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Artefact Appropriation in Facilitated Modelling: An Adaptive Structuration Theory Approach

Abstract

Scholars have long acknowledged the importance of unveiling the black box of Operational Research (OR) practice. However, despite the emerging empirical studies in the area known as ‘Behavioural OR’, there is still a dearth of research into how artefacts are used at the micro-level of OR practice. This paper addresses this gap by using Adaptive Structuration Theory (AST) to study the appropriation (use) of artefacts during a Facilitated Modelling (FM) workshop. We argue that the appropriation of artefacts from the workshop participants enables them to engage in negotiation of meaning with action implications effectively, but appropriation occurs at varying intensities (high, medium, low) depending on the issue of concern. Moreover, we identify that artefacts are reproduced if their reproduction is an aim or part of an aim of strategic discourse. Finally, we outline the limitations of our study and future research avenues.

Keywords: Facilitated Modelling, Behavioural OR, artefact, adaptive structuration theory, appropriation intensity.

Introduction

Operational Research (OR) scholars working in the area known as ‘Behavioural OR’ (Hämäläinen et al., 2013; Kunc et al., 2016) argue that understanding what OR practitioners and users do is *sine qua non* to understanding and improving contemporary OR practice (Franco & Greiffenhagen, 2018; Franco & Hämäläinen, 2016).

So far literature has mostly focused on what Franco and Greiffenhagen (2018) call studies “about OR practice rather than of OR practice” (p. 673) with a few ones investigating what happens during OR practice (Tavella & Franco, 2015; Velez-Castiblanco et al., 2016; White et al., 2016). These studies, however, have focused on the effect of talk rather than the material aspects of artefacts used (e.g. the models and technology) that play an important role in helping stakeholders to engage in conversations and achieve outcomes. To address these limitations Franco & Greiffenhagen (2019) suggested making the practice of Facilitated Modelling (FM) “visible by bringing to the fore its material and interactional features for close empirical examination” (p. 673). *It is this gap* that we address in this research by using a qualitative, micro-level analysis of a one-day FM workshop within a member-driven, food cooperative in

Denmark undergoing a process of strategic change. We draw on Adaptive Structuration Theory (AST) which is a version of Structuration Theory (Poole & DeSanctis, 1992; Poole et al., 1996) to explore (i) how the workshop participants' appropriation (use) of artefacts supports them in adopting communicative practices – the interactional elements that influence the dynamics of group conversations moment-by-moment – that foster relational engagement, that (Thomas et al., 2011); (ii) how artefacts assist participants in negotiation of meaning that has action implications; and (iii) how meaning negotiation shapes artefact use. Our study responds to calls for unravelling the black box of OR interventions at the micro-level (e.g. Franco, 2013; Franco & Greiffenhagen, 2018; Franco & Rouwette, 2011; Tavella & Franco, 2015).

Our findings show that: a) the appropriation of workshop artefacts enables participants to engage in negotiation of meaning that has action implications; b) such appropriation occurs at varying intensities (high, medium, low) depending on the issue of concern; and c) artefacts are reproduced if their reproduction is an aim or part of an aim of strategic discourse. Next we outline our theoretical foundations.

Perspectives on the Appropriation of Modelling Tools

Facilitated Modelling (FM) entails the use of group dialogue, facilitation and participatory modelling (e.g. Franco & Montibeller, 2010; Franco & Rouwette, 2011; Herrera et al., 2016; Tavella & Franco, 2015) to address complex and uncertain problems through a participatory and conversational process. A group, facilitated by an individual (or individuals), i.e., a researcher and/or consultant, engages in building models representing their views of the problem situation (Pidd, 2003). Models are then discussed by the group in an open and interactive way, while their different views, perspectives, and values are acknowledged (Ackermann, 1996; Ackermann & Eden, 2001; Cronin et al., 2014; Eden, 1992; Midgley et al. 2013). The use of FM can lead to tangible (e.g. cognitive maps and system dynamics' simulation models, rich pictures and flip charts) and intangible (understanding and learning) outcomes.

Within the broad family of FM approaches, this research focused on the Viable Systems Model (VSM) (Beer, 1981, 1985). The VSM is a framework designed to support stakeholders in diagnosing – identifying critical organizational issues and/or (re)designing the structure of organizations to make it more viable (Beer, 1981, 1985). Following the VSM principles, a viable organization consists of five systems that carry out specific functions and are interacting with each other (Rosenhead & Mingers, 2001). The systems are: System 1 (S1) including the autonomous Operational Units, also called primary activities that are responsible for carrying out operational activities enabling the organization to achieve its mission

statement; and the meta-system comprising System 2 (S2), which deals with conflicts of interest between the Operational Units, and are responsible for damping oscillations; System 3 (S3), which optimizes interactions and promotes synergy between the Operational Units; System 4 (S4) monitoring the external environment, looking for opportunities and threats; and System 5 (S5), which is responsible for closure, policy, identity and ethos (Espinosa et al., 2008; Espinosa & Walker, 2011, 2013). Diagnosis and (re)design occur during facilitated (by a researcher or consultant), iterative and participatory conversations in a workshop-format, during which the participants built a VSM of their organization on a flipchart and negotiate, take decisions, agree on and commit to possible actions to implement the VSM (Franco & Montibeller, 2010; Rosenhead & Mingers, 2001). Our VSM application was inspired by the VSM methodology for organizational self-transformation developed as a FM approach (Espinosa & Walker, 2011; 2013; Tavella & Franco, 2015).

