How do digital innovation teams function? Understanding the team cognition-process nexus within the context of digital transformation.

Abstract

Digital innovations are revolutionizing the way businesses and industries operate. Yet, the functioning of teams dealing with digital innovations remains elusive. This study offers new theoretical and empirical insights about how innovation teams function within the context of digital transformation through a better understanding of the team process-cognition nexus. In this study, a qualitative, in-depth investigation is carried out with three innovation teams, embedded in three telecommunications organizations. The innovation teams that are studied deal with the development of solutions based on digital technological innovations. The findings illustrate that digital innovation teams depend on two cognitive states to function: team-specific cognitions required for digital innovation and digital project-specific cognitions. Each cognitive state is shaped and transformed by distinct interactions between team cognition, teamwork, and taskwork throughout the digital innovation process. This study depicts a dynamic model that illustrates the functioning of innovation teams across the different stages leading to digital innovation materialization. Opportunities for further research are offered.

Keywords: Digital innovation teams; team process; team cognition; taskwork; teamwork; digital transformation.

1. Introduction

As digital transformation, that is, the ability of an organisation to "adapt, respond, and position itself for success in the face of rapid technology evolution" (Guinan, Parise, & Langowitz, 2019, p. 717) is changing the way businesses operate around the world (Chen, Ravichandar, & Proctor, 2016; Matt, Hess, & Benlian, 2015; Schadler, 2018), the relevance of understanding teams that innovate within the context of such transformation has become apparent (Guinan et al., 2019; Scuotto, Santoro, Bresciani, & Giudice, 2017).

Traditionally, innovation teams operate in the realm of established organizations (Douglas & Fitzsimmons, 2013; Wu, Kefan, Hua, Shi, & Olson, 2010), engage in team interactions and processes (Halme, Lindeman, & Linna, 2012), and generate new or improved products, services, and/or business processes (Shane & Venkataraman, 2000), which impact on organizational renewal and competitive advantage (Barton, Carey, & Charan, 2018). Recent studies portray the characteristics, content, and outcomes of teams engaging in innovation within organizations as research and development (R&D) teams (Vrontis & Christofi, 2019), product innovation teams (Guo, Su, & Zhang, 2017), process innovation teams (Puck, Rygl, & Kittler, 2007), and corporate venturing teams (Battistini, Hacklin, & Baschera, 2013). Yet, whilst studies on digital transformation have pinpointed the need to assemble innovation teams that address digital innovation processes (Guinan et al., 2019; Nylén & Holmström, 2015), there is limited understanding about how such teams function. It is not well known how team members interact and what tasks they perform while materializing digital technologies into innovative outcomes for their organization.

The purpose of this study is, therefore, to theorize about the functioning process of teams that address digital innovations in organizations. This study acknowledges that one way to develop richer theorizing is to take the context into account so that insights about the phenomena associated with teams and organizations can be generated (Johns, 2017; Maloney, Bresman, Zellmer-Bruhn, & Beaver, 2016). Context, that is, "situational or environmental constraints and opportunities that have the functional capacity to affect the occurrence and meaning of organizational behaviour" (Johns, 2006, p. 386, 2017, p. 577) is important because it carries explanatory power and allows an assessment of theories and findings (Bamberger, 2008, p. 840). In team research, context concerns with theoretical perspectives about where the team is located and the underlying notion

that teams are dynamic entities operating in larger systemic contexts of people, tasks, technologies, and settings (Maloney et al., 2016, p. 895). Recent studies highlight that innovation teams require a set of new skills, capabilities, and mechanisms in order to integrate digital technologies in the innovation process (Dery, Sebastian, & van der Meulen, 2017; Nylén & Holmström, 2015; Guinan et al., 2019). Within the context of digital transformation, innovation team members need to be digitally skillful, with a high level of improvisation and agility (Dery et al., 2017), while being able to function within dynamic environments and to address the rapid development of digital technologies (Hess, Matt, Benlian, & Wiesböck, 2016; Nylén & Holmström, 2015).

To advance understanding on the functioning of teams dealing with digital innovations, this study focuses on the team process – team cognition nexus (Cooke, Gorman, Myers, & Duran, 2013; Fiore & Salas, 2004). The interconnection between process and cognition is important in order to acquire a holistic understanding of how teams that innovate within organizations function (de Mol, Khapova, & Elfring, 2015). Team process refers to 'what teams do' (i.e. taskwork) and 'how they do it' (i.e. teamwork) (Mohammed, Tesler, & Hamilton, 2012). Taskwork involves the activities of the team, which enable them to set a direction, use resources, and fulfill team ends (Collins & Parker, 2010; Kozlowski, 2015), while teamwork involves the interactions, relationships, and norms that are needed for the team to carry out its activities (Crawford & LePine, 2013). Team cognition is metaphorically associated with the 'brains' of a team, referring to the ways in which teams use information (MacMillan, Entin, & Serfaty, 2004), construct mental models (Bierhals, Schuster, Kohler, & Badke-Schaub, 2007; Hsu, Chang, Klein, & Jiang, 2011), and shape shared understandings of the roles, capabilities, and actions of each member (Salas, Rosen, Burke, Nicholson, & Howse, 2007). To date, innovation team process and team cognition represent different research streams, which are often studied in isolation from each other, resulting

in an insufficient understanding of the functioning of innovation teams (de Mol et al., 2015; Eisenhardt, 2013). Considering the above, there is a need to study the interplay between team process and cognition in order to better understand the functioning of innovation teams dealing with digital technologies. Therefore, this article aims to address the following research question: *How do team process (i.e. taskwork and teamwork) and team cognition interact to explain the functioning process of teams that address digital innovations?*

To answer this research question, and to address calls about understanding the how and why aspects of digital innovation within organizations (Papa, Santoro, Tirabeni, & Monge, 2018; Scuotto et al., 2017), depth rather than breadth was deemed important, and thus detailed and in-depth insights were needed (Stake, 2008). This study relies on a multiple case study research (Yin, 2018) in the telecommunications industry. The research context is three teams dealing with digital innovation processes and outputs within three large organizations in Europe. Case studies represent an established approach within the methodological canon of conventional innovation teams (Ben-Hafaïedh & Cooney, 2017). Digital transformation scholars call to move beyond a single case study to a comparison of cases (Scuotto, Ferraris, & Bresciani, 2016), which may allow a richer perspective in the context of digital innovation (Urbinati, Chiaroni, Chiesa, & Frattini, 2020).

The findings illustrate that teams that address digital innovations in organizations, often referred to as 'digital innovation teams' (Nylén & Holmström, 2015), encompass team-specific cognitions required for digital innovation and digital project-specific cognitions. Each of these cognitive states is shaped and transformed by distinct interactions between team cognition, teamwork, and taskwork throughout the digital innovation process. This study contributes to understanding in the following ways. First, it advances theoretical understanding on the dynamics of innovation teams, which can be found at the intersection between innovation team cognition, teamwork, and

taskwork across the innovation life cycle. Second, it conceptualizes the 'functioning of digital innovation teams', by contextualizing the cognition-process nexus within digital transformation. Third, it introduces the concept of 'innovation team cognition' in relation to digital innovations. Fourth, it provides new empirical evidence on the collective cognitions and team process influences, dynamics, and outcomes underpinning the digital innovation team. Last, it extends the field of organizational teams through evidence on the evolution of socio-cognitive interactions throughout the lifecycle of ad hoc teams.

The article proceeds as follows. First, it reviews literature on innovation within digital transformation, as well as on team process and team cognition within innovation teams. Then, a discussion of the research methodology follows, before the article moves on to the findings. In the final sections, a conceptual model on the relation between digital innovation team cognition, teamwork, and taskwork is presented and discussed.

2. Innovation Within the Digital Transformation Context

Innovation is a multifaceted concept, encompassing a process of continuous improvement (Baregheh, Rowley, & Sambrook, 2009; Lianto, Dachyar, & Soemardi, 2018), revolving around the renewing of an organization through the creation of new or improved products, services or processes (Battistini et al. 2013; Salerno, Gomes, Silva, et al., 2015). In such a context, technology (Matt et al., 2015; Papa et al., 2018; Santoro, Vrontis, Thrassou, & Dezi, 2018) and teams (Lahiri, Pahnke, Howard, & Boeker, 2019; Schippers, West, & Dawson, 2015) play an increasingly crucial role.

