2011)	During new technology development in an engineering firm, groups of **engineers** working at **different departments** (affiliation with different social groups) differed in their vision of what functionality the built technology should have, shaping frames around cultural resources that guided.	Groups' descriptions of (1) **the goals group members have for a technology concept**; (2) **the key problems they believe must be solved to achieve the goal**; (3) **the strategies they use to solve those problems**; (4) **the requirements that must be met for a solution to work**. These concepts are based on Bijker (1995).	Different groups had different framings and were blind to why others disagreed. They could not recognize that the true nature of their disagreement was about the problems departments wanted to solve. However, by reintroducing ambiguity into their process that had become relatively concrete and reorganizing boundaries in ways that provided a structural context in which ambiguity could succeed, they were eventually able to produce a working technology.
Yeow and Sia (2008)	During choosing best practices in packaged e-procurement software, the study explored how diverse groups in a public organization differ in their technology frames regarding what constitutes 'best practices' in package software. The groups are the **Operations Department**, **Project Working Committee** and **Users**.	Groups' descriptions of their **motivations for introducing the technology**; **the goals of this technology**; and **the success criteria used for evaluating the technology**. These concepts are based on a **grounded analysis of empirical cases**.	The findings elaborate on how the frame incongruences concerning 'best practices' are resolved and eventually inscribed into the IT artefact. The study finds that it is an intricate process that demands that management make a concerted effort to create and actively work to coax and sustain allies and champion and advocate for the rhetorical justification behind these 'best practices'. Instead of benchmarking the incongruence between different frames, they suggest that the analysis of incongruence must move closer to both the artefact and the organizational practices.
Davidson (2002)	During the requirement determination process of a new system, the study explored how **developers** and **marketing representatives** had different assumptions, expectations and knowledge about system requirements.	Groups' descriptions of the framings related to **IT delivery strategies**, **IT capabilities and design**, **the business value of IT** and **IT-enabled work practices**. These concepts are based on a **grounded analysis of empirical cases**.	Shifting frames (e.g. a group of IT innovators shifted from a focus on IT-enabled business transformation to a focus on projects with limited scope) created goal inconsistencies, disrupted project participants' understanding of requirements, confused people and contributed to a turbulent development process.

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Study	Groups	Technology frames	Outcomes
IT implementation			
Lundberg, Nylén and Sandberg (2021)	During the implementation of the new digitized system, three groups of **developers** (at headquarters), **internal users** (at the regional office and manufacturing plant) and **external users** (subcontractors) differed in their technology frames about the system at the focal firm's headquarter and regional office levels.	Groups' descriptions of the **nature of technology** (understanding of technology, including its potential, functionality and capabilities); **technology strategy** (perceptions of the motivation and vision behind the new technology, and why it should be implemented); and **technology-in-use** (everyday use of technology and consequences of its use). These concepts are based on Orlikowski and Gash (1994).	This study challenges the idea of success in digital projects by pointing to the consequences of unresolved cognitive differences. They find that misaligned expectations did not allow the company to leverage the strategic benefits of digitization. Specifically, external (on-site) users did not harness digitized capabilities to generate new digitally mediated routines. Hence, the company could not leverage the system to establish new information exchange routines and realize broader collaborative inter-organizational digitalization.
Hsu, Huang and Galliers (2014)	While implementing a bank office messaging system connecting financial transaction activities, groups of **rhetors**, **IT vendors**, **fund houses** and **competing banks** differed in their technology frames about the new system.	Groups' descriptions of the **diagnostic** and **prognostic frames** about the new system. These concepts are based on Benford and Snow (2000), arguing that 'diagnostic frames' identify a problem that a technology should solve, while 'prognostic frames' involve the articulation of a proposed solution to that problem.	The study finds a lack of congruence between rhetors and stakeholders' understanding of the justification of the system for solving the problem they faced. Such incongruence creates a phase of resistance by stakeholders. However, the study reports how the leaders changed their tactics to address the lack of congruence, for example, encouraging a major bank to adopt the system, and balancing the use of a strategy of differentiation and integration. This alignment between the rhetors and their audience resulted in a sharp increase in system diffusion.
Olesen (2014)	During the long-term use of technologies and implementation of new technologies within a research institution, groups of **senior management**, **teaching staff**, **information IT mediating staff** and **IT groups** differed in their technology frames about the technology being used.	Groups' descriptions of the **nature of technology**, **technology strategy** and **technology-in-use**. Most of the differences existed between senior management and other groups within the organization, with senior management holding a dominant frame. These concepts are based on Orlikowski and Gash (1994).	The unchanging dominant technology frame meant that senior management largely ignored the problems with IT, contributing to the lack of accountability of the IT group, where little effort was made to leverage IT to enhance organizational efficiency and effectiveness.
Hsu (2009)	While implementing an IT security certification in a financial institution, the study explored how **managers** and **employees** differed regarding the certification's technology frames.	Groups' descriptions of the **nature of technology**, **technology strategy** and **technology-in-use**. These concepts are based on Orlikowski and Gash (1994).	Incongruence enhances the likelihood that security concepts may not be fully embedded in the organization's work practices and routines.