Recently, Franco & Greiffenhagen (2018) have highlighted that fine-grained studies of real-time FM (e.g. Tavella & Franco, 2015; Velez-Castiblanco et al., 2016) mainly explored how talk evolves during workshops and how it helps stakeholders achieve outcomes. However, in FM, talk and *materiality* (manifested through models and tools) become intertwined and shape the workshop dynamics (Franco & Montibeller, 2010; White, 2006). Drawing on the work of Poole & DeSanctis (1992), Franco & Rouwette (2011), refer to tool use as ‘appropriation’. What distinguishes our approach from recent studies looking at the interaction of groups with artefacts (e.g. Franco & Greiffenhagen, 2018; White et al., 2016) is that we examine the appropriation of *multiple* artefacts as (i) being designed and used by the facilitator (script, PowerPoint slide) within the same workshop, and (ii) being designed and used by the workshop participants. We are not using video recordings to zoom-in OR practice as Franco & Greiffenhagen (2018) and White et al. (2016), instead we are looking at the relationship between model appropriation intensity and the issue of concern. Our analytical lens is Adaptive Structuration Theory (AST) (Poole and DeSanctis, 1992), discussed in the next section.

Adaptive Structuration Theory as a Lens to Study OR Workshops

During meetings and workshops, organizational actors – with particular organizational roles and competencies – sit around tables, in a U-shaped format and/or use artefacts such as flip-charts, post-it notes, PowerPoint, the BCG matrix, and SWOT, as well as analytic tools and software to ‘do’ strategy (Balogun et al., 2014; Eppler & Platts, 2009; Kaplan, 2011; Knight, Paroutis & Heracleous, 2018; Vaara, 2010; Vaara et al., 2010; Whittington, 2007; Wright, Paroutis & Blettner, 2013). The use of artefacts has particularly been acknowledged in the field of strategy-as-practice, which investigates strategy as a humanly accomplished activity and work that stakeholders do rather than have (Jarzabkowski, 2008;

Jarzabkowski et al., 2013; Paroutis, Heracleous & Angwin, 2016; Vaara & Whittington, 2012). Scholars conceptualize strategy actions as a combination of communicative practices and socio-material elements (e.g. Jarzabkowski et al., 2013; Kaplan, 2011; Paroutis & Heracleous, 2013; Stigliani & Ravasi, 2012; Thomas et al., 2011). Socio-material elements comprise locations, spatial arrangements and strategy tools or artefacts that shape and are shaped through interactions among actors. Such interactions support actors in engaging in joint strategizing efforts (Balogun et al., 2014; Vaara & Whittington, 2012). Leonardi (2012a) distinguishes between socio-materiality and materiality, in that the former term highlights that it is not the ‘material’ the unit of analysis, but the *use* of material: “socio-materiality represents that enactment of a particular set of activities that meld materiality with institutions, norms, discourses, and all other phenomena we typically define as “social”” (p. 34). The socio-material turn in strategy making has been the subject of research in the wider management and organization literature (Leonardi & Barley, 2010; Orlikowski & Scott, 2008).

Two main different schools of thought have emerged, related to the study of how the ‘social’ and the ‘material’ are intertwined: in the first school, scholars (e.g. Orlikowski & Scott, 2008) suggest that the ‘social’ and the ‘material’ cannot be studied separately, as discrete entities, and hence they are ‘mutually entangled’; in the second school it is suggested that the ‘social’ and the ‘material’ can be conceived as distinct but they are mutually dependent (Barley, 1986; Carlile et al., 2013), and are, hence, ‘imbricated’ (Leonardi, 2012a, 2012b, 2013). To imbricate, according to Leonardi (2011) means to “arrange distinct elements in overlapping patterns so that they function interdependently” (p. 150).

Within the second school of thought, researchers are interested in the ways in which the ‘material’ influences the ‘social’ and vice versa and is mostly followed by strategy-as-practice scholars (Dameron et al., 2015; Werle & Seidl, 2015). Following the ‘imbrication’ school of thought, Whittington et al. (2006) have studied the production of an artefact, that is, a cardboard cube that represented and communicated the strategic orientation of the case company. Later studies focused on the role of textual and visual artefacts (e.g. Knight et al. 2018; Spee & Jarzabkowski, 2011; Vaara et al., 2010), acknowledging their role in decision-making power and social order within organizations. Jarzabkowski et al. (2013) explored what roles artefacts play in accomplishing strategy work. The authors identified which artefacts (pictures, maps, data packs, spreadsheets, and graphs) managers use for strategizing, and five practices – physicalizing, locating, enumerating, analyzing, and selecting – used for strategizing with those artefacts. Paroutis et al. (2015) investigated the ways in which managers visually interact with strategy tools (a strategy map) to produce knowledge about strategic issues, demonstrating how knowledge patterns vary depending on the patterns of visual interactions (shift, inertia and assembly). Moreover, the authors used the concept of

affordances – the properties related to the materiality of an artefact that enable or constrain its use (Gibson, 1986; Hutchby, 2001) to illustrate how the tool enables interactions and brings change or reproduction of the status quo.