Organizations of all sizes and across industries are exploring and exploiting the benefits of digital technologies (e.g. see Chaniot, 2019; Chen et al., 2016; Scuotto et al., 2016) in order to

adapt and readjust the way they function and operate (Scuotto et al., 2017). This entails a transformation of products, processes, and business models, owing to digital technologies (Hess et al., 2016; Matt et al., 2015). Digital transformation, that is "an organization's ability to adapt, respond, and position itself for success in the face of rapid technology evolution" (Guinan et al., 2019, p. 717), can be attributed to four essential dimensions: use of technologies, changes in value creation, structural changes, and financial aspects (Matt et al., 2015, p. 340). Yet, whilst digital transformation calls for the renewing and readjustment of business models that challenge the conventional way of doing business, companies engage in digital transformation at varying paces, with different motivations, and with varying levels of success, suggesting that while some have started to benefit from such progression, others may still be facing paradoxes that prevent them from transforming successfully (Westerman, Bonnet, & McAfee, 2014).

Recent studies provide evidence that digital transformation is a core driver of innovation for firms (Papa et al., 2018; Santoro et al., 2018; Scuotto et al., 2017). A number of scholars argue, though, that in the context of digital transformation, the relation and dependencies between innovation processes and innovation outcomes become more complex and dynamic (Nambisan, Wright, & Feldman, 2019). This is because digitally enabled technologies (e.g. 3D design tools, 5G, digital networking technologies, the Internet of Things) often do not only influence the outcomes, but also affect the ways people engage in the process of innovation, the way they interact, and the activities they perform (Nambisan et al., 2019). In digitizing innovation, both processes and outcomes are likely to be shaped by each other and influence one another (Bailey, Leonardi, & Barley, 2011; Huesig & Endres, 2019). For instance, the use of digital technologies in new drug discovery can create a new set of activities among scientists, which can influence the end innovation (Dougherty & Dunne, 2011). Additionally, since digital transformation strategies

can cut across various operations and functions within an organization, then complex coordination efforts related to the way that people function within such context might be needed (Matt et al., 2015). Such coordination efforts may amplify when involving the management and integration of different types of knowledge and innovation between actors in digital ecosystems (Ardito, Ferraris, Messeni Petruzzelli, Bresciani, & Del Giudice, 2019; Bresciani, Ferraris, & Del Giudice, 2018).

As digital transformation unfolds and new technologies emerge, scholars have highlighted the relevance of teams (Berges & Kon, 2019; Chaniot, 2019; Larson & DeChurch, 2020; Singh, Klarner, & Hess, 2020). Digital transformation requires agile teams that can draw on digital technologies to introduce technologically advanced products and services (Guinan et al., 2019; Nylén & Holmström, 2015). Yet, it is not clear enough how such teams function within a process, which leads to innovation outcomes within the context of digital transformation.

3. Innovation teams: Process and Cognition

Innovation teams are at the heart of the innovation process (Fay, Shipton, West, & Patterson, 2015; Lahiri et al., 2019). They comprise a collection of highly specialized and motivated people (Hu & Randel, 2014), who deal with complex problems under high uncertainty (Somech & Drach-Zahavy, 2013) and rely on knowledge sharing and integration to reach innovative solutions within organizations (Maloney et al., 2016; Hu & Randel, 2014).

Prior research illustrates that effective innovation team functioning depends on several conditions, including human capital diversity (Somech & Drach-Zahavy, 2013), role complementarity (Pearce & Ensley, 2004), team bonding, and the creation of a strong team culture (Cheung, Gong, Wang, Zhou, & Shi, 2016). More recent work emphasizes that team qualities

differ when innovation teams face the challenge of creating new products, services, processes, and business models that draw on digital technologies (Dery et al., 2017; Nylén & Holmström, 2015).

Innovation teams dealing with digital technological outputs, drawing on 5G, the Internet of Things (IoT), virtual reality, and artificial intelligence (Santoro et al., 2018; Longoni, Bonezzi, & Morewedge, 2019; Ng & Wakenshaw, 2017), need to be more agile and dynamic (Dery et al., 2017), with the ability to incorporate digital technologies within the innovation process (Nylén & Holmström, 2015; Hess et al., 2016), engage in continuous learning, and readjust their goals accordingly (Guinan et al., 2019). Yet, to comprehend how innovation teams that deal with digital technologies function, it is important to look at the interconnection between team process and team cognition (de Mol et al, 2015).

3.1 Innovation Team Process

Literature on conventional innovation/entrepreneurial teams distinguishes between the innovation process and the team process (Forbes, Borchert, Zellmer-Bruhn, & Sapienza, 2006; Leonidou, Christofi, Vrontis, & Thrassou, 2018). While the innovation process relates to endeavors to materialize ideas into innovation outcomes within existing organizations (Laursen & Salter, 2006; Baregheh et al., 2009), the team process focuses on *what* innovation teams do (i.e. taskwork) and *how* they do it (i.e. teamwork) (de Mol et al. 2015; Marks, Mathieu, & Zaccaro, 2001). Taskwork involves the activities that members of the innovation team must perform to accomplish entrepreneurial ends (de Mol et al., 2015), such as decision-making, coordination, communication, leadership, planning, expertise sharing, implementation, and control, amongst others (Marks et al., 2001; Wu et al., 2010). Organizational renewal requires teams to assume diverse roles and responsibilities, tied to their own specialisation and involvement at

discrete or all stages of the innovation process (Zhou, Vredenburgh, & Rogoff, 2015). Yet, developing a new service or product within an organization is often a process involving people from multiple organizational domains, which can make tasks such as communication and coordination of work between innovation team members difficult (Leenders & Wierenga, 2002).

Innovation teamwork involves interpersonal functions and relational conditions, which allow members of the innovation team to fulfill entrepreneurial ends within the organization (Crawford & LePine, 2013). Organizational renewal based on innovation teams needs cooperation among individuals from several units and corporate hierarchies (Holland, Gaston, & Gomes, 2000; Leenders & Wierenga, 2002). Larger organizations favor the formation of ad hoc teams every time an innovation project is pursued (Kazanjian & Drazin, 2012). Yet, innovation team members may face challenges when interacting with others across organizational boundaries every time they are called to join a product or service development team (Kleinsmann, Buijs, & Valkenburg, 2010)). Stress induced by vague task requirements, new working methods, and restrictions may present a difficult hurdle for innovation teams (Fecher, Winding, Hutter, & Füller, 2020).

Diverse studies place emphasis on the quality of interactions between members of a conventional innovation team. Particular reference is made to the dimensions of team cohesiveness (Zolin, Kuckertz, & Kautonen, 2011) and the strength of ties in the intrapreneurial or innovation teams in long-standing organisations (Discua Cruz, Howorth, & Hamilton, 2013). The stronger the relations between team members, the more cohesive the team (Zolin et al., 2011). A cohesive innovation team is more likely to encompass team members that desire to stay in the team (Lechler, 2001) and exhibit high commitment to team goals and tasks (Leary & DeVaughn, 2009). Strong teamwork ties involve emotional and relational closure between team members (Jack, Dodd, & Anderson, 2004). Strong ties are likely in innovation teams where team members know

each other well due to past cooperation or familiar relations. Weak ties, in turn, lead to the absence of relational closure between team members and the presence of limited prior acquaintance between them. In the presence of weaker teamwork ties, innovation team members are likely to interact less to discuss and coordinate team tasks (Bouncken & Barwinski, 2020; Hass & Cummings, 2020).

A number of innovation teamwork conditions, such as conflict (affective and cognitive) and trust, may enhance or hinder interactions between team members (de Mol et al., 2015). Affective conflict, which refers to interpersonal disagreements and dislikes, can be destructive in the innovation team, causing problems in taskwork dimensions such as decision making (Ensley, Pearson, & Amason, 2002). In contrast, cognitive conflict becomes a catalyst for creativity through the open exchange of ideas, collective reflection, and intense interactions on what alternatives to pursue (Wirtz, 2011). Trust enhances the relational ties and closure between team members and, therefore, strengthens teamwork and facilitates tasks such as communication and information exchange more effectively (Hans & Cummings, 2020). The drawbacks of trust within innovation teams relate to diminished attention on the accuracy of information that is gathered and processed (Chen & Wang, 2008).