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Study	Groups	Technology frames	Outcomes
Azad and Faraj (2008)	During the implementation of an e-government system over 10 years, the study explored how stakeholder groups of the **Project Unit and donors** and **middle managers, employees and advisors** differed in their technologies frames. As the two groups exhibited competing frames, several aspects were wholly opposed.	Groups' descriptions of their **beliefs**, **interests**, **system evaluation routines** and **artefact characteristics**. These concepts are based on Garud and Rappa (1994) about competing technology frames.	Differences in technology frames among stakeholder groups were significant and almost stalemated the project. However, the project had to make major adaptations and adjustments to the initial frames that moved the project towards a truce frame. They outline a process of frame differentiation during initial negotiation, frame adaptation as frames become more aligned and frame stabilization that leads to a 'truce frame' which can facilitate IS implementation.
Lin and Silva (2005)	During the implementation of a new technology in a bank, three groups of the **technical team**, **management** and **user group** differed in their technologies frames of the new system.	Groups' descriptions of their **understanding** of the technology implementation project, the **problem**, the **solution to the problem** and the **requirements**. These concepts are based on Bijker (1995) .	Members of the IT group translated other stakeholders' expectations, including those of senior management, to ensure a smooth implementation process. Researchers highlight that system implementation may have failed without the interventions to understand differences and reframe understandings and expectations associated with the new email system.
McGovern and Hicks (2004)	During the implementation of a new technology in a small make-to-order company, the **Research Team** and the **Managing Director** groups differed in their technology frames about the initiative and the technology.	Groups' descriptions of the **type of partnership** (the interpretation and attitudes of the two parties to the management of the programme), **nature of technology** (people's understanding of the capabilities and functionality of the technology), **technology structure** (the reasons why the technology was acquired and implemented, including its potential value to the firm) and **technology in use** (how the technology was to be used and any associated consequences of this use). The latter three concepts are based on Orlikowski and Gash (1994).	The study confirms that where incongruent 'technology frames' exist, 'configurational intrapreneurs' will experience considerable difficulties in developing and implementing an IT system. In these circumstances, the type of system implemented will likely be determined by the dominant 'frame'. In the case of management, this includes decision-making authority, how processes should be organized, what the division of labour should be and how much autonomy employees should have.
Gallivan (2001)	During the implementation of a new technology and reskilling of IT staff for significant organizational change, the study demonstrated that **change managers**, **IT staff** (the target of the changes) and **miscellaneous others** (working with IT but not the target of the changes) attached different meanings to the change initiative, its objectives and the organizational changes needed.	Groups' descriptions of the **nature of technology**, **technology strategy**, **technology-in-use** and **orders of change magnitude** about different levels of change perceived by group members (first-order, second-order, third-order changes). These concepts are based on Bartunek and Moch (1987) and Orlikowski and Gash (1994).	Incongruences affected communication processes. Managers could not communicate their intentions about the extent of the anticipated transformation to other stakeholders. Hence, they could not shape the expectations of the employees targeted for reskilling about the goals of the initiative and the sacrifices required of them.

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References

Ackermann, F. and J. Alexander (2016). 'Researching complex projects: using causal mapping to take a systems perspective', *International Journal of Project Management*, **34**, pp. 891–901.

Ananth, C., D. L. Nazareth and K. Ramamurthy (2011). 'Cognitive conflict and consensus generation in virtual teams during knowledge capture: comparative effectiveness of techniques', *Journal of Management Information Systems*, **28**, pp. 311–350.

Anthony, C. (2018). 'To question or accept? How status differences influence responses to new epistemic technologies in knowledge work', *Academy of Management Review*, **43**, pp. 661–679.