We are still lacking studies that investigate how artefacts are used at the micro-level of OR practice (Franco & Greiffenhagen, 2018; Franco & Montibeller, 2010). Such studies are important because they help identify (i) what happens during workshops when stakeholders combine conversational and socio-material elements, and for what purpose (Spee & Jarzabkowski, 2009; Vaara & Whittington, 2012); and (ii) how socio-material elements, and in our case FM artefacts, can shape workshop outcomes, thus informing practice about the use of artefacts (material) and conversation (talk) in OR situations and particularly FM modelling. Thus, our research question is: *How are material and conversational elements imbricated during FM modelling?* To study this question, we propose the use of Adaptive Structuration Theory (AST).

From a structuration perspective, group interactions “can be conceived as the production and reproduction of *positions* regarding group action, directed toward the convergence of members on a final choice” (Poole et al., 1985, p. 84, emphasis in original). Structuration implies the production and reproduction of a social system – a social entity engaged in practices, which trigger observable patterns of relations (Poole et al., 1996) – through stakeholders’ *appropriation* (use) of generative structures, that are, rules and resources. Appropriation occurs by stakeholders adopting particular structuring moves, for instance, explicitly or implicitly referring to structures, substituting a structure with another one, combining or contrasting structures, and rejecting structures (Poole & DeSanctis, 1992; Poole et al., 1996). *Structures* are dualities, namely, they are appropriated to produce and reproduce social systems and act within them. At the same time structures are produced and reproduced through action (structuration). Production and reproduction occur within communicative interactions through an increasing stakeholders’ joint understanding and coordinated actions. Structures, with particular structural potential, gain power only if adopted and activated within the system they help constitute. Specifically, “members of the system appropriate structures and adapt them to their own purposes, and structuration results in a configuration of structures-in-use specific to the system” (Poole & DeSanctis, 1992, p. 10). Structures-in-use impose conditions for structuration, thus determining the range of possible actions within the system, in other words, enabling and constraining group action.

We draw on Adaptive Structuration Theory (AST) (Poole & DeSanctis, 1992) to operationalize the process of FM through talk and artefact use. Leonardi (2013) has acknowledged the use of AST as a theoretical perspective to the study of socio-materiality, as the appropriation of technology provides

people and groups with “capabilities and opportunities to do things they could not do before” (p. 63). However, so far, AST has not been used in the OR literature to study the imbrication of conversational and material elements. We use AST to identify how workshop participants interacted with and used artefacts during the workshop and identify whether the use of artefacts enabled and/or constrained the employment of conversational elements. To identify conversational elements in our analysis, we draw on the notion of communicative practices (Thomas et al., 2011), the interactional tools that influence the dynamics of conversations moment-by-moment.

AST is a version of Structuration Theory (Giddens, 1979; Poole et al., 1985; Poole et al., 1996) suitable for the analysis of group interactions. Importantly, from a structurational perspective, group interactions “can be conceived as the production and reproduction of positions regarding group action, directed toward the convergence of members on a final choice” (Poole et al., 1985, p. 84, emphasis in original). Appropriation occurs by members adopting particular structuring moves, for instance, explicitly or implicitly referring to structures, substituting a structure with another one, combining or contrasting structures, and rejecting structures (Poole & DeSanctis, 1992; Poole et al., 1996). Production and reproduction occur within communicative interactions through an increasing stakeholders’ joint understanding and coordinated actions. Structures-in-use impose conditions for structuration, thus determining the range of possible actions within the system, in other words, enabling and constraining group action.

Using the above theoretical apparatus, we (i) operationalize the FM process as supported by artefacts; (ii) analyse the extent to which the workshop participants’ appropriation (use) of artefacts supports them in adopting communicative practices that foster relational engagement (Thomas et al., 2011), thus engaging in negotiation of meaning with action implications; and (iii) discuss how artefacts assist participants in negotiation of meaning and how the latter shapes their use. The analysis of workshops within strategy-as-practice and cross-disciplinary problem-solving domains is well established (e.g. Ackermann & Eden, 2010, 2011; Eden & Ackermann, 2010; Paroutis et al. 2015). In AST terms, a group of stakeholders engaged in artefact-supported workshops appropriates the structuration potential of the workshop and the artefacts used to achieve specific goals. In appropriating workshop structures (e.g. artefacts) stakeholders may use them as intended, or use some aspects and ignore others, thus “producing and sharing a particular version of structure as part of its structures-in-use” (Poole and DeSanctis, 1992, p. 12). Importantly, in line with AST, workshop structures do not automatically determine and guarantee stakeholders’ interactions and problem solving, they must be appropriated during interactions to have an impact (ibid. 1992). Next, we outline the method of our study.

