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SHARING LEADERSHIP THROUGH DIGITAL COLLABORATIVE TOOLS

Research paper

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Abstract

This paper contributes to the understanding of the role of collaborative tools and objects in the emergence and support of shared leadership, which has been associated with positive team dynamics and innovative outcomes. We draw on ideas from the recent discourse on viewing leadership as a practice that involves human actors and material or technological tools to provide the first analysis of the features of collaborative tools that can support shared leadership. We present our early findings and insights from a multiple case study of ten innovation teams in their interaction with a collaborative tool that is particularly designed for coordination. We suggest that collaborative tools can contribute to shared leadership through two facilitating features: shared problem space and shared visualisation. Through our findings, we highlight the role of collaborative tools in supporting teams in sharing leadership for the purpose of joint innovation.

Keywords: Shared leadership, Collaborative tools, Innovation, Distributed teams.

1 Introduction

Among the various forms that leadership can take, shared leadership has recently been considered among the most effective for continuous innovation (Ensley et al., 2006; Hoch, 2013; Hoegl and Muethel, 2007). Shared leadership is a “dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both” (Pearce and Conger, 2003, p. 1). The idea stands in contrast to what Pearce and Manz (2005, p. 139) called “the top-heavy, heroic model of leadership in order to extract work-product from their employees”. The study of shared leadership has gained importance as work is increasingly organised around horizontal, distributed, and cross-boundary teams (Chuang et al., 2016; Edmondson and Harvey, 2017). Such teams are better suited to undertaking innovation and complex projects that require the collaboration of individuals with different sets of expertise (Faraj and Sproull, 2000).

Several studies have investigated the relationship between shared leadership and the performance of innovation teams (e.g., Ensley et al., 2006; Hoch, 2013; Hoch and Kozlowski, 2014; Hoegl and Muethel, 2007). They conclude that teams in which leadership is shared generate more creative ideas in terms of quantity and quality, display greater willingness to share their ideas and unique information with each other, and implement these ideas more effectively. Moreover, shared leadership promotes satisfaction in virtual team members (Robert and You, 2017), who rely chiefly on information and communication technologies to collaborate, making them prone to negative experience (see De Guinea et al., 2012).

There has been growing interest in the antecedent conditions of shared leadership and the type of environments that enable it (DeRue and Ashford, 2010; Dinh et al., 2014; Lord and Shondrick, 2011; Serban and Roberts, 2016). For example, Carson et al. (2007) suggested that an environment favourable to the emergence of shared leadership consists of three highly interrelated dimensions: shared purpose (team members have a common sense of purpose and focus on collective goals), social support (team members support each other through encouragement and recognition of others’ contributions and achievements), and voice (team members have constructive change-oriented conversations during which everybody can provide input and make decisions).

Other scholars have noted the importance of analysing shared leadership not only as a purely social phenomenon but as a practice that both influences and is influenced by the material objects and technologies (Spillane et al., 2004; Spillane, 2009). Several studies regarded technology as a mediator between shared leadership and performance (Al-Ani et al., 2011; Avolio et al., 2014; Hoch and Dulebohn 2017; Powell et al., 2004) and have noted how information technologies can be a mediator between shared leadership and performance. Other studies regarded technologies and objects as enablers or antecedents of shared leadership, that in turn influence performance (e.g., Balthazard et al., 2004; Mailhot et al., 2014; Oborn et al., 2013). However, little is yet known on what it is in the technologies and tools that supports shared leadership.

In this research project, we build on the recent works on the performativity of collaborative tools on group dynamics, i.e. the tools that are used to communicate, promote shared understanding and negotiation (Nicolini et al., 2012). We seek to open the black box of the interaction between collaborative tools and shared leadership by analysing the features of the tools that support or enable shared leadership. Therefore the question we seek to answer is: *What are the main features of the collaborative tools that facilitate the emergence of shared leadership?*

To do so, we report insights from the cases of innovation projects that were supported by an innovation consulting company that incorporated a collaborative tool called the Team Alignment Map (hereafter referred to as “the Map”) in its innovation methodology. The Map is a digital tool that was designed for its impact on team coordination for the purpose of a larger study on the role of collaboration objects in innovation teams (Avdiji et al., 2018). The Map supports teams in defining four fundamental elements that members should agree on for effective collaboration: joint objectives, joint commit-

ments, joint resources, and joint risks. The teams used the Map in a mixture of collocated workshops and virtual meetings in moving toward their innovation goals. We collected data on ten distributed innovation teams through semi-structured interviews to analyse their practices and the interaction with the Map. Our contributions are twofold: (1) we found two facilitating features of a collaborative tool that enable innovation teams to share leadership: shared problem space and shared visualisation, and (2) we identified social contract as an additional antecedent condition that is important in the emergence of shared leadership. These two contributions suggest that technologies that emphasize a collaborative definition and decision on the elements of work could provide adequate means for distributed and cross-boundary teams to organize their work.

