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A new managerial perspective on self-organization in product development

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Abstract

Technological changes and faster information flows motivate managers and management scholars to explore new forms of product development organizing, departing from the managerial hierarchy and building increasingly on self-organization. With few exceptions such explorations and experimental efforts have proven challenging to sustain over time. From the contrasting point of view from inside product developers' practice, scholars studying communities of practice, temporary organizations, and self-managing groups have found self-organization prevalent, not least in contexts such as product development, even in organizations characterized by a managerial hierarchy. From the managers' point of view self-organization of product development work seems promising in effect but challenging to attain and sustain, but from the point of view of product developers' practice it is to be considered modus operandi. How can this ambiguity of self-organization in product development be explained? In the present thesis the author explores this question conceptually and proposes that a better understanding of self-organization in product development is a matter of perspective rather than new concepts or elaborate organizational forms. Theoretical as well as practical managerial implications of this are outlined and discussed drawing on empirical fieldwork in large organizations engaged in complex product development.

Keywords: Product development, Self-organization, Metaphor, Management, Practice

Appended papers

Paper CN: *Communication needs in R&D teams*
– investigating the impact of task interdependency and competence diversity
Berglind Söderqvist, J. and L. Lindlöf.
An earlier version of this paper was presented at the R&D Management Conference in Cambridge 2016.

The first author did fieldwork and initial analysis. The writing process and further analysis was equally shared between the authors.

Paper MP: *Self-organization of the product and organization relationship*
– A processual perspective on the mirroring hypothesis
Berglind Söderqvist, J., L. Lindlöf., R., Hoda
Presented at the R&D Management Conference in Milan 2018.

The first author did the fieldwork. The analysis and writing were equally shared among the authors.

Paper LE: *How to enable leadership among self-organizing developers*
Berglind Söderqvist, J. and S. Spiegler
Presented at the R&D Management Conference in Paris 2019.

The authors took equal part in fieldwork and analysis while the writing was mainly done by the first author.

Paper BM: *The blind leading the mute*
– Formal leaders' potential to facilitate institutionalization of the agile myth
Berglind Söderqvist, J. and G. Pushpananthan
Presented at the EURAM Conference in Lisbon 2019.

The first author did the main conceptual work and writing, the second author did the main fieldwork, and analysis was carried out jointly by the authors.

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1 Introduction

Driven by faster information flows and sudden technological changes managers and management scholars experiment with less hierarchical forms of organizing and self-organization, in search for viable alternatives to the managerial hierarchy (Lee & Edmondson 2017), not least so in product development (e.g. Rigby et al. 2016). Yet, such experimental efforts are seemingly far from trivial to sustain (Ingvaldsen & Benders 2020, Lee & Edmondson 2017). The same driving forces also foster a technically skilled workforce that tend to develop work processes and methods that are best understood by themselves and their peers (Barley 1996). They organize themselves both for learning purposes within their individual area of expertise (e.g. Wenger & Snyder 2000), and for problem solving purposes when individuals depend on the expertise of others for carrying out their work (e.g. Nonaka 1988a, Meyerson et al. 1996, Rennstam & Kärreman 2020).

On the one hand it seems like developers organizing themselves in communities of practice and temporary groups spontaneously in contexts such as product development (Barley 1996, Meyerson et al 1996, Wenger & Snyder 2000, Bechky & Chung 2018, Rennstam & Kärreman 2020), on the other hand attaining self-organizing teams as a sustaining basis of a product development organization seems to be a significant managerial challenge (Lee & Edmondson 2017). Portrayed as entwined with practical work self-organizing seems to be a defining characteristic of product development organization (Barley 1996, Rennstam & Kärreman 2020), but circumscribed by the notion of a formalized group, 'a team' it becomes extraordinary and managerially challenging (Rigby et al. 2016, 2018). While self-organization stands out as an important aspect of product development organization, how it should be understood and addressed in this context is seemingly ambiguous.

How can this ambiguity of self-organization in product development be explained? Bringing clarity to it is of broad relevance to research on product development organization and management considering that individuals engaged in product development work organize themselves to a significant extent (Barley 1996, Cohendet & Simon 2007, Bechky & Chung 2018, Rennstam & Kärreman 2020), and considering the interest in self-organization from organization and management research in general (Lee & Edmondson 2017), and product development organization in particular (Rigby et al. 2016, 2018). In subsequent sections answers to this question are sought through synthesizing organization literature from the point of view of product development management as well as product development practice. Against this backdrop theoretical as well as practical managerial implications are outlined and discussed drawing on empirical fieldwork in large organizations engaged in complex product development.