Method

Research setting: Single Case of a Non-Profit, Food Cooperative

Data was collected within KBHFF, which is a non-profit, member-driven food cooperative in Copenhagen, Denmark. KBHFF supplies weekly local, organic vegetables and fruit to its members at affordable prices, and in exchange the members work three hours a month within the cooperative, for instance, ordering, packaging and handing out (in bags) vegetables and fruit, organizing meetings and events, and updating the website. The structure of the cooperative includes: 10 local shops, in which every Wednesday members collect the vegetables and fruit bags they have ordered in advance; five operational groups, that is, the distribution, the purchasing, the communication, the economics and the events groups; a board which is responsible for economic and legal viability, strategic development and long-term planning; and member meetings, the highest instance within KBHFF, in which once a year members review and approve accounts and budgets through consensus processes. This structure was designed and is currently implemented as a result of the workshop reported in this paper. The need for redesigning the organizational structure of KBHFF and carry out a workshop arose due to the uncertain future of KBHFF. Prior to the workshop, KBHFF lacked strategic focus and long-term planning, causing uncertainty among members concerning the future survival and prosperity of KBHFF. Furthermore, the rapid growth in the size of KBHFF (i.e. development of shops and member uptake and leave) created issues such as lack of organizational transparency and availability of internal information, as well as ambiguity regarding each member's responsibilities and communication. To address these issues KBHFF initiated a one-day workshop, which was externally facilitated by the first author, and supported by the use of the VSM. KBHFF and the facilitator believed that the VSM principles that focus on long-term sustainability and viability, as well as on mechanisms to monitor the external environment could help KBHFF address its issues and enhance its strategic orientation.

Data collection: One Day VSM Workshop

Data collected during the one-day VSM workshop comprised the transcript of the audio-record, notes taken and observations made during the workshop, and pictures or copies of the workshop outcomes (the reformulated mission statement, the VSM on two flipcharts, two rich pictures and a list illustrating the issues within KBHFF, and an action plan). To enrich data analysis the authors also drew on notes taken and conversations (face-to-face and via e-mail) held before (planning stage) and after the workshop (dissemination and implementation of outcomes), and online documentation and videos describing the new organizational structure of KBHFF (resulting from the VSM workshop), as well as the project plan

of the changes. The workshop lasted approximately 7 hours, was conducted in Danish and attended by 8 participants representing six different local shops, as well as the main operational groups. Because of KBHFF members' inability to attend the workshop due to other commitments, five of the 10 local shops and the purchasing group were not represented.

The workshop started by the facilitator and participants introducing each other. The facilitator then, by using a PowerPoint presentation explained the process of the workshop, outlined an agenda and the aims for the day, introduced the principles and elements of the VSM and the group tasks to be carried out. Latter broadly comprised (i) identifying critical issues within KBHFF, (ii) reformulating KBHFF's mission statement, (iii) building the VSM on flipcharts (filling in the systems of the VSM with content arising from group conversations), and (iv) formulating an action plan. Although these tasks were designed to be carried out linearly, iterations occurred when needed during the workshop. To facilitate the workshop and carry out outcome-oriented tasks the facilitator, being a novice, used scripts (Ackermann et al, 2011; Hovmand et al, 2012; Tavella & Papadopoulos, 2015).

The workshop was audio-recorded, transcribed verbatim (by a professional transcriber who is a Danish native speaker) and translated from Danish into English by the first author of this paper. Prior to the workshop the first author asked and received the consent of the participants to audio-record the workshop and use the transcript for research. Audio recordings enable, through accurate transcription, to capture and systematically code appropriation and communication behavior 'in a fine grained, holistic and consistent manner' (Liu & Maitlis, 2014, p. 206).

Data analysis

Data analysis took place as follows:

Stage 1: Identifying transcript segments. We examined the transcript to identify segments that would be amenable to theoretically meaningful interpretation (Franco & Rouwette, 2011) in which particular topics were discussed (e.g. improving collaboration between the operational groups) and tasks (e.g. reformulating the mission statement) carried out. The beginning of a segment was typically signaled by the facilitator inviting the participants to engage in the discussion of particular topics or undertaking of particular tasks. The end of a segment was indicated by participants' agreement on the addition of content to the VSM on the flipcharts, changing the structure and content of the mission statement, or moving to the next topic/task, usually after deciding that enough discussion about the topic had taken place. In total 16 segments were identified.