2 Conceptual Background and Prior Studies

2.1 Sharing leadership in innovation projects

The notion of shared leadership was conceived by Pearce and Sims (2000; 2002) in the quest of giving voice to the followers while keeping the leading figures in the limelight. To them, leadership is shared when it emanates from members of the team, and not simply from the appointed leader. Shared leadership is defined as “a dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both” (Pearce and Conger, 2003, p. 1). Based on this definition, the main characteristics of shared leadership can be summarized as follows: (1) multi-direction of influence and (2) ownership of joint goals; and (3) the interchange of the assumed leadership role without necessarily distributing or stretching it among several team members. This is different from distributed leadership in which influence is distributed across several individuals working on different sub-tasks of the overall project through mechanisms, structures, and processes, without these individuals necessarily working together. The substitution of the role of vertical leaders is manifested in new forms of leadership. Among them are self-leadership, emergent leadership, and shared leadership (Hoch and Dulebohn, 2017). Table 1 provides a comparison among the three constructs.

Construct	Definition	Reference
Self-leadership	Self-influence process through which people achieve the self-direction and self-motivation necessary to perform	Neck and Houghton (2006, p. 271)
Emergent leadership	Individual's completion of leader-like work duties and occupying positions of leadership or authority either within or outside of the work domain	Cogliser et al. (2012, p. 753)
Shared leadership	A dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both	Pearce and Conger (2003, p. 1)

Table 1. Comparing self-leadership, emergent leadership, and shared leadership

Compared to vertical leadership, shared leadership has been found to enhance team potency and cohesion, and the number and quality of product ideas in the context of new product development (Cox et al., 2013). Moreover, shared leadership allows teams to inquire and solve complex problems more effectively (Cox et al., 2003; Huelshager et al., 2009; Morgeson et al., 2010). It has a positive impact on idea generation and creativity, it allows team members to inquire and solve complex problems more effectively, and team members are more willing to share information and display higher commitment (Cox et al., 2003; Huelshager et al., 2009; Morgeson et al., 2010; Pearce and Manz, 2005). Also, studies on virtual collaboration found that shared leadership leads to better team dynamics and higher team performance (i.e., innovation) than vertical leadership (Hoch, 2013; Hoch and Dulebohn, 2017).

2.2 Antecedent conditions of shared leadership

Given the effectiveness of shared leadership for innovation and collaboration, several scholars were interested in identifying its antecedent conditions and the types of environments that enable it (*e.g.*, DeRue and Ashford 2010; Dinh et al., 2014; Lord and Shondrick, 2011; Serban and Roberts, 2016). Shared leadership emerges when both the team's internal and external environments are supportive of it (Avolio et al., 1996; Carson et al., 2007). Carson et al. (2007) identified four antecedent conditions of shared leadership that relate to these environments. An internal team environment that supports shared leadership is determined by three dimensions: (1) *shared purpose* that is manifested in similar understandings of team's primary objectives and focus on collective goals; (2) *voice* that is exhibited through interaction facilitation and participative behaviours in teams; and (3) *social support* in encouraging and recognizing individual and team contributions and accomplishments. When the team's internal environment enables shared leadership, it encourages team members to assume leadership roles and rely on the leadership of their peers. In addition to these dimensions, (4) supportive external environment (*e.g.*, coaching from an external leader) helps team members make coordinated and task-appropriate use of their collective resources in accomplishing their tasks.

2.3 Shared leadership and collaborative tools

The last decades have seen a shift from the leader-centric view towards a more relational view of leadership practices. Scholars have applied the relational perspective in different contexts, such as school leadership (*e.g.*, Coldren and Spillane, 2007; Halverson, 2007) and policy making (*e.g.*, Oborn et al., 2013). The relational perspective sees leadership as mechanisms that enable collaboration and that are enacted through the interaction between leaders, followers, and the material and symbolic artefacts in the situation (Huxham and Vangen, 2000; Spillane et al., 2004; Spillane, 2009). Several authors have thus considered the role of collaborative tools in the practice of sharing leadership as an assemblage of actors and objects building on Latour's (2005) actor-network theory. Oborn et al. (2013) examined how policy makers constitute leadership through a socio-technical entanglement of polls, statistics, technologies, and coalitions. They found that technologies (*e.g.*, clinical tools and computer animations) play important roles in supporting sensemaking and democratization in the policy process. Mailhot et al. (2014) conceptualized leadership to involve actor-object couplings and delved into how it empowered collaborative ventures across disparate thought worlds. What these studies have in common is that: (1) they exhibited how and why a certain leadership practice takes place by considering material entities as its defining components, (2) they confirmed the nature of leadership practices as emergent and fluid (Gronn, 2000; 2002), and (3) they have demonstrated how leadership roles are transmitted among multiple individuals over time through objects and technologies.