2 Organization theory background

2.1 A brief history of general management and organization theory

In a comprehensive overview of established organization theories, Scott and Davis (2007) conceptualize organization as "social structures created by individuals to support the collaborative pursuit of specified goals" (p. 11). As such, organization is fundamental to most human activity but the dominating idea of what it is and how it should be managed has varied over time. Kaj Sköldberg (2002) metaphorically departs from the "Tragic power machine of the rational classics" (p. 39) in his account of organization theory during the 20th century - indicating an initial approach to the management of organizations heavily influenced by the natural science of the late 19th and early 20th century and its inherent belief in rationality.

From such a rational perspective, people at times behave irrationally, not least so in the large groups needed for industrial organizing. Mitigating such irrationality seeing needs for organizing hundreds and thousands of people, early management scholars focused their efforts on crafting organizations to ensure rational behavior through goal specificity and formalization (Scott & Davis 2007). Notably, Max Weber's conception of formalization as written rules, procedures and instructions has become highly influential for later organizational research (Adler & Borys 1996). Similarly, out of the varying, partly functional, partly dysfunctional behavior of workers industrial engineers employed 'scientific management' to distill and control the most rational form of behavior in every task needed to be performed (Sköldberg 2002). The organizing of people and technology corresponded to the trimming of an engine, of a machine with components of individuals and pieces of equipment.

However, over time it seemed that not all irrational behavior was in need of rationalization. As needs and wants apart from pay seemed to affect productivity attention by management scholars such as Elton Mayo was drawn to a more social idea of industrial organization (Sewell 2001). Human needs and wants were added in the requirement specification of organization design. Supervising people at work were no longer seen as a matter of control alone, but also a matter of adhering to peoples social and psychological needs (Scott & Davis 2007) and human resource management grew to become an established field of management research (Sköldberg 2002). Attributing social an psychological needs to people also shed new light on their work environment, including the technology employed in industrial organization. As a result the organization as a whole was regarded as both social and technical and some argued these two aspects were of equal import for the function of the whole (Cherns 1976). The shift in managerial outlook on people in organizations was made explicit in the influential distinction between theory X and theory Y by Douglas McGregor (Lee & Edmondson 2017) and echoed in early studies of social psychological aspects of scientific management such as the study of coal mine workers by Trist and Bamforth (1951). Theory X, underlying scientific management, held assumptions about people as inherently lazy and in need of control while the contrasting theory Y assumed people to be willing to work, improve themselves and their context and contribute to an organizational whole (Scott & Davis 2007). This new outlook on people meant that management had to be less concerned with details of job design, and that autonomous groups of people to a larger extent could be left to manage themselves and their work tasks (Sköldberg 2002, Lee & Edmondson 2017).

What seems rational in one context turns out irrational in another. Distinguishing between mechanistic and organic forms of organization, scholars such as Lawrence and Lorsch (1967), Thompson (2003/1967) and Galbraith (1977) introduced what became known as contingency theory, namely that the optimal type of organization design is contingent on its environment (Sköldberg 2002). If the previous managerial outlooks on people and technology in organization can be described as rationalistic (e.g. scientific management) and natural (e.g. human relations) respectively, contingency theory proposes that organizations can take either metaphorical form and should thus be adapted to their specific environments. It was Burns and Stalker (2001/1961) who labeled the two opposite pools for the metaphorical forms organizations can take mechanistic and organic respectively, the latter of which encouraged organization designs that foster flexibility rather than efficiency.

This early distinction between mechanistic and organic forms has cemented and connected associations with formalization to the mechanistic form, being a legacy of the early rationalistic organization theorists, while the organic is less associated with formalization (Adler & Borys 1996). Schreyögg and Sydow (2010) point at the inadequacy of the contingency logic by drawing the dualism to its extreme -the more complex the environment, the more fluid and dynamic (i.e. absence of formalization) the organization and vice versa given that most organizations in turbulent environments also have to handle simple, repetitive and predictable operations. They conclude that contingency theory guides organizational design towards a separation of the two forms, either in separate organizations or at the individual level, both of which come with significant costs, either for integration between radically different organizations, or in terms of pressure on the individual. Adler and Borys (1996) nuance the idea of formalization somewhat alleviating the tension between the organic and mechanistic, suggesting a distinction between enabling and coercive formalization that can be identified in literature on bureaucracy since Weber and particularly in Alvin Gouldner's (1954) work. Coercive formalization is designed "to force reluctant compliance and to extract recalcitrant effort" (Adler & Borys 1996, p. 69) whereas enabling formalization are such "that facilitate responses to real work contingencies" (p. 71).