Stage 2: Coding. Each segment was coded in four sub-stages: (i) turns in which appropriation (use) of artefacts occurred – the facilitator and participants using the PowerPoint slide showing the mission statement and the VSM on the flipcharts, and the facilitator using the scripts – were identified; (ii) following AST each turn in which appropriation occurred was coded with the ‘structuration moves’ by Poole & DeSanctis (1992) (see table 1) identifying, for example, whether stakeholders referred to the artefacts, combined, contrasted, or rejected artefacts; (iii) to explore the employment of conversational elements, each segment was examined to identify which meanings regarding specific tasks or topics emerged, and how meaning negotiations unfolded and ended within the conversation (Thomas et al., 2011); and (iv) each turn in which stakeholders appropriated artefacts and the following turns in the segment were coded based on the communicative practices in Thomas et al. (2011) (see codes in table 2). Thomas et al. (2011) describe two different modalities of interaction, each characterized by different intersections of communicative practices, which lead to different dynamics in the negotiation of meaning. One modality of interaction is relational engagement, which occurs when stakeholders openly comment on each other’s contributions and acknowledge their willingness to collaboratively resolve issues and maintain their social relationships. Stakeholders express relational engagement through communicative practices, such as, inviting others to engage in the negotiation of meaning, agreeing with alternative meanings, and clarifying and building on others’ contributions. Relational engagement is likely to produce new knowledge, which is useful to construct and share new meanings. Following Orlikowski (2002), new knowledge is “an ongoing social accomplishment, constituted and reconstituted as actors engage the world in practice.” (p. 249). Constructing and sharing new meanings can support stakeholders in addressing organizational issues and identifying new practices that foster organizational change (Thomas et al., 2011; Tsoukas, 2009). The other modality of interaction, calculated engagement, occurs when stakeholders adopt limited collaborative behaviors and are not open to mutual influence. Calculated engagement is expressed by, for instance, stakeholders ignoring alternative meanings, deploying authority to eliminate meanings, and undermining others’ contributions. Instead of new knowledge and new meanings, calculated engagement leads to reproduction of old knowledge through which stakeholders fix their preferred meanings making them non-negotiable. No implications for solving organizational issues and enabling organizational change follow (*ibid*).

INSERT TABLE 1 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

To ensure coding reliability, the second author identified topics and segments, as well as coded the turns in which the participants interacted with each other and with the artefacts. Whilst the selection of segments remained the same, there were minor disagreements concerning the coding. The first author's detailed understanding of KBHFF and the VSM helped achieve agreement amongst the coders.

Stage 3: Analyzing the interplay between structuration and negotiation of meaning. Drawing on Thomas et al. (2011) we wrote summary narratives for each coded segment describing which meaning(s) concerning tasks and topics are negotiated. Next, we identified sequences of reoccurring appropriation and communication codes in the transcript illustrating how appropriation of artefacts, communicative practices and negotiation of meanings are intertwined. Identifying those sequences helped analyze how the facilitator and the participants appropriated structures, how appropriation influenced the employment of communicative practices and shaped negotiation of meanings. By discussing and comparing the different sequences, we identified two distinctive patterns in the way knowledge was created (*'generating new knowledge' pattern*; 8 segments) or common knowledge shared (*'sharing existing knowledge' pattern*; 7 segments) (in one segment both patterns occurred).

Stage 4: Explaining the interplay between negotiation of meaning and the structures. The authors explained how negotiation of meaning resulting from structuration shaped the (re)production of the artefacts used within the workshop. This interplay was identified by linking the patterns of negotiation of meaning to the artefacts as the content and structure they embodied emerged by the end of the workshop.

Stage 5: Linking negotiation of meaning to organizational change: Finally, the authors identified how negotiation of meaning resulting from structuration shaped workshop outcomes that had implications for organizational change. This was identified by linking the patterns of negotiation of meaning to workshop outcomes that were implemented and have brought change within KBHFF.

Findings

The appropriation of artefacts (in our case, the VSM on flipchart, the scripts and the slide) occurs in each segment of the transcript and is characterized by combinations of structuration moves (SMs) (Poole & DeSanctis, 1992) and communicative practices (CPs) (Thomas et al., 2011). These imbrications of conversational and material elements shift, turn-by-turn, within the conversation. Appropriation enables participants to engage in CPs that foster relational engagement (there are no instances of calculated engagement). Relational engagement is manifested through two patterns of negotiating meaning that we

label as ‘generating new knowledge’ and ‘sharing existing knowledge’. Within the ‘generating new knowledge’ pattern participants interact with each other using the artefacts to generate ‘new’ knowledge. No contrasting initial participant positions need to be abandoned during the conversation. Instead, participants bring their organizational knowledge (knowledge about the organization, e.g., managerial and operational issues, decision-making processes, collaboration with external partners, and trends in the food sector) in the discussion and engage in a mix of SMs and CPs that allows the development of novel meanings and knowledge in a non-conflicting manner. In contrast, within the ‘sharing existing knowledge’ pattern, participants do not generate knowledge that is new to the particular ‘problem-solving situation’ but share existing knowledge. Specifically, participants interact with each other using artefacts – supported by SMs and CPs – to gather and share existing meanings and knowledge concerning the issue at hand.

In both patterns, the negotiation of meaning leads to workshop outcomes, such as contribution (entailing either new or existing knowledge) to model content (VSM), reformulation of the mission statement and action plan with first deadlines and assigned responsibilities. Contribution to model content (VSM) and reformulation of the mission statement imply the reproduction of the artefacts used. The VSM on the flipcharts is used to guide organizational diagnosis, and within the conversation content is gradually added to the different VSM elements (systems S1-S5). The mission statement of KBHFF, which is reformulated during the workshop, is shown by the facilitator on a PowerPoint slide. During the conversation the structure and content embodied in the slide are reproduced. This is because the mission statement is reformulated in a different structure and the content is shortened and sharpened. The ‘generating new knowledge’ and ‘sharing existing knowledge’ patterns are illustrated below using excerpts from the transcript.