3.2 The Cognition-Process Nexus Within Innovation Teams

Innovation cognition focuses on the mental processes that individuals go through to generate, refine, and transform ideas into novel products, services, or processes (Gemmell, Boland, & Kolb, 2012; Hadida & Paris, 2014). It influences choices of techniques and approaches to conceive, develop, and implement creative ideas (Gemmell et al., 2012). Such cognition encourages the use of intuition in the innovation process (Kickul, Gundry, Barbosa, & Whitcanack, 2009), including

the decisions to pursue particular opportunities (Mitchell, Friga, & Mitchell, 2005). Team innovation cognition refers to cognitive or mental understandings, shared at the level of the team, which are important in realizing entrepreneurial outcomes (de Mol et al., 2015; West, 2007).

A systematic literature review by de Mol et al. (2015, p. 239) suggests that team cognition in innovation teams assumes the form of "an emergent state that encompasses three key properties": a) being an emergent state, in the sense that it arises from the merging of team members' individual cognitions; (b) embedded in team processes, meaning that team cognition is separate from team process but can influence this process; and (c) involves sharing content-related knowledge, meaning that team members share both thought processes, including the knowledge that stems out of these processes. Such conceptualization suggests that innovation team cognition delves beyond collective memory (Bryant, 2014), shared knowledge (Bierhals et al., 2007), or shared consensus within the team (Vissa & Chacar, 2009). It involves the complex interactions and negotiations between team members, leading to the integration of individual cognitions, and explains the way that team cognition influences behaviors and outcomes within the innovation process (de Mol et al., 2015), suggesting the importance of considering the interconnection between team process and cognition.

Team cognition and team process represent different spheres of interactions in the innovation process that merit further attention (de Mol et al., 2015; Eisenhardt, 2013). Nevertheless, studies have not shed sufficient light on the innovation team cognition - team process nexus (Larsson, 2018; Selden & Fletcher, 2015). To advance understanding on the relationship between team cognition and team process, scholars in the field of innovation argue that it is better to concentrate on the taskwork and teamwork processes of the innovation team (de Mol et al., 2015). A handful of studies have begun to untangle innovation team cognition in relation to the taskwork processes

of team decision making (Eisenhardt, 2013; Souitaris & Maestro, 2010) and team information-processing (Furr, Cavarretta, & Garg, 2012). A team's decision making has been identified as being influenced by a set of cognitive rules, heuristics (Eisenhardt, 2013), shared preferences, and shared beliefs at the team level (Souitaris & Maestro, 2010). The team's information-processing tasks (Furr et al., 2012) have been found to be influenced by team cognitive flexibility, which refers to the ability of team members to share their individual cognitions and process the necessary information to meet requirements as these unfold (Amason, Shrader, & Tompson, 2006; Furr et al., 2012).

Research at the nexus of innovation team cognition and teamwork is also limited (de Mol et al. 2015). To date, most studies are centered around the role and importance of cognitive conflict (as a manifestation of teamwork process), evidenced to positively influence the functioning and outcomes of the innovation team (Francis & Sandberg, 2000; Li & Li, 2009). When team members share understanding relevant to the need to debate and critically reflect on ideas, share concerns, and freely express their own opinions, then decisions and actions are more likely to be comprehensive and effective (Ensley et al., 2002; Wirtz, 2011). Yet, there is insufficient insight as to how team cognitions influence team building, team development, and associated teamwork conditions such as trust, motivation, and affect.

The present study draws on the dimensions of team cognition and team process (i.e. taskwork and teamwork) to elucidate the way that organizational teams address innovations (de Mol et al., 2015) in the context of digital transformation. We next discuss the method and context in which such dynamics were studied.

4. Methodology

To address our research question, detailed and in-depth insights from innovation teams in organizations were needed. A qualitative research approach was chosen to understand the dynamics of the digital innovation process from the perspective of participants of innovation teams (Fecher et al., 2020) and to contribute to the development of empirical knowledge based on evidence across settings (Corbin & Strauss, 2014; Miles, Huberman, & Saldana, 2013). Qualitative research allows the answering of 'how' and 'why' questions, understanding the world from the perspective of those studied while examining and articulating processes (Pratt, 2009, p. 856). We rely on a multiple case approach (Yin, 2018) to provide the setting for understanding the links between innovation team cognition and innovation team process. This approach has been used in recent studies to enhance our understanding of digital transformation, and thus it is relevant to our concerns to study innovation teams (Bordeleau, Mosconi, & Santa-Eulalia, 2020; Singh et al., 2020; Urbinati et al., 2020). Research was carried out within three teams (i.e. the cases) generating innovation outputs linked to digital technologies. The selected 'digital innovation teams' are embedded within separate large-sized telecommunications organizations in Europe.

4.1 Sampling and Data Collection

Cases were selected based on where *"the processes being studied are most likely to occur"* (N. Denzin & Lincoln, 2000, p. 370). Contextualisation is important in understanding innovation in the context of digital transformation (Guinan et al., 2019; Ardito et al., 2019; Matt et al., 2015). Thus, the selection criteria were based on replication logic and theoretical interest, where a few cases with exemplary outcomes are chosen, based on mainstream theories and in relation to our main research question (Yin, 2018, p. 55). Case studies of purposefully selected firms provided a

systematic way of looking at the digital innovation process, observing team-specific innovation phenomena within real-life contexts, gathering and analyzing data, and reporting results.

Cases of digital innovation teams were selected based on a set of pre-determined criteria (Fletcher & Plakoyiannaki, 2011), including: a) a selection of cases embedded in large innovative organizations, which draw heavily on digital technologies; b) a selection of cases from organizations situated in a single industry (to control for industry-related differences; c) cases that fit the definition of digital innovation teams – i.e. designated teams within an existing organization, dealing with the process leading to the creation of improved/new products, services, processes, and ways of organizing drawing on digital technologies (Dery et al. 2017; Nylén & Holmström, 2015); d) cases that completed the innovation lifecycle, i.e. from idea to commercialization; and e) cases that maximize cross-case diversity (demographics, background characteristics, and innovation outcomes) to strengthen generalization across cases (Yin, 2018).

As the case selection was purposive, we needed privileged access. Based on the first criterion, and as a result of one of the co-authors' established industry contacts, the telecommunications industry was chosen. Telecom organizations are a relevant context to study digital innovations as they are at the forefront of digital transformation and rely heavily on digital technologies and innovation teams to develop and launch new products, services, or processes (Ashmarina, Kandrashina, & Dorozhko, 2020; Wehrheim, Dalay, Fosfuri, et al., 2020). Drawing on the replication and saturation logic (Yin, 2018), three cases (digital innovation teams) from separate organizations were successively studied in order to provide more insight into the nexus of team cognition-process and help develop theory. To access digital innovation teams, the authors communicated with the head of the innovation unit or department of each firm. This process led to the selection of teams that fulfilled the case selection criteria.

The cases presented here are drawn from a small number of case studies and are not intended for generalization. Focusing on three case studies allows exploration of *"dynamics present within given settings"* (Eisenhardt, 1989, p. 534) and offers a context for a rich description of a phenomenon (Miles et al., 2013) to understand the way that digital innovation teams function. The small number of cases allowed the possibility to explain particularities and differentiating factors thoroughly, and also offered a unique opportunity to approach key themes of interest around the phenomenon of digital innovation (Saunders, Lewis, & Thornhill, 2009). These three cases were selected because of their ability to illustrate general findings on digital innovations at the team level, to present the possibility of a cross-case analysis, while at the same time offering opportunities to learn more about the phenomenon (Stake, 2008; Yin, 2018). The cases in these different companies within the same industry added external validity (Riege, 2003) and helped better examine the complex dynamics in organizations in the digital technology context.

The chosen cases are labelled *ComPack, Mobility-Combi, and Orbit*[1]*,* and are embedded in large telecommunication organizations in Europe: TELECOM, DATACOM and INTERCOM respectively[2]. *ComPack* was an ad hoc team within TELECOM, which had approximately 3,000 employees and €500 million revenue in 2018. TELECOM was established in 1960, with successful digital innovations in the areas of remote customer assistance services and integrated voice-message-data plans. *ComPack* involved 23 members, working on a 20-month project to create a VoIP service for businesses (Chakraborty, Misra, & Prasad, 2019). Through this service, a business can connect its various offices and business units across the globe via TELECOM's IP VPN. The key benefits that a client company can have include highly secure and cost-efficient

[1] Pseudonyms are used.