Archer, M. S. (1995). *Realist Social Theory: The Morphogenetic Approach*. Cambridge: Cambridge University Press.

Armstrong, D. J. (2005). 'Causal mapping: a discussion and demonstration'. In V. K. Narayanan and D. J. Armstrong (eds), *Causal Mapping for Research in Information Technology*, pp. 20–45. Hershey, PA: Idea Group Publishing.

Armstrong, D. J., J. E. Nelms, C. K. Riemenschneider and M. F. Reid (2012). 'Revisiting the barriers facing women in information systems', *Journal of Computer Information Systems*, **53**, pp. 65–74.

Axelrod, R. (1976). *The Structure of Decisions: The Cognitive Map of Political Elites*. Princeton, NJ: Princeton University Press.

Azad, B. and S. Faraj (2008). 'Making e-government systems workable: exploring the evolution of frames', *The Journal of Strategic Information Systems*, **17**, pp. 75–98.

Azad, B. and S. Faraj (2011). 'Social power and information technology implementation: a contentious framing lens', *Information Systems Journal*, **21**, pp. 33–61.

Balta, M., K. Spanaki, T. Papadopoulos and M. N. Ravishankar (2022). 'Understanding the use of digital technologies in entrepreneurial start-up settings and growth-oriented firms', *International Journal of Information Management*, https://doi.org/10.1016/j.ijinfomgt.2022.102616.

Barrett, M. I. (1999). 'Challenges of EDI adoption for electronic trading in the London Insurance Market', *European Journal of Information Systems*, **8**, pp. 1–15.

Bartunek, J. M. and M. K. Moch (1987). 'First-order, second-order, and third-order change and organization development interventions: a cognitive approach', *The Journal of Applied Behavioral Science*, **23**, pp. 483–500.

Bellini, C. G. P., R. de Cássia de Faria Pereira and J. L. Becker (2016). 'Organizational structure and enterprise systems implementation: theoretical measures and a benchmark for customer teams', *Information Technology & People*, **29**, pp. 527–555.

Benford, R. D. and D. A. Snow (2000). 'Framing processes and social movements: an overview and assessment', *Annual Review of Sociology*, **26**, pp. 611–639.

Berger, P. and T. Luckmann (2016). 'The social construction of reality'. In W. Longhofer and D. Winchester (eds), *Social Theory Re-Wired*, 2nd edn, pp. 110–122. New York: Routledge.

Bijker, W. E. (1995). *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press.

Bougon, M. G. (1983). 'Uncovering cognitive maps: the Self-Q technique'. In G. Morgan (ed.), *Beyond Method: Strategies for Social Research*, pp. 173–188. Beverly Hills, CA: Sage Publications.

Bougon, M. G., K. Weick and D. Binkhorst (1977). 'Cognition in organizations: an analysis of the Utrecht Jazz Orchestra', *Administrative Science Quarterly*, **22**, pp. 606–639.

Burton-Jones, A., E. R. McLean and E. Monod (2015). 'Theoretical perspectives in IS research: from variance and process to conceptual latitude and conceptual fit', *European Journal of Information Systems*, **24**, pp. 664–679.

Califf, C. B., S. Sarker and S. Sarker (2020). 'The bright and dark sides of technostress: a mixed-methods study involving healthcare IT', *MIS Quarterly*, **44**, pp. 809–856.

Carley, K. and M. Palmquist (1992). 'Extracting, representing, and analyzing mental models', *Social Forces*, **70**, pp. 601–636.

Carrington, D. J., I. A. Combe and M. D. Mumford (2019). 'Cognitive shifts within leader and follower teams: where consensus develops in mental models during an organizational crisis', *The Leadership Quarterly*, **30**, pp. 335–350.

Chakraborty, S. and S. Sarker (2010). 'An exploration into the process of requirements elicitation: a grounded approach', *Journal of the Association for Information Systems*, **11**, pp. 212–249.

Chen, Y., J. I. Richter and P. C. Patel (2021). 'Decentralized governance of digital platforms', *Journal of Management*, **47**, pp. 1305–1337.

Clarke, I. and W. Mackaness (2001). 'Management "intuition": an interpretative account of structure and content of decision schemas using cognitive maps', *Journal of Management Studies*, **38**, pp. 147–172.

Colbert, A., N. Yee and G. George (2016). 'The digital workforce and the workplace of the future', *Academy of Management Journal*, **59**, pp. 731–739.