The ‘generating new knowledge’ pattern

Within Excerpt 1 (Appendix), our first example of how conversational and material elements are imbricated, the participants discuss the issue of ‘lack of communication’ between the operational groups of KBHFF, that is, the distribution, the purchasing, the communication, the economics and the events groups (the groups mentioned here are redefined during the workshop, P1 turn 26), and highlight the need for addressing this issue (turns 1-12).

In turn 13 the Facilitator (F) asks the participants how the communication between the groups could be improved in terms of the VSM elements (*constraint queries, SM*) and defines the VSM on the flipchart

(*constraint definition, SM*) as a framework, through which new means for resolving issues and conflicts can be visualized and structured, and are implemented after the workshop. Thus, F *invites (CP)* the participants to engage in the negotiation of meaning on resolving the communication issue. Next, P2 (turn 14) refers to the VSM to provide organizational knowledge (*constraint definition, SM*) on how to address this issue and *proposes (CP)* organizing regular and parallel meetings of each operational group (meetings that would take place at the same time), followed by a short meeting amongst all groups. These meetings represent a new means (that did not exist before in KBHFF) to addressing the lack of communication among the groups, thus, we can see that new knowledge is arising. The participants then discuss the meaning of organizing such meetings by *affirming (affirmation agreement, SM in turn 15)* and *reiterating (CP)* previous contributions (turns 15-17). Next (turn 18, and 23) F *clarifies (CP)* whether ‘regular meetings’ should be added to the VSM on the flipchart (*constraint status request, SM*), which is *affirmed (affirmation agreement, SM and CP)* by P1 (turn 19, and 24). The participants further discuss the meaning of organizing regular meetings by *reiterating, clarifying, building on, and affirming (CP)* previous contributions (turns 20-22, and 25-36). F then *reiterates (CP)* that ‘coordinating the existing meetings better and organizing regular meetings (4-6 times a year) amongst the operational groups’ has been added to the VSM on the flipchart as a new practice to be implemented within KBHFF (*constraint status report, SM*) (turn 37). P2 *agrees* on the content added to the VSM (*affirmation agreement SM and CP*) (turn 38).

This excerpt shows how appropriation (use) of artefacts occurs through particular combinations of SMs and CPs, for instance, *constraint queries and constraint definition and inviting; constraint definition and proposing; constraint status request and clarifying and affirmation; constraint status report and reiterating and affirmation* that shift during the workshop. Such combinations support participants in relationally engaging in conversations, negotiating the meaning of the issues at hand, and achieving outcomes as additions to model content. Relational engagement helps participants reconsider customary organizational practices and produce new knowledge that relates to the improvement of communication amongst the operational groups. ‘Coordinating the existing meetings better and organizing regular meetings (4-6 times a year) amongst the operational groups’ is added as a new practice to the VSM on the flipchart.

The ‘sharing existing knowledge’ pattern

In Excerpt 2 (Appendix), our second example of how conversational and material elements are imbricated, the participants reformulate the mission statement of KBHFF, which is shown by F on a PowerPoint slide. F refers to the PowerPoint slide and the scripts (*combination composition, SM*) to *invite (CP)* the participants to engage in the negotiation of meaning concerning the content of the mission

statement (turn 1 and the invite is *reiterated* in turn 3). P7 reads (*building, CP*) the mission statement from the slide (*direct appropriation explicit, SM*) (turn 2) and P7 and P4 *affirm* (*CP*) that the content of the mission statement still reflects the identity of KBHFF (*affirmation agreement, SM*) (turns 4-5). P1 provides a definition of the mission statement by referring to the slide (*constraint definition, SM*) and *proposes* (*CP*) shortening the mission statement in order to communicate the identity of KBHFF more clearly and compellingly (turn 6). Next, P2 *clarifies* (*CP*) whether the participants are supposed to discuss, eventually change the content of the mission statement (*constraint queries, SM*) (turn 7). In response, F refers to the PowerPoint slide and the scripts (*combination composition, SM*) to highlight that the focus should be both on the content and formulation of the mission statement, at the same time *building* (*CP*) on P1's contribution (turn 8). Next, the content of the mission statement represented on the slide is *clarified* (*constraint queries, SM and CP*) by P3 (turn 9) and further defined (*constraint definition, SM and building, CP*) by P1 and P2 (turns 10-11). In contrast to the other pattern, the participants share common knowledge as the content of the mission statement does not change to convey a new identity. Instead, the content is elaborated in order to communicate the existing mission in a more clear and compelling way. Next, the participants discuss the formulation of the mission statement, specifically P5 *clarifies* (*CP*) whether community and the social aspects of selling vegetables and fruit should be highlighted in the mission statement (*constraint queries, SM*) (turn 12). In response, P3 *builds* (*CP*) on P5's question by stating that 'inclusive' should be highlighted as an aspect of the mission statement (*constraint definition, SM*) (turn 13), which is *reiterated and affirmed* (*CP*) (turns 14-18). Thereby the participants gather and share common knowledge about the mission statement.