Studies on the roles of technology in shared leadership and virtual teams can be summarized in the following themes (*see* Avolio et al., 2014 *for a complete review*). Scholars have observed increased use of technologies, such as instant messaging (*e.g.*, Cameron and Webster, 2005) and 3D collaborative virtual environment (*e.g.*, Montoya et al., 2011) that reduce the transmission of nonverbal cues. Therefore, research in affective, haptic, and robotic devices to enrich virtual communication is flourishing to address the challenge (*see* Pentland and Choudhury, 2000; Smith and MacLean, 2007). Technologies indeed contribute to greater transparency and access to information that in turn may influence team perception, support, and trust (Kahai, 2013). Leaders-followers' relationship and team dynamics are also influenced by the rise of social networks through social media (Kahai, 2013), the increasing use of tracking devices (Silverman, 2011), and constant availability (MacLean, 2008).

In Information Systems, leadership has been studied with regards to the technologies used by teams (Dennis and Garfield, 2003; Li et al., 2016; Sharma and Rai, 2015) and in the context of virtual collaboration (Boughzala et al., 2012; Faraj et al., 2015; Malhotra et al., 2007). Despite their widely acknowledged importance, there is still little known about how digital collaborative tools support shared leadership. The few studies that have analysed this interaction either emphasize on social dynamics without considering what it is in the tools that enables shared leadership (Mailhot et al., 2014)

or they focus their discussion on boundary objects (Oborn, 2013). Boundary objects work as translators between different thought worlds or boundaries as they can be interpreted differently across boundaries but have enough immutable content to maintain a common identity across the different social worlds (e.g. maps, field notes). However, as noted by Nicolini et al. (2012), collaborative tools do not only act as boundary objects. There are three additional types of objects with different affordances and functions: *infrastructure objects* that provide the "mundane" infrastructural support of collaboration and make interaction and exchange possible (e.g. emails, meeting rooms); *epistemic objects* that fuel cooperation and generate mutuality and solidarity by displaying what is missing or what is not yet known to the group who is attached to filling the lacks (e.g. prototypes, research proposals); and *activity objects* which provide a problem space for individuals to negotiate the objective and the direction of their joint activity (e.g. contract).

Given the variety of functions that collaborative tools can perform, it is crucial to understand what features of the collaborative tools enable and influence shared leadership. We believe IS scholars can contribute to the discourse on shared leadership by considering the roles of both actors and objects in the practice. For that purpose, we seek to answer the following question: *what are the main features of the collaborative tools that facilitate the emergence of shared leadership?*

3 Methods

3.1 Collaboration setting and the use of the Team Alignment Map

The digital collaboration setting we investigate in this paper involves a total of ten teams that worked on four innovation themes (e.g., new pharmaceutical product development, new methods of product evaluation). It means, two or more teams can be involved in one innovation theme. These innovation teams were indeed formed for the purpose of identifying, developing, and evaluating new ideas by individuals from diverse roles and expertise who collaborated during a given time period with a dedicated external coach. Consequently, each team is expected to have its own project with distinct deliverables/ outcomes, even though it may share an innovation theme with other teams. Teams are composed of an external coach and an innovation methodology expert from an innovation consulting company, and a project sponsor and specialized team members from the client organization. The innovation company is headquartered in Switzerland and employs more than 40 employees. The company specializes in developing trainings, tools, and methodologies for managing innovation projects with external client companies. Most of the employees work remotely in different countries. Members of these teams collaborated in both collocated and distributed settings.

All innovation teams used a collaborative tool called the Team Alignment Map, which is a digital shared display in the form of a canvas that supports team conversations for coordination. It was designed for its performativity on team coordination (Figure 1) (Avdiji et al., 2018). The Map was designed as part of a design science research project for cross-boundary team coordination (Mastrogiacomo et al., 2014; Missonier et al., 2014). In Avdiji et al. (2015), the content of discussions for effective team coordination is defined as consisting of four domains: joint objectives, joint commitments, joint resources, and joint risks.

This conceptual background was instantiated in the Map for the purpose of providing visual support to frame the content (through the four columns) and form (collective and active participation) of team discussions during meetings. Individuals collectively discuss and fill these four domains using sticky notes (in a collocated setting) or with digital tags (in a digital setting). For a given project, team members first define the joint objectives that should be reached for the project. Team members then attach to each objective at least one commitment. A commitment represents an action or activity that one or more team members agree to do to achieve an objective. Finally, team members outline the joint resources they need for their project and the joint risks that might impede on their activity. Teams were suggested that the usage of the Map be closed when team members are mutually satisfied with all the elements in the columns and they all feel they understand the elements correctly. The directions for

use of the Map are similar in collocated and distributed settings. The digital version has the same shared display and participants fill it collectively and in real-time using tags and text boxes rather than sticky notes.

The Map was initially integrated by an innovation consulting organization in their methodology specially tailored for innovation projects, for the purpose of coordinating the different stakeholders: their clients' innovation teams, the external coaches, and the methodology experts from the innovation consulting organization. The latter organization decided to use the Map on their own initiative. This suggests that the Map has practical relevance to the teams and is appropriate to their contexts. In all cases, the Map was used between one and two weeks after the beginning of the project to negotiate the terms of the project and how teamwork would be carried out. In one case (PHARM, Table 2) it was used every quarter as the project spanned over 18 months. The contents of the Map were often refined with project management tools, such as work breakdown structures for the joint objectives or Trello for the joint commitments.