Cornelissen, J. P. and M. D. Werner (2014). 'Putting framing in perspective: a review of framing and frame analysis across the management and organizational literature', *Academy of Management Annals*, **8**, pp. 181–235.

D'Arcy, J., A. Gupta, M. Tarafdar and O. Turel (2014). 'Reflecting on the "dark side" of information technology use', *Communications of the Association for Information Systems*, **35**, pp. 109–118.

Davidson, E. J. (2002). 'Technology frames and framing: a socio-cognitive investigation of requirements determination', *MIS Quarterly*, **26**, pp. 329–358.

Davidson, E. J. (2006). 'A technological frames perspective on information technology and organizational change', *Journal of Applied Behavioral Science*, **42**, pp. 23–39.

Davidson, E. J. and D. Pai (2004). 'Making sense of technological frames: promise, progress, and potential'. In B. Kaplan, D. P. Truex, D. Wastell, A. T. Wood-Harper and J. I. DeGross (eds), *Information Systems Research*, pp. 473–491. Boston, MA: Springer.

Deng, X. and L. Chi (2013). 'Understanding postadoptive behaviors in information systems use: a longitudinal analysis of system use problems in the business intelligence context', *Journal of Management Information Systems*, **29**, pp. 291–326.

Duxbury, L., C. Higgins, R. Smart and M. Stevenson (2014). 'Mobile technology and boundary permeability', *British Journal of Management*, **25**, pp. 570–588.

Eden, C. and F. Ackermann (2004). 'Cognitive mapping expert views for policy analysis in the public sector', *European Journal of Operational Research*, **152**, pp. 615–630.

Eden, C., F. Ackermann and S. Cropper (1992). 'The analysis of cause maps', *Journal of Management Studies*, **29**, pp. 309–324.

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Elbanna, A. and H. C. J. Linderoth (2015). 'The formation of technology mental models: the case of voluntary use of technology in organizational setting', *Information Systems Frontiers*, **17**, pp. 95–108.

Fang, T. P., A. Wu and D. R. Clough (2021). 'Platform diffusion at temporary gatherings: social coordination and ecosystem emergence', *Strategic Management Journal*, **42**, pp. 233–272.

Fiss, P. C., A. Marx and B. Cambré (2013). 'Configurational theory and methods in organizational research: introduction'. In P. C. Fiss, B. Cambré and A. Marx (eds), *Configurational Theory and Methods in Organizational Research*, pp. 1–22. Bingley: Emerald Group Publishing Limited.

Gallivan, M. J. (2001). 'Meaning to change: how diverse stakeholders interpret organizational communication about change initiatives', *IEEE Transactions on Professional Communication*, **44**, pp. 243–266.

Garud, R. and M. A. Rappa (1994). 'A socio-cognitive model of technology evolution: the case of cochlear implants', *Organization Science*, **5**, pp. 344–362.

Gary, M. S. and R. E. Wood (2011). 'Mental models, decision rules, and performance heterogeneity', *Strategic Management Journal*, **32**, pp. 569–594.

Gerring, J. (2008). 'The mechanismic worldview: thinking inside the box', *British Journal of Political Science*, **38**, pp. 161–179.

Ghobadi, S. and Z. Ghobadi (2015). 'How access gaps interact and shape digital divide: a cognitive investigation', *Behaviour and Information Technology*, **34**, pp. 330–340.

Ghobadi, S. and L. Mathiassen (2015). 'Perceived barriers to effective knowledge sharing in agile software teams', *Information Systems Journal*, **26**, pp. 95–125.

Ghobadi, S. and L. Mathiassen (2020). 'A generational perspective on the software workforce: precocious users of social networking in software development', *Journal of Management Information Systems*, **37**, pp. 96–128.

Giorgi, S. (2017). 'The mind and heart of resonance: the role of cognition and emotions in frame effectiveness', *Journal of Management Studies*, **54**, pp. 711–738.

Greenfield, A. (2010). *Everyware: The Dawning Age of Ubiquitous Computing*. Indianapolis, IN: New Riders.

Hall, J. A., C. Xing, E. M. Ross and R. M. Johnson (2021). 'Experimentally manipulating social media abstinence: results of a four-week diary study', *Media Psychology*, **24**, pp. 259–275.

He, Q., M. Meadows, D. Angwin, E. Gomes and J. Child (2020). 'Strategic alliance research in the era of digital transformation: perspectives on future research', *British Journal of Management*, **31**, pp. 589–617.