[2] To maintain the focus on theory-building, whilst protecting the anonymity of the participating organization, embedded cases, and respondents, this study has been anonymized at the country level. If the name of the country was revealed, it would take only a few minutes of online search to identify the organizations.

voice communication within the company and optimization in the use of internet network resources.

The second case, *Mobility-Combi,* was an ad hoc team within DATACOM, a company with 1,900 employees and €300 million revenue in 2018. DATACOM was established in 1991 and has a strong record in successfully integrating digital and mobile technologies, introducing novel live streaming services (Wongkitrungrueng, Dehouche, & Assarut, 2020), and in providing video conferencing services for businesses. *Mobility-Combi* involved a total of 19 members working on a 17-month project to develop a chatbot-based customer care service, which draws on machine learning technology (Adamopoulou & Moussiades, 2020). Through this digital solution, the company can attend customer requests in real time, faster, and at a lower cost than before.

The third case, *Orbit,* emerged within INTERCOM, a company with 1,500 employees and €240 million revenue in 2018. INTERCOM was established in 1995 and has been innovative in the provision of super high-speed internet and creative TV-internet-phone bundles (Kim, Nam, & Ryu, 2020). *Orbit* involved a total of 15 members working on a 14-month project to launch the Orbit TV App, allowing INTERCOM cable TV subscribers to access live TV channels from their mobile and tablet devices when connected to the internet.

Intended to maximize within-case variation, which is essential for getting a holistic grasp of the phenomenon within each case (Yin, 2018), a diverse blend of people was interviewed around each case (see Table 1). The interviewees were selected by drawing on a blend of purposive and snowball sampling techniques (Bryman & Bell, 2015), using the innovation director of each company as a gatekeeper for initial access. The data collection process was initiated in January 2018 and lasted approximately four (4) months. In total, 31 individuals were interviewed. Table 1 provides details on the number of people (and respective roles) interviewed from each case.

[Insert Table 1 near here]

As team processes and cognition are dynamic phenomena (Hass & Cummings, 2020; Mohammed, Hamilton, Tesler, et al., 2015), the interview guide was structured in such a way that it could help capture insights and shifts throughout the innovation process of each case. The guide was prepared by drawing on a unitary sequence model of innovation process – comprised of the stages of 'Idea generation and Evaluation', 'Design and Development', and 'Testing and Implementation' (Gopalakrishnan & Damanpour, 1994; Saren, 1984). A 'unitary sequence model' allows studying team and organization-specific phenomena that emerge and develop alongside stages of the innovation life cycle (Westerman, McFarlan, & Iansiti, 2006). Yet, we acknowledge that innovation narratives may not necessarily proceed in a straightforward manner across time and settings (Ellwood & Horner, 2020).

The interviewees were asked to elaborate on their cognitive states and processes concerning each stage of their team's innovation life cycle. The interviewing process was progressive, interviewing until a saturated understanding of the phenomena within each team had been reached (Eisenhardt, 1989; Yin, 2018). Each interview lasted between 45 and 60 minutes. Data were recorded verbatim and transcribed for analysis.

4.2 Analysis: From Data to Theory

Given the presence of a body of literature on team cognition and team process, the present study uses a 'partially' grounded approach (Jack, Dodd, & Anderson, 2008; Miles et al., 2013). Drawing on this approach, the study is loosely informed but not constrained by prior theoretical understanding, so as to provide space for emergent insights (Dubois & Gadde, 2002), leading to theory building (Eisenhardt, 1989; Pratt, 2009; Yin, 2018).

The first coding round involved open coding, analyzing the transcripts sentence by sentence and assigning conceptual codes to chunks of texts (Corbin & Strauss, 2014). Through axial coding, relationships between open codes were identified, leading to the generation of a number of first-order categories (Corbin & Strauss, 2014; Gioia, Corley, & Hamilton, 2013). Repeating this with a second round of axial coding and looking at the relationships between first-order categories, a number of second-order themes emerged. During the second and third coding rounds the authors began considering how the emergent concepts helped explain the phenomenon at hand (Gioia et al., 2013). In doing so, they introduced a back-and-forth process between data and literature to get a better sense of secondary codes (categories) and relations between them, and 'distill' these to broader meaningful aggregate dimensions (Gioia et al., 2013). The final data structure is depicted in Figure 1. Methods consistent with within and cross-case analyses were employed (Eisenhardt, 1989; Miles et al., 2013; Yin, 2018). Manual analysis methods and data in tables support the key themes emerging from the analysis (Pratt, 2009). The aim was to increase transparency and address the validity of the article (Gibbert & Ruigrok, 2010).

[Insert Figure 1 near here]

5. Findings

5.1 Digital Innovation Team Cognition Duality, Socio-cognitive Arenas, and the Links Between Cognition and Process

Analysis of the data from the three cases (*ComPack, Mobility-Combi, and Orbit*) suggest that digital innovation teams draw on a dual cognitive structure. Such a dual structure reflects two types of team cognitions, which are contextualized within the realm of digital transformation and are

important for team functioning across stages of the digital innovation process: 'team-specific cognitions' and 'project-specific cognitions'. Team-specific cognitions revolve around the 'team' and involve *shared understandings on the identity of, and conditions within, the innovation team*, which are needed for the team to address digital technological outcomes. For instance, the findings illustrate that team members across the three cases held shared perceptions on the value of a 'positive and creative team climate', rationalizing this as a key tenet for team members to integrate their perspectives and think differently in order to meet the challenges of digital innovation. Nicholas [an *Orbit* team member] mentioned that: *"there was a positive climate shared in our team and we all valued creativity. These were essential ingredients for mixing ideas, knowledge, and technologies to innovate at this level (referring to the digital level)".*

Project-specific cognitions center on the 'project' of the team and involve *shared understandings on the value and future impact of the project,* considering the challenges, risks, and commitment needed for addressing digital technological outcomes. For instance, research participants recalled the presence of shared perceived expectations on 'high project novelty'. This cognition was contextualized within digital transformation, since it was suited for allowing a team to pursue novel ideas and draw on advanced technologies to create digital solutions that would have a high impact in the markets. Luke [a *ComPack* team member] emphasized that when they started working on the project there was *"a shared perception that our project was very novel and thus needed to incorporate the latest technologies and knowledge to disrupt the market".*

Data analysis illustrates that team-specific cognitions and project-specific cognitions occur within diverse socio-cognitive arenas: the 'team socio-cognitive arena' and the 'project socio-cognitive arena', respectively (see Table 2). Each socio-cognitive arena functions around a cross-feeding between team process and team cognition, leading to the construction of respective

cognitions at the level of the digital innovation team. The 'team socio-cognitive arena' involves interactions, socialization, and the teamwork conditions needed for team members to get to know one another, acknowledge their respective personalities, values and knowledge backgrounds, and come to exchange their personal and workplace stories. The analysis of the cases suggests that these 'teamwork' functions emerge a relevant milieu to enable the construction of team-specific cognitions, such as the shared perceptions on the team climate needed to address digital innovations. Aaron [a *Mobility-Combi* team member], indicated that *"our shared perception on the presence of a forward-looking and creative team environment"* {i.e. team-specific cognition} was influenced by "*our close socialization in the team and respect for one another"*{i.e. teamwork functions}. Therefore, a 'team socio-cognitive arena' emerges as a cross-feeding setting between 'teamwork' and 'team-specific cognitions'.