Similar to the 'generating new knowledge' pattern, the 'sharing existing knowledge' pattern involves appropriation of artefacts through particular combinations of SMs and CPs, such as, *combination composition and inviting; direct appropriation explicit and building; constraint definition and proposing; combination composition and building; constraint definition and building; constraint queries and clarifying; constraint diagnosis and building* that lead to relational engagement. However, the sharing pattern does not involve the creation of new knowledge, which may culminate in the formulation of new organizational practices. Instead, participants gather and share common knowledge about the mission statement, which is useful for shortening and sharpening its content, and reformulating it to convey a clearer and more compelling message. Thus, the content and the structure of the PowerPoint slide showing the mission statement are reproduced.

Appropriation Intensity: Gaining insights to keep the Conversation and Interaction live

Our findings illustrate that appropriation of artefacts occurs at different intensities: low appropriation intensity within the excerpt 1 (on the lack of communication between the operational groups) and high appropriation intensity within excerpt 2 (the reformulation of the mission statement). Through our analysis, we have identified that there is no relationship between appropriation intensity and knowledge generation and sharing, namely the intensity does not determine whether knowledge is created or shared. Low and high intensity can lead to knowledge generation and sharing via relational engagement. We define appropriation intensity as the frequency to which participants use the artefacts and the extent to which they combine them. The intensity of appropriation varies depending on the issue discussed. In the discussion about the lack of communication between the operational groups the participants appropriate the VSM to a low intensity (only in turns 13-15, 18, 19, 23, 24, 37, and 38), because the VSM does not provide a direct solution to the issue of concern. Instead the solution emerges from participants drawing on and discussing their organizational knowledge (e.g. about which operational groups should join the regular meetings, lacking communication between operational groups, and organizing regular meetings amongst the operational groups that could help resolve communication issues). The VSM plays the role of a *conversational device* as it helps keep the conversation alive and focus on the issue of concern.

In contrast, while reformulating the mission statement the participants appropriate the PowerPoint slide and the scripts (appropriated by the facilitator), often combined by the facilitator, to a high intensity (almost in each turn: 1-13, 19-23, 26-28, and 33-37), because the slide and scripts provide a direct means to reformulating the mission statement. Firstly, the slide shows the structure of the mission statement to be changed and its content to be shortened and sharpened. Secondly, the scripts include questions such as ‘Do you still agree on the mission statement?’, ‘What are you here for?’, and ‘What is your identity?’, which help the facilitator manage the conversation within a set time frame and focus on achieving outcomes (i.e. reformulation of the mission statement). The PowerPoint slide and scripts play the role of *problem-solving devices* as their appropriation enables participants to identify a solution to the issue of concern.

Our analysis also shows that artefacts are appropriated to a medium intensity when participants face issues that can partially be resolved when using the artefacts but require some organizational knowledge. Within Excerpt 3 (Appendix) the participants discuss how and to which extent the operational units of KBHFF (represented in the VSM on the flipchart) interact with the external environment. Appropriation intensity is medium (in turns 1-4, 12-14, 16, 17, 25-27, 28-33, 48, and 49) as the VSM shows the operational units, but how and to which extent they interact with the environment is identified through organizational knowledge (e.g. about external relationships and dissemination, and the use of the internal

registration system). The VSM, in this case, plays the role of a *supportive device* as its appropriation provides a partial solution to addressing issues.

Table 3 illustrates the different characterization of artefacts based on their role and intensity.

INSERT TABLE 3 AROUND HERE

Discussion and conclusion

This paper responded to calls for unravelling the black box of FM at the micro level of group conversation (e.g. Franco, 2013; Franco & Greiffenhagen, 2018; Franco & Rouwette, 2011; Tavella & Franco, 2015), drawing on an alternative lens, that is, AST (Poole and DeSanctis, 1992), to investigate the appropriation of artefacts during FM workshops. Our findings indicate that the negotiation of meaning is manifested through two patterns, namely ‘generating new knowledge’ and ‘sharing existing knowledge’. Both patterns, following Orlikowski (2002), suggest that different voices and ideas are heard in the discussions and deliberations, where participants aim at finding a common way to think and engage in improvement of communication amongst the operational groups (relational engagement according to Thomas et al. (2011)). The ‘generating new knowledge’ pattern is related to the creation of new knowledge (which in excerpt 1 is added to model content on the flipchart and action plan), and the reproduction of artefacts in terms of addition to model content. The ‘sharing existing knowledge’ pattern relates to gathering and sharing existing knowledge (which in excerpt 2 is added to the mission statement on the PowerPoint slide), and the reproduction of artefacts in terms of the reformulation of the mission statement. Furthermore, we discussed how artefacts assist participants in negotiation of meaning and how the latter shapes their use. Although our findings did not indicate a relationship between appropriation intensity and knowledge generation or sharing, we have introduced and defined the concepts of low, medium, and high appropriation intensity. Knowledge creation could occur when the solution to an issue emerges from the organizational knowledge of the group and is related to low appropriation intensity. This is because new knowledge is needed to address issues for which the artefacts do not provide a direct solution but require organizational knowledge (e.g. lack of feedback between groups, and lack of communication and dissemination within KBHFF). The artefact role is to help initiate and keep discussion alive. During knowledge sharing the artefact provides a solution or partial solution to the problem, thereby relating to high and medium appropriation intensity respectively.