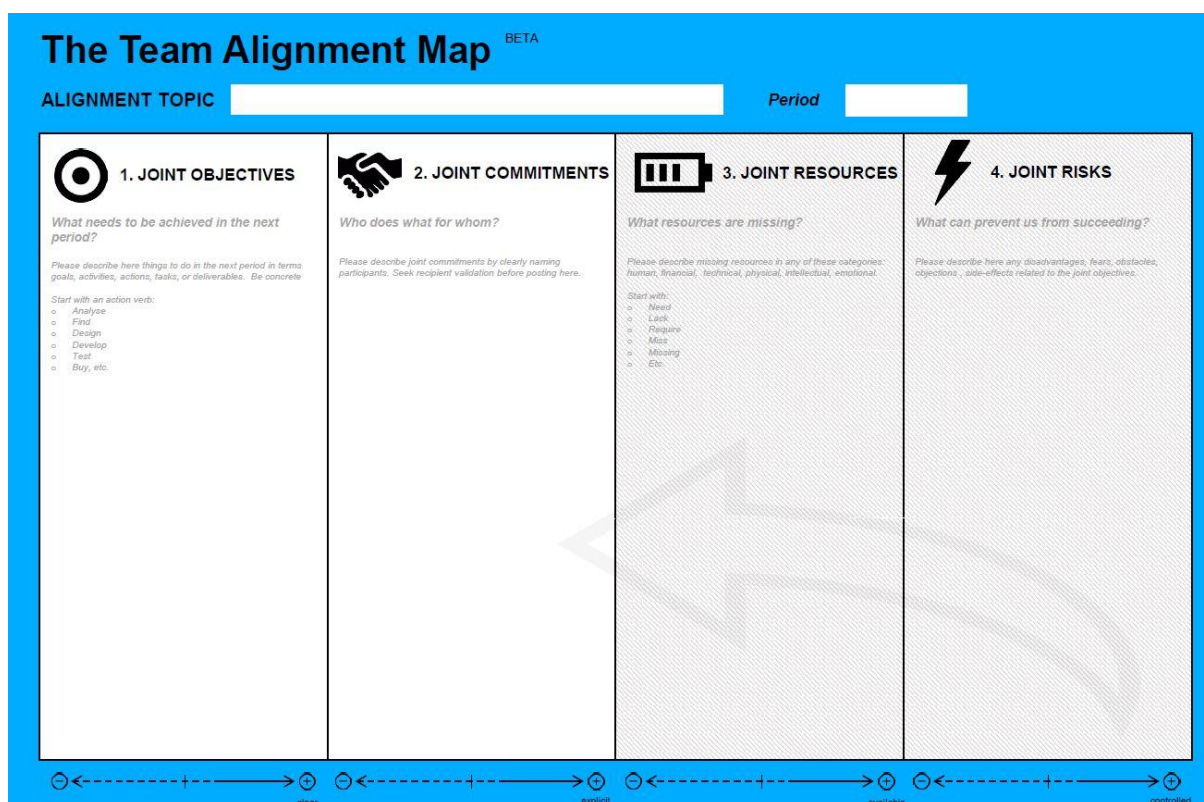


Figure 1. The shared display of the Team Alignment Map.

3.2 Data collection

The research question calls for a qualitative and exploratory approach as little is known about the role of collaborative tools and objects in the emergence of shared leadership. The purpose of our paper is to develop initial theoretical insights on this role. In fact, qualitative data is well-suited to analyse complex social processes and phenomena (Eisenhardt and Graebner, 2007). Interview remained the chief source of first-hand data in this study, in agreement with Walsham's (1995, p. 78) observation that "it is through this method that the researcher can best access the interpretations that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants". We review the data resulting from 7 semi-structured interviews with 3 experts in an innovation methodology and 4 external coaches (Table 2). This study was conducted as a part of a larger research project on the material practices of innovation ventures.

We chose external coaches and innovation methodology experts as our informants for three reasons: (1) they have worked intensively with each innovation team, (2) they can use both insider’s and outsider’s perspective in observing the teams’ collaboration dynamics, (3) they have been sensitised with the features of the Map and are therefore able to articulate specific features in use when narrating their story.

The aim of the interviews for this paper was to gather initial insights on how the teams made use of and were influenced by the Map, even though multiple instances of collaborative tools were used within the teams. In the first part of the interviews, informants were asked to provide general and contextual information about their teams and projects, their roles and responsibilities within the project, the dynamics of the interactions between team members, and the main collaborative challenges they faced. The second part of the interviews was dedicated to understanding the impact of the use of the Map. Thereby, informants were asked to describe and explain the situated practices and uses of the Map within each context. More importantly, each informant was explicitly asked to think of a specific team when narrating a story. The interviews were transcribed verbatim and resulted in 51 single-spaced pages.