[Insert Table 2 about here]

Analysis of the data from the three cases suggested that the project socio-cognitive arena involves discussions, decisions, and tasks centered on digital technologies and their use in delivering new digital products or services in the firm. This is the arena where team process assumes the form of 'taskwork', i.e. what needs to be done to design and successfully implement new digital-based solutions. Within this socio-cognitive arena, team members engage in exhaustive discussions around the utilization and applicability of digital technologies, brainstorm about how to improve their ideas iteratively, as well as make relevant decisions to develop and implement new digital solutions. All cases suggested that such 'taskwork' aspects become essential in shaping project-specific cognitions at the level of the team. For instance, participants referred to their teams developing at the start of the project a "*collective understanding on project originality"* {i.e. project-specific cognition} [Theo, *Orbit* team member], suggesting that such

originality was attributed to their hands-on engagement with "*the very demanding requirements of our digital project, which started with the need to constantly brainstorm for very innovative ideas"* {i.e. taskwork activities} [Paul, *ComPack* team leader]. Therefore, the evidence suggests that the project socio-cognitive arena exists around a cross-feeding between 'taskwork' and 'project-specific cognitions' at the level of the innovation team.

The next section examines the intersection between (digital innovation) team cognition and team processes in more depth. A unitary sequence model of innovation (Gopalakrishnan and Damanpour, 1997) is used to present the emergence, interactions, and shifts on the team process – team cognition nexus.

5.2 Team Cognition and Team Process Across Digital Innovation Stages

The following sections offer discussion and evidence in support of the emergence and development of team cognition, in relation to team process, across different stages of the digital innovation endeavor. Table 2 summarizes the key features across the dimensions of team cognition (i.e. team-specific and project-specific cognitions) and team processes (i.e. teamwork and taskwork), for all three innovation stages in a unitary sequence model.

5.2.1 Stage 1: Team Cognition Emerges From, and Influences, Team Processes

Stage 1, 'idea and evaluation', frames the emergence of digital innovation team cognition. The cases represent digital innovation teams, formed on an ad hoc basis and, thus, team members get to know one another during the first stage of the innovation process. The data analysis suggests that team cognition emerges within contextual and socio-cognitive interactions between innovation team members.

The findings shed light on the way the two types of cognitions (i.e. team-specific and digital project-specific) emerge and influence team processes during the first stage of the innovation lifecycle (Table 2). Table 2 shows that team-specific cognitions during this stage appear in the form of a shared 'positive and creative team climate' and possess an acknowledgement between team members of their 'traits and values in common'. These cognitions emerge out of initial teamwork functions, including 'interactions and socialization', team members 'getting to know each other', and 'sharing their stories'". Carl [*Orbit*, team leader] expressed that *"by sharing stories* {teamwork functions} *we have realized the similarities between our personalities* {team-specific cognition}*".* Similar quotes from other cases highlighted the notion of how team-specific cognitions emerge out of the early interactions of teams.

Yet, while team-specific cognitions appear to emerge out of early teamwork functions, these emergent cognitions need to guide teamwork functions over time and create a context for future collaboration. Steve [*ComPack*, Director of Innovation at TELECOM] provides a compelling excerpt by suggesting that through *"sensing their presence in a positive climate* {team-specific cognition}*, the members of the team were keen to mingle and socialize between themselves* {teamwork functions}".

Evidence of shared project-specific cognitions in this stage involve a collective understanding on 'high project novelty' and 'high project risk'. The findings suggest that these project cognitions emerge out of the taskwork activities that team members engage in and accomplish in this first stage of the innovation process. These tasks include 'team brainstorming', 'focus groups with experts and prime users' and the use of 'idea information management software to list, score, and organize ideas'. The findings illustrate a contextualization of team tasks within digital transformation requirements. For instance, the team had to run focus groups with IT departments,

telecom experts, consultants, and prime users, also drawing on virtual discussions to reach out to experts residing abroad in order to open the circle for the flow of specialized and fresh ideas. At the same time, it acquired idea management software to allow both the management of ideas and the offering of opportunities to employees across the organization to participate in the ideation process. Joanna [*Mobility-Combi* team leader] articulated the way that taskwork feeds project cognitions: "*through these brainstorming sessions and focus groups* {taskwork activities}, *we got to realize better the risks associated with the project and how impactful this could be if eventually successful* {project-specific cognitions}*"*. Similar quotes from other members across the cases supported such shared views in digital teams.

Interestingly, in a bidirectional fashion, shared project cognitions would reinforce taskwork activities at the 'idea and evaluation' stage. As team members would crystalize their shared project expectations and understandings, they would also come to realize how certain tasks could be done better and differently. For instance, participants from diverse cases indicated that they started with the need to brainstorm, but progressively, after realizing the magnitude of the endeavor, they brought this brainstorming to a different level. Sophia [*Combi*, team member] expressed that *"coming to realize that we are developing a new tech-based solution with a high level of uncertainty and risk* {team-specific cognition} *[...] we felt the pressure to do more with the brainstorming tool. We discussed and agreed that we need to approach it more professionally, to make it more systematic and offer space for study and preparation for each member to generate concepts beforehand. We also undergo training on best practices in brainstorming sessions"* {taskwork activities}.

Taken together, at this stage, data analysis suggests that team cognition emerges from and influences the team tasks and teamwork for digital innovation teams.

5.2.2 Stage 2: Refined Team Cognition Influences Team Processes on Design and Development

In this subsequent stage, data analysis suggests that digital team-specific cognitions go through a process of refinement, which manifests as a shared understanding that 'the team is above the individual' and a shared sense that 'team members complement one another'. These cognitions, shaped in the context of digital transformation, value collective work and complementarities in terms of personalities and personal qualities. Teamwork functions and conditions in this stage appear in the form of 'positive work relations', 'mutual support'", and 'openness and acceptance' between team members (Table 2).

Analysis of the data uncovered that digital team-specific cognitions and teamwork functions interact and reinforce one another, following a sequence: First, the refined team-specific cognitions, which are observed at the second stage of the innovation process, stem from teamwork functions (e.g. interactions, socialization, and story-sharing) occurring during the previous innovation stage of 'idea and evaluation'. Ethan [*Mobility-Combi*, team member] emphasized that *"it helped that we bonded early* {teamwork function, Stage 1} *[..] it took time but it led to a feeling of being in a team and sacrificing something for the team* {team-specific cognition, Stage 2}*".* Second, the refined team cognitions shape the teamwork functions and conditions of the second stage, reinforcing positive work relations, mutual support, openness, and acceptance between team members. Louise [*Compack*, team member] mentioned that *"by understanding our specific and complementary roles* {team-specific cognition, Stage 2}*, we were more able to support one another for our mutual benefit and the benefit of the team* {teamwork functions, Stage 2}*".* Taken together, such evidence suggests a bidirectional but reinforcing relationship between team-specific cognitions and teamwork, allowing teams to function as they develop digital transformation projects.

Likewise, Table 2 shows that digital project-specific cognitions can change during this innovation stage to a shared sense of 'clarity on project direction', 'project leadership is crucial', and 'commitment to the project'. Taskwork activities of this stage involve 'project management', 'assessment of market, competition, company capabilities', and 'decisions on digital product content and features'. The idiosyncrasies of digital transformation were infused within these tasks. For instance, the findings suggest that due to the dynamic environment of digital transformation (i.e. linked to constant technological advancements, competitive moves, the shifting needs of consumers, etc.) there was a need for the use of a very specialized information system to facilitate formal project management to ensure the precise meeting of deadlines, the sequencing of activities, reporting and documentation, control of costs and quality, and that resources are constantly in place to develop the project idea.

Data analysis suggests that digital project-specific cognitions and taskwork activities interact and reinforce one another, following a sequence: First, the refined (second-stage) project-specific cognitions emerge from taskwork activities taking place in the earlier stage. Characteristically, Nicholas [*Orbit*, team member] argued that "*brainstorming was a useful technique* {taskwork activities, Stage 1}, *which helped us to clarify a lot of aspects of the very challenging Orbit project* {project-specific cognition, Stage 2}*"*. Second, the refined project-specific cognitions guide taskwork activities of the second stage. Referring to the *Mobility-Combi* team, Barry [Director of Innovation at DATACOM] emphasised that "*in either case we had a mixture of team members who were committed to the project* {project-specific cognition, Stage 2}, *who were very serious in managing the software and tasks needed for a very meticulous and professional project management* {taskwork activities, Stage 2}". Taken together, evidence from this stage suggests that the context

generated by the pursuit of digital transformation allowed the refinement and remaking of team processes based on team cognition.