Heinz, M. and R. E. Rice (2009). 'An integrated model of knowledge sharing in contemporary communication environments', *Annals of the International Communication Association*, **33**, pp. 135–175.

Hodgkinson, G. P., A. J. Maule and N. J. Bown (2004). 'Causal cognitive mapping in the organizational strategy field: a comparison of alternative elicitation procedures', *Organizational Research Methods*, **7**, pp. 3–26.

Hsu, C., J. Huang and R. D. Galliers (2014). 'Conceptualizing the dynamics of rhetorical practice and technological frame in the context of technology diffusion and adoption', *Information & Management*, **51**, pp. 984–994.

Hsu, C. W. (2009). 'Frame misalignment: interpreting the implementation of information systems security certification in an organization', *European Journal of Information Systems*, **18**, pp. 140–150.

Iannacci, F., C. Fearon, P. Kawalek and B. Simeonova (2022). 'Aligning the Qualitative Comparative Analysis (QCA) counterfactual approach with the practice of retroduction', *Information Systems Journal*, **33**, pp. 467–485.

Illari, P. and F. Russo (2014). *Causality: Philosophical Theory Meets Scientific Practice*. Oxford: Oxford University Press.

Jenkins, M. and G. Johnson (1997). 'Entrepreneurial intentions and outcomes: a comparative causal mapping study', *Journal of Management Studies*, **34**, pp. 895–920.

Kiss, A. N. and P. S. Barr (2017). 'New product development strategy implementation duration and new venture performance: a contingency-based perspective', *Journal of Management*, **43**, pp. 1185–1210.

Konlechner, S. and V. Ambrosini (2019). 'Issues and trends in causal ambiguity research: a review and assessment', *Journal of Management*, **45**, pp. 2352–2386.

Kun-Chang, L. and K. Soon-Jae (2006). 'The use of cognitive maps and case-based reasoning for B2B negotiation', *Journal of Management Information Systems*, **22**, pp. 337–376.

Kuniavsky, M. (2010). *Smart Things: Ubiquitous Computing User Experience Design*. Amsterdam: Elsevier.

Kyriakidou, M. and J. J. O. Osuna (2017). 'The indignados protests in the Spanish and Greek press: moving beyond the "protest paradigm"?', *European Journal of Communication*, **32**, pp. 457–472.

Langfield-Smith, K. and A. Wirth (1992). 'Measuring differences between cognitive maps', *Journal of the Operational Research Society*, **43**, pp. 1135–1150.

Langley, A. (1999). 'Strategies for theorizing from process data', *Academy of Management Review*, **24**, pp. 691–710.

Laukkanen, M. (1994). 'Comparative cause mapping of organizational cognitions', *Organization Science*, **5**, pp. 322–343.

Laukkanen, M. (1998). 'Conducting causal mapping research: opportunities and challenges'. In C. Eden and J. C. Spender (eds), *Managerial and Organisational Cognition Theory, Method, and Research*, pp. 168–191. London: Sage Publications.

Laukkanen, M. and E. Päivi (2013). 'New designs and software for cognitive causal mapping', *Qualitative Research in Organizations and Management: An International Journal*, **8**, pp. 122–147.

Leonardi, P. (2011). 'Innovation blindness: culture, frames, and cross-boundary problem construction in the development of new technology concepts', *Organization Science*, **22**, pp. 347–369.

Lin, A. and L. Silva (2005). 'The social and political construction of technological frames', *European Journal of Information Systems*, **14**, pp. 49–59.

Linberg, K. R. (1999). 'Software developer perceptions about software project failure: a case study', *Journal of Systems and Software*, **49**, pp. 177–192.

Linderoth, H. C. J. and G. Pellegrino (2005). 'Frames and inscriptions: tracing a way to understand IT-dependent change projects', *International Journal of Project Management*, **23**, pp. 415–420.

Loconte, R., G. Orrù, M. Tribastone, P. Pietrini and G. Sartori (2023). 'Challenging ChatGPT '*intelligence*' with human tools: a neuropsychological investigation on prefrontal functioning of a large language model'. Available at https://ssrn.com/abstract=4377371 or http://dx.doi.org/10.2139/ssrn.4377371.

Lundberg, O., D. Nylén and J. Sandberg (2021). 'Unpacking construction site digitalization: the role of incongruence and

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inconsistency in technological frames', *Construction Management and Economics*, **40**, pp. 987–1002.