Innovation Theme	Innovation goal	Duration	Informants
TEX 1 team of 7 individuals	Testing and validating a new product for a competitive advantage.	10 weeks	Methodology expert External coach
R&D 4 teams of 5 individuals	Developing a common language among cross-functional research and development teams.	4 weeks	Methodology expert
PHARM 2 teams of 5 and 6 individuals	Developing new products.	18 months	External coach 1 External coach 2
TDC 3 teams of 5 to 10 individuals	Developing new product.	10 weeks	Methodology expert External coach

Table 2. Description of innovation themes, teams, and our informants

3.3 Data analysis

The data was analysed using qualitative methods (Flick, 2007; Yin, 2013). As previous studies have identified three internal environment antecedent conditions of shared leadership (shared purpose, social support, voice), an initial framework consisting of these three general categories was used to facilitate the first fragmentation of the data. These three categories served only as a foundation for the iterative process which involved going back and forth between the data and the categories.

Given that previous research on shared leadership had been quite silent on the role of collaborative tools, we relied on emergent coding in which we undertook a second round of coding, this time with the open coding approach (Miles and Huberman, 1994). Two emerging categories emerged from data (shared problem space and shared visualisation), and this process allows also to identify a new category related to antecedent conditions of shared leadership (social contract). We then conducted axial coding to explore links between those emerging categories and also comparing these categories with what has been described in the literature as the roles of collaborative tools. Therefore, theory and evidence informed each other in our analysis. This open coding process and the creation of categories and the subsequent division, combination, or abolishment of the same, were maintained in successive examinations of the transcription.

During the course of our research, we have undertaken several measures to demonstrate five quality criteria as proposed by Lincoln and Guba (1985) and Marton (2013) in the following ways: (1) justifying how the methods of data collection and analysis are suitable for the characteristics of our cases and informants; (2) providing thick description in our analysis; (3) following Yin’s (2013) guidelines to

conducting and analysing case study; (4) conducting confirmability audit with our informants; (5) ensuring agreement between the authors' interpretations.

4 Findings

Our findings reveal in all teams that the use of the tool facilitates the emergence of 4 major categories that relate to the antecedent conditions of shared leadership: shared purpose (extended to team alignment based on the findings), voice, social support, and social contract. The first three categories have already been identified by previous literature (Carson et al., 2007). Our analysis adds that social contracts (i.e. when team members agree on their commitments and feel they are bound to them collectively) are supported by the Map and prove important as an antecedent condition for shared leadership. We also identified two emerging categories that are related to the facilitating features that enable and direct the shared leadership dynamics within the team: shared problem space and shared visualisation. Hereafter, we will describe in greater detail how voice, social support, team alignment, and social contracts were enabled by the features of the Map. We present the major categories in Table 3. Before elaborating on each category, we will outline the emergence of shared leadership with the teams.

High-level category	Subordinate category	Source	Definition
Antecedent conditions	Shared purpose extended to Team alignment	Carson et al. (2007) Extended in the findings	Team alignment defined as: Shared purpose and knowledge on the elements of the joint activity (i.e., joint objectives, commitments, resources, and risks). It results into a social contract that represents the mutual agreement by the participants on the four elements.
	Voice	Carson et al. (2007) Confirmed in the findings	The degree to which a team's members have input into how the team carries out its joint activity.
	Social support	Carson et al. (2007) Confirmed in the findings	Supporting and encouraging each other's contributions.
	Social contract	Emerged in the findings	Mutual agreement and commitment by the participants on their contributions to the joint activity.
Facilitating features	Shared problem space	Emerged in the findings	Collaborative physical or virtual space in which individuals must jointly encode the elements of their shared problem.
	Shared visualisation	Emerged in the findings	Quality of an object allowing all participants to see the object and its evolution simultaneously.

Table 3. Definition of the categories

4.1 Emergence of shared leadership

All projects included stakeholders from different organizations and with different roles and functions (innovation teams, project sponsors, methodology expert, and external coach) and there were no pre-established structures, rules, functions, and responsibilities. In all cases except the PHARM project, the innovation projects were undertaken by ad hoc teams consisting of individuals from different functions in the client organization. Therefore, the methodology experts and external coaches decided to use the Map on their own initiative, to create alignment between the different stakeholders at the beginning of the projects. In fact, it was important for all respondents to start the project in a well-aligned way and have everyone on the same page. Interestingly, the coach of the TEX project regarded the Map as "a good sanity check on [...] the things that we need to be aware of and mindful of".

Our informants narrated dynamics in their teams that display three characteristics of shared leadership as defined in Section 2: (1) multi-direction of influence, (2) ownership of goals, and (3) the interchange of the assumed leadership role.

Regarding the multi-direction of influence, one informant described the dynamic in his team as a safe environment in which anyone within the team could state their needs, expectations, and obstacles. The external coach of the TDC project related his own experience this way: *“I can share stories. I can share a heavy need for utilisation and where not so much [...] It’s not a negotiation about a contractual thing. It’s more a negotiation about what kind of... for example resources, what kind of commitments I need.”* This illustration implies the multi-directionality of influence among team members, in which each member can ask the team for support, resources, and commitments. The multi-directionality becomes more apparent in the explanation of the Map by the external coach in the TEX project when they *“would come back to [the tool] as a placeholder: ‘Hey remember when we said we were going to do this and this? You know, if this changes, it makes it more difficult for us’”*.