5.2.3 Stage 3: Refined Team Cognition Guides Project Implementation

Table 2 shows that during 'testing and implementation' (i.e. the third stage), team-specific cognitions shift to a shared 'sense of team cohesiveness' and 'team efficacy', while teamwork manifests in 'positive work relations', 'trust between team members', and 'bonding'. Analysis of the data strongly indicated that these teamwork features are bound within a context of digital transformation, which requires rigorous and timely testing and implementation, while ensuring the production of novel solutions. In the words of Carl [*Orbit*, team leader], *"without rigorous interactions and trust between us we would not be able to push the [digital] product through the testing phase and implement it on time".*

In this third stage, the evidence suggests that the relationship between team-specific cognitions and teamwork evolves but sustains the same mutually reinforcing logic. Initially, team-specific cognitions of the third stage emerge from teamwork functions of the previous innovation stage. Paul [*ComPack*, team leader] mentioned that *"from the way team colleagues behaved in the team, supporting and respecting each other throughout the creation of the digital solution* {teamwork functions, Stage 2}, *we had a firm unit, which was ready to support the launch of an innovative VoIP service* {team-specific cognition, Stage 3}". Similar quotes from other cases supported a notion that these refined team cognitions shape the teamwork functions of the third stage. Joanna [*Mobility-Combi*, team leader] emphasized that *"trust came later* {teamwork function, Stage 3} *and was a consequence of working in a cohesive team* {team-specific cognition, Stage 3}*".*

Interestingly, shared project-specific cognitions appear during the third stage, based on the 'confidence on project success' and 'commitment to commercialize the project on time'. Taskwork activities at this stage are bound within the requirements of implementing a digital innovation, and involve 'testing of the digital product with end users' and 'usability testing with experts', including team members' 'coordination of tasks for timely commercialization'. In a similar pattern, the project-specific cognitions of this stage stem out of previous stage taskwork. Steve [*Compack*, Director of Innovation at TELECOM] emphasized that *"the team undertook all major tasks and decisions for developing the ComPack project* {taskwork activities, Stage 2} *and this infused the team with increased commitment to implement and launch the digital service on time* {project-specific cognition, Stage 3}*".* Then, these cognitions guide taskwork during the third stage, as suggested by Max [*Orbit*, team member]: *"towards the end, the confidence on success was growing stronger* {project-specific cognition, Stage 3}, *and this was increasing our willingness to speed up the actions needed to put the product into the market* {taskwork activities, Stage 3}". Similar notions suggest that at this stage, shared project-specific cognitions guide the implementation of digital products by teams.

5.3 Cross-feeding Between Arenas, Across Innovation Stages

The findings illustrate that while team-specific and project-specific cognitions emerge within separate socio-cognitive arenas, these arenas would also cross-feed themselves across stages. This is an interesting finding, as it suggests that while team-specific cognitions are largely underpinned by teamwork functions (e.g. interactions), taskwork activities (e.g. brainstorming) also exert influence on the construction of team-specific cognitions. Such a notion is best exemplified by the *Orbit* and *Mobility-Combi* teams. John [*Orbit*, team member] emphasized that *"we had plenty of*

discussions and brainstorming sessions {taskwork activities, Stage 1}. *Most of them were very creative and fruitful. They were strengthening the feeling of sharing a common team* {team-specific cognition, Stage 2}". Sebastian [*Mobility-Combi*, team member] supported this notion by expressing that *"having knowledgeable people who could carry out key tasks and decisions on the content of new digital products* {taskwork activities, Stage 2} *enhanced our perception on our team's ability to deliver what was contracted for* {team-specific cognition, Stage 3}".

Moreover, teamwork functions play a role in the shaping of shared project-specific cognitions at a digital project level. Joanna [*Mobility-Combi*, team leader] emphasized that *"the team's commitment to the development of Mobility-Combi* {project-specific cognition, Stage 2} *was driven by the fertile relations between team members, which were apparent from the start of the project* {teamwork functions, Stages 1, 2}*".* Taken together, the cross-feeding activity between arenas had an impact on the accomplishment of tasks and the progression of a digital innovation.

The section that follows presents a conceptual diagram, which depicts the findings in an illustrative manner.

6. Discussion

In answering our question about how team process and cognition interact in the way a digital innovation team functions, our study provides empirical evidence of the key features of the digital innovation team cognition-process nexus. These features relate to the emergence, development, and content of such a nexus. The findings expand on recent works related to the emergence of digital innovation teams (Guinan et al., 2019) by providing a contrasting view to previously conceptualized intra and entrepreneurial teams by de Mol et al. (2015). The findings suggest that teams engaged in pivoting organizations through digital innovations engage in a process that

allows them to align their views about the change needed and its purpose. In doing so, our study contributes to understanding how digital innovation teams function (Dery et al., 2017; Nylén & Holmström, 2015; Guinan et al. 2019).

In line with the notion that context should play a more central role in theory development (Johns, 2017; Maloney et al., 2016), our study has incorporated contextual features and offers opportunities for context-sensitive theorizing in digital innovation teams research. The contextualization of our findings within digital transformation has allowed us to identify and appreciate the idiosyncratic features of teams (Kouchaki, Okhuysen, Waller, & Tajeddin, 2012, p. 171) addressing digital innovations. For instance, our findings highlight that digital innovation teams require rigorous ideation techniques, the flow of ideas from experts, and the use of intelligent systems to manage and organize ideas whilst seeking novelty. Further, as emerged from the findings, the challenges posed by digital innovation may often push team members to transform their tasks and perform them at higher (than expected) levels. For example, while beginning with simple ideation techniques, the team members in the three cases ended by professionalizing their brainstorming sessions and incorporating IT to register and manage new ideas.

The findings support the introduction of a conceptual model (Figure 2), which explains the emergence and transformation of two types of digital innovation team cognitions and the way they relate to specific (digital innovation) team process dimensions within particular socio-cognitive arenas. The model depicts the findings across three innovation stages. These stages advance from the digital project idea to its implementation. As explained, digital innovation team cognition is conceived within the context. The cases reflect digital innovation teams that are formed on an ad hoc basis within the telecommunications corporation in which they are embedded. Consequently, digital innovation team cognition emerges during the initial stage of the innovation project; this is

the stage where the digital technologies and their exploitation are explored, and team members socialize.

During the first stage of the project (idea and evaluation), digital innovation team cognition emerges as a dual outcome: a) team-specific cognitions required for digital innovation: these involve shared understandings on the identity of, and conditions within, the innovation team; and b) digital project-specific cognitions: these involve shared understandings on the value and future impact of the innovation project. During the first stage and in subsequent stages of the digital innovation project, each type of team cognition emerges from and influences team process, within a particular socio-cognitive sphere and in a mutually reinforcing manner. Digital innovation team-specific cognitions emerge out of teamwork and influence teamwork in the team socio-cognitive sphere. Digital innovation project-specific cognitions emerge out of taskwork and influence taskwork in the project socio-cognitive sphere. A cross-feeding between arenas may be possible, where taskwork and teamwork functions can influence (to a lesser extent) the emergence of team-specific and project-specific cognitions respectively. Taken together, the findings reveal that team processes construct team cognitions, which then influence teamwork and taskwork practices at different stages of the digital innovation project lifecycle.

[Figure 2 near here]

The present study contributes to our understanding of digital innovation teams literature, both theoretically and empirically.

6.1 Theoretical Contributions

Our study contributes theoretically in three ways: First, it advances theoretical understanding on hidden dynamics within innovation teams. This study conceptualizes the mutually reinforcing nexus between innovation team cognition, teamwork, and taskwork across an innovation life cycle. Prior studies have posed that team cognition and team process represent two diverse but interconnected spheres of entrepreneurial team functioning (de Mol et al., 2015; Eisenhardt, 2013). Our analysis has uncovered linkages and co-influences between critical innovation team functions. The dynamics that emerged in the findings illustrate the way innovation team cognition, teamwork, and taskwork interact and influence one another over time and across the entrepreneurial stages.