Luo, X., W. Zhang, R. Bose, H. Li and Q. B. Chung (2018). 'Producing competitive advantage from an infrastructure technology: the case of cloud computing', *Information Systems Management*, **35**, pp. 147–160.

Markíczy, L. and J. Goldberg (1995). 'A method for eliciting and comparing causal maps', *Journal of Management*, **21**, pp. 305–333.

Mazmanian, M. (2013). 'Avoiding the trap of constant connectivity: when congruent frames allow for heterogeneous practices', *Academy of Management Journal*, **56**, pp. 1225–1250.

McGovern, T. and C. Hicks (2004). 'How political processes shaped the IT adopted by a small make-to-order company: a case study in the insulated wire and cable industry', *Information & Management*, **42**, pp. 243–257.

Meyer, A. D., A. S. Tsui and H. R. Hinings (1993). 'Configurational approaches to organizational analysis', *Academy of Management Journal*, **36**, pp. 1175–1195.

Mingers, J. and C. Standing (2017). 'Why things happen – developing the critical realist view of causal mechanisms', *Information and Organization*, **27**, pp. 171–189.

Murungi, D. and R. Hirschheim (2022). 'Theory through argument: applying argument mapping to facilitate theory building', *European Journal of Information Systems*, **31**, pp. 437–462.

Nadkarni, S. and P. S. Barr (2008). 'Environmental context, managerial cognition, and strategic action: an integrated view', *Strategic Management Journal*, **29**, pp. 1395–1427.

Narayanan, V. K. and L. Fahey (1990). 'Evolution of revealed causal maps during decline: a case study of Admiral'. In A. S. Huff (ed.), *Mapping Strategic Thought*, pp. 109–133. Chichester: Wiley.

Nardon, L. and K. Aten (2012). 'Valuing virtual worlds: the role of categorization in technology assessment', *Journal of the Association for Information Systems*, **13**, pp. 772–796.

Nelson, H. J., D. J. Armstrong and K. M. Nelson (2009). 'Patterns of transition: the shift from traditional to object-oriented development', *Journal of Management Information Systems*, **25**, pp. 271–298.

Niederman, F., T. W. Ferratt and E. M. Trauth (2016). 'On the co-evolution of information technology and information systems personnel', *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, **47**, pp. 29–50.

Olesen, K. (2014). 'Implications of dominant technological frames over a longitudinal period', *Information Systems Journal*, **24**, pp. 207–228.

Oliver, A. L. and K. Montgomery (2008). 'Using field-configuring events for sense-making: a cognitive network approach', *Journal of Management Studies*, **45**, pp. 1147–1167.

Orlikowski, W. and S. Scott (2008). 'Sociomateriality: challenging the separation of technology, work and organization', *Academy of Management Annals*, **2**, pp. 433–474.

Orlikowski, W. J. and D. C. Gash (1994). 'Technological frames: making sense of information technology in organizations', *ACM Transactions on Information Systems*, **12**, pp. 174–207.

Paroutis, S., L. Alberto Franco and T. Papadopoulos (2015). 'Visual interactions with strategy tools: producing strategic knowledge in workshops', *British Journal of Management*, **26**, pp. S48–S66.

Pascal, A., C. Thomas and A. G. L. Romme (2013). 'Developing a human-centred and science-based approach to design: the knowledge management platform project', *British Journal of Management*, **24**, pp. 264–280.

Riemenschneider, C. K. and D. J. Armstrong (2021). 'The development of the perceived distinctiveness antecedent of information systems professional identity', *MIS Quarterly*, **45**, https://doi.org/10.25300/MISQ/2021/14626.

Riemenschneider, C. K., M. W. Buche and D. J. Armstrong (2019). 'He said, she said: communication theory of identity and the challenges men face in the information systems workplace', *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, **50**, pp. 85–115.

Rothbard, N. P., L. Ramarajan, A. Ollier-Malaterre and S. S. Lee (2022). 'OMG! My boss just friended me: how evaluations of colleagues' disclosure, gender, and rank shape personal/professional boundary blurring online', *Academy of Management Journal*, **65**, pp. 35–65.

Rowe, F., O. Ngwenyama and J.-L. Richet (2020). 'Contact-tracing apps and alienation in the age of COVID-19', *European Journal of Information Systems*, **29**, pp. 545–562.

Sætre, A. S. and A. Van de Ven (2021). 'Generating theory by abduction', *Academy of Management Review*, **46**, pp. 684–701.