The ownership of goals is reflected in the stories where, once the conversation with the Map is initiated, team members influence each other towards their joint goals. Team members would go as far as reminding themselves about their own commitments as well as those of their colleagues in order to ensure that everyone is advancing towards the goal. What is meant by joint goals is captured by *“Do we all understand what we’re trying to march towards?” Because if we don’t, you know, it’s easy to get side trapped in innovation sprints and chase something that is shiny and that doesn’t fit to your goals. It’s good to kind of bring people back.”* (external coach, PHARM).

Moreover, the teams displayed an interchange of leadership role, as is obvious in the following stories about the Map related by the external coach of the TDC project *“[The team] uses it to practically look at ‘what is the next thing? Who is going to do that?’ and we use it as a way to look at tasks and resources allocation”*. In the same vein, he also stated that with the Map *“you get to the very meaningful discussion of ‘who needs to do what?’, everybody takes a step back and crosses their arms because now they have to do something”*.

These examples illustrate how the Map helped shared leadership emerge within the teams by addressing its three characteristics. The remainder of the findings is dedicated to outlining the categories that emerged in our findings relating to the antecedent conditions of shared leadership and how these were supported by the features of the Map.

4.2 Team alignment (shared purpose)

Team alignment was perceived as the result of making the four elements of the activity explicit and on which everybody agrees. Team alignment then not only includes sharing the purpose of the activity, but also the commitments, resources, and risks. This suggests that shared leadership does not only depend on the extent to which people share the objective as has been outlined by previous literature, but that individuals should be aware and agree on the four elements. The external coach of the TEX project described this need as follows: *“My fear there and that’s happened to me in the past: if you’re not aligned on the goals, on what you’re trying to achieve, what the level of commitment is and then talk about who’s involved and what’s involved and the risks... then you risk coming out of any hands-on session and everybody going in different directions that they think they agreed because they didn’t explicitly visualise or ever talk about it”*. This also suggests that team alignment is supported by the facilitating feature of **shared visualisation** that the Map provides. In fact, it is facilitated by the fact that team members *“have that all explicit on the tool”* (external coach, TDC) which makes *“[the discussion] more tangible”* (methodology expert, TEX).

4.3 Voice

Voice is the degree to which a team’s members have input into how the team carries out its joint activity. In each project, team members related that the Map was useful in facilitating interaction among

them and that they felt a collective sense of contribution and responsibility. Voice is more than just interaction or communication - it is about the feeling of being heard and listened to, and therefore being empowered through communicative participation in a project discourse, including critical events such as sense making and decision making. In what follows, the rise of voice in team collaboration with the Map is elaborated.

The methodology expert of the TEX project described that using the Map *“is not so much filling it out and assigning roles and responsibilities to people. It’s more ‘okay here are the main points we need to make sure that we cover’”*. Team members interpreted the empty columns of the Map as a problem space that was shared and was to be used by all parties. This feature of the tool made participants perceive the conversation as an exercise in which everyone had to fill the parts of the empty spaces. As the external coach of the TEX project underlined, *“it becomes more about the structured conversation and the tool, and less an emotionally charged thing where people are just free-form building other’s fears. And it’s okay, you know, ‘now we’re just trying to fill this out, we’re just talking about it’. You can really redirect it back to the [tool]”*. This objectification of the conversation made conversations less personal, in which individuals felt welcome to share their opinions and views and where criticism and disagreement were welcome. The external coach of the TDC project regarded the tool as *“a good way for [others] to challenge me and my thinking”*. Furthermore, each member could notify any inconsistencies between the elements in the four columns or any missing elements they had noticed, and they did so on their own initiative. *“I find that it also helps you come up with more. Be able to look at it and say ‘there’s something missing here’ or ‘we forgot to discuss about the objectives, we didn’t talk about the resources’. Visually, it just helps prompt, it becomes a prompt to make sure that it’s as complete as possible”* (external coach, PHARM).

Based on these accounts, we can distinguish two ways in which **shared problem space** was perceived to be a facilitating feature in the emergence of voice: Firstly, it facilitated a collective dynamic during the conversation in which everyone was involved and asked for their input. Secondly, the shared problem space provided a visual overview of the elements of the activity that team members put on the Map, allowing them to refine the alternatives that they agreed on.