Second, it conceptualizes the 'functioning of digital innovation teams', by shedding light on what digital innovation teams do and how they approach projects in practice across the digital innovation lifecycle. This way, it draws on the call to theorize on this type of team in order to shed light on its idiosyncratic dynamics (Dery et al., 2017; Nylén & Holmström, 2015; Guinan et al., 2019). Our findings support the notion that innovation teams that are set deliberately (or assembled ad hoc) to drive and enable digital transformation are expected to have diverse yet complementary specialised skills, a disposition to learn, and to be able to renew their goals as they engage in a process that allows organisations to pivot (Guinan et al., 2019). We extend such a notion by elucidating the functioning features of a digital innovation team related to enhancing, through technologies (Santoro et al., 2018) and through constant refinements in action, the team tasks and the conditions required for materialising a digital innovation. An emphasis on digital transformation separates such teams from conventional innovation and entrepreneurial teams (Ben-Hafaïedh & Cooney, 2017) in the way that they go about accomplishing tasks, the nature of opportunities or projects they pursue (i.e. technology based), (Papa et al., 2018; Santoro et al.,

2018; Scuotto et al., 2017), and the unique socio-cognitive dynamics they engage in to generate ideas, merge new knowledge, and manage processes to implement digital solutions for their organizations. This study suggests that the nexus between team cognition and process allows digital innovation teams to accomplish the goals set by organizations in the context of digital transformation (Hess et al., 2016; Matt et al., 2015).

A third contribution is suggesting the relevance of what we term 'innovation team cognition'. Such a concept explains the way cognition at the level of the innovation team emerges and transforms across innovation stages. This concept allows us to theorise further on how teams function within existing organizations (Halme et al., 2012) and in the context of digital transformation. The unfolding of team-specific and project-specific cognitions, which occur within separate socio-cognitive arenas, suggests that team cognition can be conceptualised as a feature of digital innovation teams, underpinned by parallel processes of cognitive construction. Such a concept has potential applicability across organisational levels, as it can be extended to relationships between team members engaging in enabling digital transformation.

6.2 Empirical Contributions

Empirically, our study contributes to the innovation teams and digital innovation literatures in three ways. First, we extend knowledge in the innovation team literature on team cognition and the team processes of teamwork and taskwork. These are features that have been researched within entrepreneurial teams creating new ventures (de Mol et al., 2015; Eisenhardt, 2013) but not within innovation teams acting intrapreneurially within large organizations. At the same time, to the best of our knowledge, this is the first study to provide empirical understanding on the links between team cognition and team process within the innovation process.

Second, our study extends current knowledge on 'digital innovation teams' by addressing dynamics that have been latent so far in the literatures on digital innovation and digital transformation. We provide new empirical knowledge on the collective cognitions and team process influences, dynamics, and outcomes underpinning the digital innovation team. The digital innovation team is a type of entrepreneurial team; it has been limitedly researched compared to teams linked to new venture creation, until now (Ben-Hafaïedh & Cooney, 2017). Third, by addressing the team cognition – team process nexus within ad hoc teams, this study contributes empirically to the organizational teams literature by offering novel understanding on the evolution of socio-cognitive interactions through the lifecycle of ad hoc teams. It also provides new knowledge on the processes underpinning the construction of diverse types of team cognitions, which are not reflected in the literature on organizational teams.

7. Conclusion

The main purpose of this study was to theorize about the way digital innovation teams in organizations function by focusing on the interaction between team process (teamwork and taskwork) and team cognition. This study suggests that the digital transformation context does indeed matter for team processes and team cognition to unfold, and that the interaction between these two team dimensions is important for addressing digital innovations. This study contributes to our understanding and appreciation of context as an integrated part of the nexus of team processes and cognition.

Moreover, this study shows that digital innovation team cognition emerges and transforms in relation to teamwork and taskwork within innovation stages. Team cognition and team process cross-feed one another, in a cyclical and reinforcing manner. This study brings to light the

emergence of diverse nuances of team cognition, shaped by distinctive interactions between team cognition, teamwork, and taskwork within specific socio-cognitive arenas. Team-specific cognitions are shaped and transformed in relation to teamwork, within the team socio-cognitive arena, while project-specific cognitions emerge and unfold in relation to taskwork within the project socio-cognitive arena. Thus, the team cognition – team process nexus is critical for the cognitive and process functioning of a digital innovation team throughout the process of digital transformation.

7.1 Managerial Implications

The managerial implications of this study relate to the sources of practical knowledge and advice in the way digital teams operate, which can support and benefit organisational actors involved in digital innovation activities. The findings have practical implications for managers who have to design and execute digital strategies where business-oriented decision making may be intrinsically linked to the way businesses benefit from the use of technology (Scuotto et al., 2017). First, digital transformation will require not only a focus on technology but the nurturing of a culture where knowledge management systems, relying on digital technologies, allow leaders of innovation projects to obtain information about experts across departments and their complementary skills. Such an approach will enhance the way digital innovation teams move beyond an ad hoc forming stage (Guinan et al., 2019). The blend of experts coming together and their respective personalities is essential to the emergence of team cognitions that can shape effective teamwork and taskwork throughout the digital innovation project.

Second, the findings suggest that managers need to become more aware about the way digital innovation team conditions and constraints can take place in the context of digital innovation

projects. In doing so, managers can have a more effective intervention in the functioning of teams, providing training, solutions, and information tools that can allow a fruitful interaction between team cognition and team process (Singh et al., 2020). Overall, a better understanding of the nexus between team cognition, teamwork, and taskwork can make managers more effective in the team innovation cycle (Hass & Cummings, 2020) and make teams accomplish tasks in the process of digital transformation.

7.2 Limitations

This study has a few caveats, so the findings must be interpreted with caution. First, the sample of comparative cases is small, and the sampling logic would have been stronger if a broader sample of cases from industries with significant levels of digital transformation had been included. Nonetheless, the sample consists of teams embedded in an industry that is at the forefront of digital transformation (i.e. telecommunications) in Europe, allowing theoretical relevance (Eisenhardt, 1989). Moreover, we relied on a unitary sequence model of innovation (Gopalakrishnan & Damanpour, 1997; Saren, 1984), which may not apply across settings and industries (Ellwood & Horner, 2020).

7.3 Future Research Opportunities

This study underscores that a focus on digital innovation teams, and how they might have implications for digital transformation, opens up avenues for theorising. As suggested by Santoro et al. (2018), comparative studies between several countries could and should expand our knowledge on and understanding of the subject, particularly if the underlying cultural factors are introduced to the local innovation system. Such studies will be increasingly relevant as digital

transformation will see the emergence of diverse teams (Guinan et al., 2019) where cultural diversity can influence innovation teams' performance (Wang, Cheng, Chen, & Leung, 2019). Drawing on theoretical saturation principles, future qualitative studies can select and research more digital innovation teams embedded within diverse organizations. Further studies at the group level, for example, may focus on digital transformation associated to the increasing use of virtual teams, which calls for attention to the nexus depicted in this study as well as adaptation processes required within organizations (Breuer, Hüffmeier, Hibben, & Hertel, 2020). Future lines of research that may be very interesting to explore relate to how heterogeneous teams work in diverse contexts that call for the analysis of organisations in collaboration with others, in an ecosystem such as smart city projects (e.g. Ardito et al., 2019; Ferraris, Erhardt, & Bresciani, 2019). This can provide more insights on both cross-team socio-cognitive similarities and within-team practices. Also, the relationships depicted in our model can be tested empirically, using large-scale surveys or panel data. This will allow generalizing to a broader population of high-tech organizations and extend our understanding of digital innovation teams across industries.

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Table 1.