Figure 1 shows the two different patterns identified, the artefact appropriation taking place within each, as well as the outcomes associated to each pattern.

INSERT FIGURE 1 AROUND HERE

Our study: (i) underlines the role of material agency of FM artefacts (Franco, 2013; White, 2006; Ormerod, 2013) and extends previous OR work and the focus on the effect of group talk. It sheds light on the imbrication of material and conversational elements during workshops as imbrication occurs through the appropriation of artefacts. Imbrication enables participants to engage in communicative practices (CP) (Thomas et al., 2011) that foster relational engagement; and (ii) supports the argument of Franco & Montibeller (2010) that talk and materiality become intertwined and shape the dynamics unfolding during workshops (Franco & Montibeller, 2010). Furthermore, our paper extends the literature on the material aspects of group dynamics and more specifically the research by Franco & Greiffenhagen (2018) and White et al. (2016). Although both studies have used video analysis to zoom-in on the interactions between participants and the models, they have not explored the combination of *different types of artefacts* (that may be used in OR practice), or the relationship between *artefact appropriation and the issue of concern*. We introduce the concept of ‘appropriation intensity’ (that might vary within the conversation) that offers a framework to understand how groups use artefacts during FM workshops (Franco, 2013; Franco & Greiffenhagen, 2018; White et al., 2016) and link appropriation to the types of artefact and issues discussed. Thus, this paper offers a way to highlight not only the presence of artefacts but also their intentional use that helps achieve workshop outcomes, further explaining the agentic role of materiality for OR and strategy practices (Balogun et al., 2014; Burgelman et al., 2018; Franco, 2013; Franco & Montibeller, 2010).

In terms of practical implications, we offer managers and organizations an innovative lens to analyze decisions in complex group settings, as well as a framework to influence group settings and outcomes through artefacts. For instance, managers could use artefacts during a workshop to keep the discussion going (supportive device) or may need group knowledge to discuss a topic/issue of strategic importance (in this case, groups could use artefacts as strategizing devices). Furthermore, depending on whether managers would like a group to engage in sharing knowledge, they could appropriate artefacts in either a low intensity (when encouraging knowledge sharing) or high or medium intensity (helping to initiate and keep discussion alive).

Similar to other studies (e.g. Franco & Greiffenhagen, 2018; Tavella & Papadopoulos, 2017; White et al., 2016), this paper is based on a single workshop restricting the generalizability of the findings. Future investigations could thus consider more workshops in the same or across different contexts in order to further strengthen our findings and conclusions. Furthermore, KBHFF is at the moment undergoing a structural transformation and hence our results do not allow for further analysis on how the appropriation of artefacts has implications for organizational change.

Notwithstanding these limitations, there is considerable potential for future research. We call for longitudinal studies that look into how artefacts and group interactions are intertwined. Furthermore, it would be fruitful to discuss the imbrication of artefacts and interactions across different hierarchical levels.

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Table 1: Structuration moves – adapted from Poole and DeSanctis (1992)

Code	Sub-code	Description
Direct appropriation	Explicit	Openly use and refer to the artefact
Combination	Composition	Combine two artefacts in a way consistent with the spirit of both
Constraint	Definition	Explaining the meaning of the artefact and how it should be used
	Command	Giving directions or ordering others to use the artefact
	Diagnosis	Commenting on how the artefact is working, either positive or negative
	Ordering	Specifying the order in which artefacts should be used
	Queries	Asking questions about the artefact's meaning or how it should be used
	Status report	State what has been or is being done with the artefact
	Status request	Question what has been or is being done with the artefact
Affirmation	Agreement	Agree with an appropriation of the artefact
	Bid agree	Ask other group members to agree with appropriation of the artefact
Negation	Reject	Disagree or otherwise directly reject the appropriation
	Indirect	Reject appropriation of the artefact by ignoring it, such as ignoring another's bid to use it

Table 2: Communicative practices – adapted from Thomas et al. (2011)

Code	Description
Inviting	Statements that encourage participation by other group members in negotiation of meanings
Proposing	Statements that introduce a new meaning
Affirming	Statements that agree with alternative meanings proposed by other group members
Clarifying	Questions that open up negotiation of meaning
Building	Statements that engage with, elaborate, and develop alternative meanings proposed by other group members
Reiterating	Statements that return to and repeat meanings
Dismissing	Statements that serve to rebuff or ignore alternative meanings proposed by other group members
Deploying authority	Statements that contain directives that eliminate alternative meanings proposed by other group members
Challenging	Statements that reject or critique alternative meanings proposed by other group members

Table 3: Characterisation of artefacts

Type of 'Device'	Definition	Knowledge creation/sharing	Intensity
<i>Conversational</i>	Helps keep the conversation alive	Knowledge creation (related to generative pattern)	Low
<i>Problem-solving</i>	Enables participants to identify a solution	Knowledge sharing (related consolidating pattern)	High
<i>Supportive</i>	Provides a partial solution to addressing issues.	Knowledge creation (related to generative pattern)	Medium