The **shared visualisation** made team members more engaged during the conversation as the conversation became visual and easier to follow. The methodology expert of the R&D project compared a virtual conversation with the Map to a voice-only and concluded *“if someone had to do this over the phone with me and the client, I might just daze out and then I’d be like ‘hey what were we talking about?’. This is just an easy way to keep track on what point we’re on. Or what are we working on. I’m super visual.”* The methodology expert of the TEX project even related shared visualisation to the binding impact of putting a sticky note that everyone can see: *“The Team Alignment Map makes them pay attention more because they want to make sure ‘ok what did I commit to? What did I say I would do?’. I think it makes them a little bit more engaged than kind of designing the agreement [alone].”*

4.4 Social support

All respondents perceived that the Map supported their conversation and allowed them to point to topics of discussion that they consider as difficult to address. As the tool was perceived as a **shared problem space** in which the goal was to come up with a mutually satisfying solution, it allowed team members to prompt conversations about topics which they may have left unnoticed but which might have caused harm to the team in the long run. Team members were able to support each other in designing the elements of their activity in a way that might be beneficial to everybody. The external coach of the TEX project related: *“One of the teams I worked with, there weren’t any design skills in the team and that was a risk because we needed them. Because I knew this from experience, from our past running experiments that we were going to need some design built. So the Team Alignment Map kind of facilitated the conversation of ‘how do we get design skills?’ or ‘how do we have somebody even host on the team that we can rely on?’”*.

4.5 Social contract

Our analysis identified an additional element that proved important to shared leadership and team alignment in the cases, in the form of social contracts. When alignment is reached, it resulted into a social contract between all team members according to six out of seven respondents. This social contract consisted of an “*agreement on what everybody committed to doing*” (external coach, PHARM). It was a social contract “*between what [the team] needs and what we need from each other*” (external coach, TEX). The social contract was in all cases considered as binding. The Map acts a liability that individuals can refer to if commitments are amended unilaterally or not fulfilled. The social contract is what makes team alignment binding and lasting over time. The respondents stressed two critical dimensions of social contracts: (1) they relied on the participation and agreement of all parties, and (2) the social contract must be in a tangible form to avoid any deviations in the future. These dimensions are supported by two features of the Map. The first dimension is supported by the **shared problem space** which calls for the participation and input of all individuals. The second dimension is supported by the **shared visualisation**. The methodology expert of project TEX defined the Map as “*some sort of contract where everyone is saying ‘Okay, I commit to this’. It’s in writing, it’s in front of us. Everyone can see that this is something I agree to [...] It’s all laid out.*”

4.6 Summary of findings

The results from our analysis show that collaborative tools can through the features of shared visualisation and shared problem spaces support the antecedents of shared leadership. While both features are highly interrelated and interdependent in the Map (i.e., the shared problem spaces are represented visually on a shared visual display), our analysis suggests that it is important to consider them separately as they each support a different set of the antecedent conditions of shared leadership (Table 4).

The antecedent conditions of shared leadership that shared visualisation supports are team alignment, voice, and social contract. Team alignment is facilitated as the elements that team members agree on are made explicit through tangible marks that are visible by all. This suggests that collaborative tools can support alignment by providing shared tangible points of references. These marks also support the antecedent condition of voice by helping team members follow and understand the conversation. Team members thus have a greater awareness of the conversation. Results suggest that this makes them more comfortable to contribute to the conversation and voice their opinions and suggestions. Finally, shared visualisation has a binding impact on team members. When visible by all, the tangible marks cannot be ignored by team members. Whenever an element of the conversation is agreed on and written on sticky notes, team members automatically consider that they all commit to it. This thus creates a social contract between participants for which they feel they all have shared responsibility.

The antecedent conditions of shared leadership supported by shared problem spaces are voice, social support, and social contract. In general, shared problem spaces promote a sense of joint inquiry in which everyone is involved and play an active role. Joint inquiry is a process through which individuals jointly explore and define the problem, and jointly explore and evaluate alternative solutions (Steen 2013). This function contrasts with other project management tools such as Trello or work breakdown structures which are mostly concerned with planning rather than the exploration of both the problem and the solution. With shared problem spaces, team members feel that it is appropriate for them to voice their opinions and suggestions for both the problem and the solutions to the four domains. Team members can also collectively assess whether they cover all the elements that are essential to their project and detect any inconsistencies. Relatedly, the shared problem space supports social support by making it easier for teams to prompt conversations on elements that might harm the team in the long run. Finally, as the shared problem space calls for the participation of all team members, it creates a sense of collective ownership between them, which translates into a social contract.

Feature of the collaborative tool	Antecedent condition	Description of the relationship
Shared visualisation	Team alignment	Tangible marks (e.g., sticky notes in the Team Alignment Map) of the team conversation that are visible by all team members provide explicit points of reference to team members. This facilitates the alignment of the members' understanding of the conversation.
	Voice	Shared visualisation allows team members to follow the conversation more easily which makes them more engaged and active in the conversation. It also allows team members to see and voice any inconsistencies or missing elements,
	Social contract	The tangible marks of the elements that the team members agree on have a binding impact as they cannot be ignored or denied.
Shared problem space	Voice	A shared problem space suggests that all team members are to play an active role in the conversation and the solution of the problem. Team members consider that the empty problem spaces are to be used by all parties.
	Social support	With shared problem spaces, team members perceive the conversation as a problem-solving activity in which they feel more comfortable to voice any inconsistencies or missing elements.
	Social contract	As the shared problem space calls for the input and participation of all team members, it creates a binding sense of ownership between them.