Sarker, S., X. Xiao, T. Beaulieu and A. S. Lee (2018). 'Learning from first-generation qualitative approaches in the IS discipline: an evolutionary view and some implications for authors and evaluators', *Journal of the Association for Information Systems*, **19**, pp. 752–774.

Seidel, V. P., T. R. Hannigan and N. Phillips (2020). 'Rumor communities, social media, and forthcoming innovations: the shaping of technological frames in product market evolution', *Academy of Management Review*, **45**, pp. 304–324.

Siau, K. and X. Tan (2008). 'Use of cognitive mapping techniques in information systems development', *Journal of Computer Information Systems*, **48**, pp. 49–57.

Sørensen, C. (2016). 'The curse of the smart machine? Digitalisation and the children of the mainframe', *Scandinavian Journal of Information Systems*, **28**, pp. 57–68.

Sperry, R. C. and A. J. Jetter (2019). 'A systems approach to project stakeholder management: fuzzy cognitive map modeling', *Project Management Journal*, **50**, pp. 699–715.

Spieth, P., T. Röth, T. Clauss and C. Klos (2021). 'Technological frames in the digital age: theory, measurement instrument, and future research areas', *Journal of Management Studies*, **58**, pp. 1962–1993.

Steffen, J. H., J. E. Gaskin, T. O. Meservy, J. L. Jenkins and I. Wolman (2019). 'Framework of affordances for virtual reality and augmented reality', *Journal of Management Information Systems*, **36**, pp. 683–729.

Swan, J. (1997). 'Using cognitive mapping in management research: decisions about technical innovation', *British Journal of Management*, **8**, pp. 183–198.

Tan, F. B. and M. G. Hunter (2002). 'The repertory grid technique: a method for the study of cognition in information systems', *MIS Quarterly*, **26**, pp. 39–57.

Tyler, B. B. and D. R. Gnyawali (2009). 'Managerial collective cognitions: an examination of similarities and differences of cultural orientations', *Journal of Management Studies*, **46**, pp. 93–126.

Van de Ven, A. H. (2007). *Engaged Scholarship: A Guide for Organizational and Social Research*. Oxford: Oxford University Press on Demand.

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Venkatesh, V., S. A. Brown and Y. Sullivan (2016). 'Guidelines for conducting mixed-methods research: an extension and illustration', *Journal of the AIS*, **17**, pp. 435–495.

Walsham, G. (2005). 'Doing interpretive research', *European Journal of Information Systems*, **15**, pp. 320–330.

Wang, B., Y. Liu and S. K. Parker (2020). 'How does the use of information communication technology affect individuals? A work design perspective', *Academy of Management Annals*, **14**, pp. 695–725.

Wang, C., R. Medaglia and T. B. Jensen (2021). 'When ambiguity rules: the emergence of adaptive governance from (in)congruent frames of knowledge sharing technology', *Information Systems Frontiers*, **23**, pp. 1573–1591.

Weick, K. E. (1979). *The Social Psychology of Organizing*. Reading, MA: Addison-Wesley.

Weick, K. E. (1996). *Sensemaking in Organizations*. Thousand Oaks, CA: Sage Publications.

Weick, K. E. and M. G. Bougon (1986). 'Organizations as cognitive maps: charting ways to success and failure'. In H. P. Sims, D. A. Gioia and Associates (eds), *The Thinking Organization: Dynamics of Organizational Social Cognition*, pp. 102–135. San Francisco, CA: Jossey-Bass.

Wells, P. and P. Nieuwenhuis (2017). 'Operationalizing deep structural sustainability in business: longitudinal immersion as extensive engaged scholarship', *British Journal of Management*, **28**, pp. 45–63.

Wilkinson, A., M. Knoll, P. K. Mowbray and T. Dundon (2021). 'New trajectories in worker voice: integrating and applying contemporary challenges in the organization of work', *British Journal of Management*, **32**, pp. 693–707.

Yeow, A. and S. K. Sia (2008). 'Negotiating "best practices" in package software implementation', *Information and Organization*, **18**, pp. 1–28.

Young, S. D., B. D. Adelstein and S. R. Ellis (2007). 'Demand characteristics in assessing motion sickness in a virtual environment: or does taking a motion sickness questionnaire make you sick?', *IEEE Transactions on Visualization and Computer Graphics*, **13**, pp. 422–428.

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