Profile of Interviewees

Case	No.	Pseudonym	Role	Innovation Stage Involved		
				Idea & evaluation	Design & Development	Implementation & Implementation
Compack team (case 1)	1	Paul	Team leader	√	√	√
	2	Jessica	Customer services		√	√
	3	Luke	Marketing		√	√
	4	Sophia	Business support systems	√	√	√
	5	Nathan	Analytics	√	√	
	6	Albert	Database development		√	√
	7	Mary	Business Market			√
	8	Louise	Software development	√	√	√
	9	Peter	Business market			√
	10	Mathew	Mobile services	√	√	√
	11	Susan	Commercial services director - TELECOM	√	√	√
	12	Steve	Director of innovation - TELECOM	√	√	√
Mobility-combi team (case 2)	1	Joanna	Team leader	√	√	√
	2	Jake	Business market	√	√	√
	3	Sebastian	Networks & platforms	√	√	√
	4	Edward	Business support systems		√	√
	5	Aaron	Software applications		√	√
	6	Ethan	Mobile services	√	√	√
	7	Alice	Marketing	√		√
	8	Chloe	Consumer market			√
	9	Hannah	Technology & information systems director – DATACOM	√	√	√
	10	Barry	Director of entrepreneurship & innovation - DATACOM	√	√	√
Orbit team (case 3)	1	Carl	Team Leader	√	√	√
	2	Susan	TV services			√
	3	Max	Software applications	√	√	√
	4	John	Software development	√	√	√
	5	Theo	Customer support			√
	6	Nicholas	Information technology systems	√	√	√
	7	Daisy	Streaming services	√	√	√
	8	Mike	Director of corporate strategy - INTERCOM	√		
	9	Laura	Head of innovations - INTERCOM	√	√	√

Table 2.
Team Cognition and Team Process: Key Features

Theme	Sub-theme	Innovation Stage		
		Idea & Evaluation	Design & Development	Testing & Implementation
Team socio-cognitive arena	Team-specific Cognitions	Positive & creative team climate Traits & values in Common	Team and individual How we complement one another	Sense of team cohesiveness Collective efficacy
	Teamwork features & conditions	Getting to know each other Sharing stories Interactions & socialization	Positive work relations Mutual support Openness and acceptance	Positive work relations, trust, bonding
Project socio-cognitive arena	Project-specific Cognitions	High project novelty High project risk	Clarity on project direction Project leadership is crucial Commitment to the project	Confidence on project success Commitment to commercialise project on time
	Taskwork activities	Team brainstorming Focus groups with experts and prime users IS to register, score, and organize ideas	IS supported formal project management (deadlines, processes, costs, quality resources etc) Assessment of market, competition, company capabilities to align project Decisions on digital product content & features	Testing digital product with users (end user testing) and refinements Usability testing with experts and refinements Coordination for timely commercialization

Figure 1. Final data structure

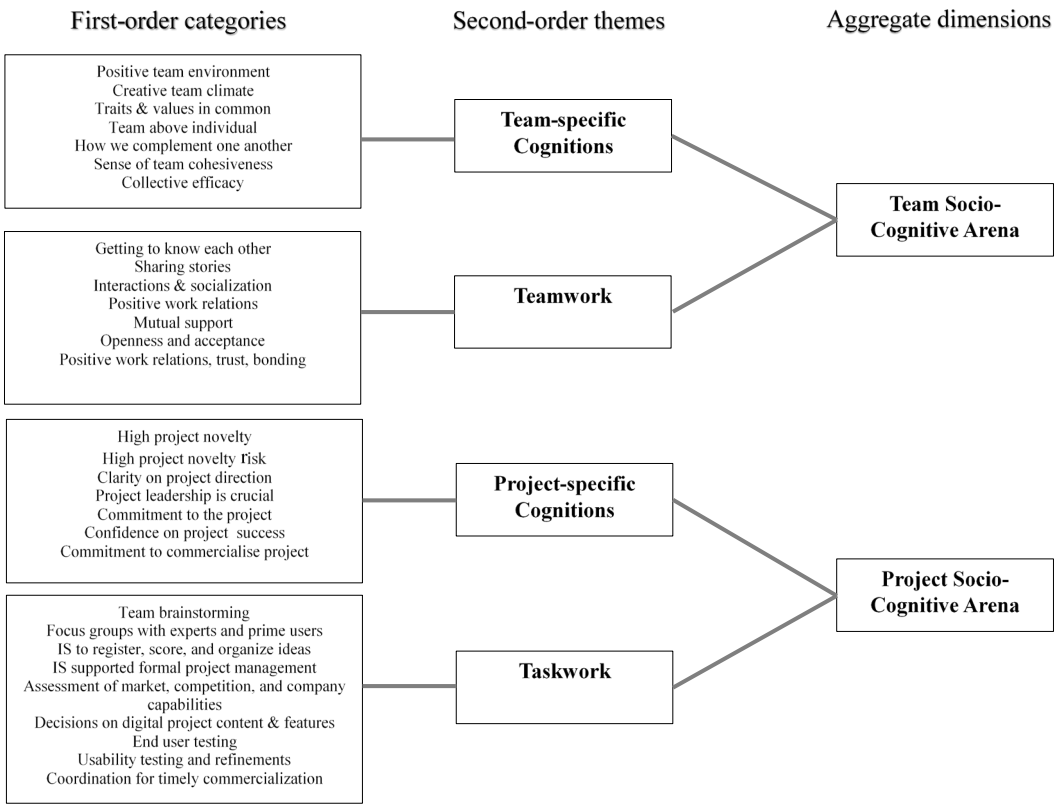
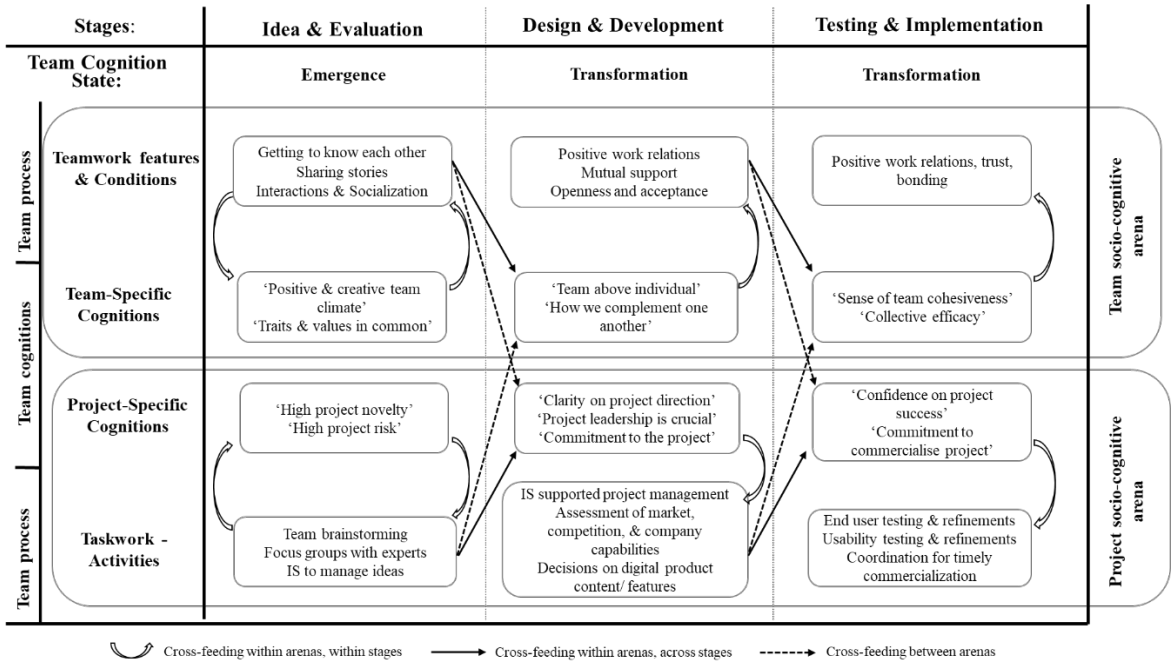


Figure 2


Stages:
Idea & Evaluation
Design & Development
Testing & Implementation
Team Cognition State:
Emergence
Transformation
Transformation
Team process
Team cognitions
Team process
Teamwork features & Conditions
Team-Specific Cognitions
Project-Specific Cognitions
Taskwork - Activities
Getting to know each other
Sharing stories
Interactions & Socialization
'Positive & creative team climate'
'Traits & values in common'
Positive work relations
Mutual support
Openness and acceptance
'Team above individual'
'How we complement one another'
Positive work relations, trust, bonding
'Sense of team cohesiveness'
'Collective efficacy'
Team socio-cognitive arena
'High project novelty'
'High project risk'
Team brainstorming
Focus groups with experts
IS to manage ideas
'Clarity on project direction'
'Project leadership is crucial'
'Commitment to the project'
IS supported project management
Assessment of market, competition, & company capabilities
Decisions on digital product content/ features
'Confidence on project success'
'Commitment to commercialise project'
End user testing & refinements
Usability testing & refinements
Coordination for timely commercialization
Project socio-cognitive arena
Cross-feeding within arenas, within stages
Cross-feeding within arenas, across stages
Cross-feeding between arenas