Table 4. Description of the dynamics between the facilitating features of collaborative tools and the antecedent conditions of shared leadership.

5 Discussion

Our results inform us on the role of collaborative tools in the emergence of shared leadership through the case of the Map. Two features of collaborative tools in the form of shared visualisation and shared problem space suggest that teams feel a collective sense of contribution and responsibility. The two features create a sense of sharedness for both the problem and its resolution. Through these features, team members influence each other and have a shared responsibility for the joint activity. They thus all contribute to the problem and lead one another to its resolution. The features address the mutual influence that is characteristic of shared leadership.

In this regard, social contract emerged in the findings as an important condition. The results suggest that the shared nature of the collaborative tool through the combination of the shared visualisation and the shared problem space creates a sense of collective commitment. In fact, the combination of these two features makes it evident to everyone that they are all aware of the four elements of the activity and that they agree on them. It is team members themselves who agreed on their own commitments. This indicates that the influence on everyone's actions comes from team members themselves, which is in line with the definition of shared leadership as a mutual influence that comes from team members themselves.

Previous research had not identified social contracts as an antecedent condition of shared leadership and we believe this is one key aspect in the role that collaborative tools can play. In fact, our study suggests that when a tool is used collectively for exploring solutions and making decisions on these solutions, it creates a moral commitment between all individuals. Social contracts are made possible by and are a confirmation of Leonardi's (2013) shared affordance for tools that involve highly interdependent members. Our study suggests that the "sharedness" of a tool through features that promote a spirit of joint inquiry can support dynamics of shared leadership. Not only is this spirit of joint inquiry considered as crucial to the performance of innovation teams, it is also difficult to achieve due to the boundaries that might impede their collaboration (Carlile, 2004; Edmondson and Harvey, 2017).

Our study also advances research on the link between shared leadership and innovation to consider the role of technological support and provides an illustration of this link through a collaborative tool, i.e. the Team Alignment Map. Hoch (2013) found shared leadership to be a strong predictor of both idea generation and idea implementation. With regards to ideation, team members who share leadership find themselves in an empowering environment that is supportive of new ideas and creativity (Amabile et al., 2004; Spreitzer et al., 1999). In our study, we confirm these findings through the antecedent conditions of voice and social support, and highlight how a shared problem space (and shared visualisation to a lesser extent) can create such an environment. As for idea implementation, several studies have shown that is correlated with a collective and shared vision where team members have a focus on collective goals (Eisenbeiss et al., 2008; Kouzes and Posner, 2009; Morgeson et al., 2010). These insights are reflected in our findings through the antecedent conditions of team alignment and social contract. We show how shared visualisation (and shared problem space to a lesser extent) supports the alignment on collective goals and sustains the related commitments through the emergence of social contracts. In general, our study suggests that features of sharedness can support the emergence of shared leadership and improve the material conditions of innovation teams. Our study suggests that one way to go around such challenges is to improve the material conditions of innovation teams through collaborative tools that incorporate features of sharedness.

6 Future Work and Conclusion

Our study provides initial insights for the analysis of how features of collaborative tools can support the emergence of shared leadership. It is thus important to replicate these results in additional cases of innovation teams. Future analysis should not only include more cases, it should also collect data from a greater variety of sources. Our analysis was limited to interviews as a source of information about the practices of innovation teams. Through additional data collection methods such as non-participant observations, future research could understand the socio-technical dynamics of shared leadership in greater detail and as they unfold. This could overcome the reliance on the ex-post data of our study. It is also necessary to analyse additional collaborative tools to replicate and contrast the findings of our study which was based on the case of the Map only. This could allow future research to confirm our findings and potentially identify other features of collaborative tools that might support the emergence of shared leadership. In general, theoretical advancement and replication is required.

Research has demonstrated two sides of how digital technologies transform our ways of organising (see Berry, 2014). Consider how digital technologies have enabled us to go beyond the boundary of time and space in collaboration, but at the same time make us prone to technostress, dissatisfaction, and lack of trust among collaborators (i.e., De Guinea et al., 2012). Such challenges are experienced due to the virtuality of the collaboration - in which the practically viable asynchronous and synchronous communication medium for team members was mediated by digital technologies (Jarvenpaa and Leidner, 1999; Kirkman and Matthieu, 2005). Sharing leadership has been proposed as a mechanism that helps to address these challenges and promote satisfaction among team members (Robert and You, 2017). It is our collective aim to move forward and explore how technologies can help to reverse the side effect. We do so through this study, exploring how shared leadership emerges in teams that employ collaborative tools and suggest the features of collaborative tools that can fulfil our collective aim. Pearce (2004) stressed that one of the most pressing questions is *how to develop shared leadership*. In today's digital era, this concern can be reformulated as *how to develop shared leadership through designing appropriate collaborative tools and technologies*. This paper is a contribution to the development of such an endeavour.

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