Contingency theory has been nuanced and drawn away from the idea of steady states to a perception of a multitude of possible system states that organizations can take (e.g. Scott (1987), the predecessor of Scott & Davis (2007)), a shift that also emphasized the importance of studying transitions, changes between states (Sköldberg 2002). Together with scholars such as Karl Weick (e.g. loosely coupled systems as described by Weick (1976)) and Burell and Morgan (1979), indicating a paradigm shift from stability to change, contingency theory paved the way for a more dynamic outlook on organization (Sköldberg 2002).

2.2 Contingency theory ad absurdum - a turn to practice

Organization as contingent on its environments is core to contingency theory and singling out relevant contingencies to inform the design of organizational structures is therein central to it (Thompson 2003/1967). As mentioned above, Schreyögg and Sydow (2010) argued that given an increasing level of turbulence in the environment a contingency logic falls short and they encourage theoretical inspiration that embraces complexity and contradiction, such as Gidden's structuration theory. Assuming that contingencies are impossible to analytically isolate in a meaningful way and instead assuming situated practice as the core of organization, a more

emergent and dynamic outlook on organization takes off (Simpson 2009). Anthony Gidden's structuration theory has been influential in this regard (Sköldberg 2002, Scott & Davis 2007), suggesting that organizational structure is generated from situated practice, and constituted by recurrent practice resulting in a recursive relation between structure and agency (Feldman & Orlikowski 2011). This underscores the organizational role of every aspect of a situated context including both the social and the technological. Informed by such theoretical conceptions Barley (1986) showed that the implementation of new technology significantly impacts organizational structure and Orlikowski (1992) further showed a continuous interplay between the organization structures, human actors and technology including change of technology imposed by social processes and vice-versa.

Contingency theory also inspired the development of institutional theory (Scott 2003). Institutional theory suggests that organizations are part of an environment consisting of similar and related organizations referred to as an institutional environment (Scott and Davis, 2007). For most organizations, it is not enough to demonstrate great products, but they must follow the norms of their environment in terms of structures, processes and ideologies as well (Brunsson, 1989). In this way, they are contingent on their environment, but internal action within an organization also shapes the organization's environment to some extent (Barley and Tolbert, 1997). The needs for efficiency and effectiveness in the internal operations of the organization are usually at odds with the norms of its environment (Meyer and Rowan, 1977) resulting in the emergence of two distinct structures succinctly distinguished by Nils Brunsson:

> "One is the formal organization which obeys the institutional norms and which can easily be adapted to new fashions or laws, literally by a few strokes of the pen on an organization chart. A quite different organizational structure can be used in 'reality', i.e. in order to coordinate action. This second type is generally referred to as the 'informal organization'." (1989, p. 7)

How such institutional norms are created was initially somewhat neglected question calling for a combination of institutional and structuration theory to account for the dynamics and change of institutions (Barley and Tolbert, 1997). The theoretical development of 'institutional work' can be seen as a response to this call, theorizing the work that produce, maintain and alter institutions (Lawrence et al. 2006). As such, institutional work can be seen as a way of understanding organization as fundamentally based on situated practice (Feldman & Orlikowski 2011).

A seemingly paradoxical problem entailed by the adoption of a practice perspective is a struggle to be relevant beyond the academic community, to make the practice approach relevant to practitioners (Lawrence et al. 2013, Cecez-Kecmanovic et al. 2014). Focusing on situated context sheds light on ontological concerns about what is real (Simpson 2014). What is social and what is material (Zammuto et al. 2007, Orlikowski & Scott 2008), what is technology (Leonardi 2012) and what organization actually is (Latour 1996, Schoeneborn et al. 2018) are far from trivial concerns and are only to be followed by concerns about how that which is real is real (e.g. Sayes 2014, Gond et al. 2016). The detailed zooming in on theoretical essentials can be seen as a parallel to Brunsson's distinction above, as it is sometimes more governed by intra-academic fashion and pen strokes than by the practical reality it claims to depict - as Andrew Spicer and his colleagues put it: "Just like everything seemed to be discourse for a certain kind of Organization Theorist about decade or so ago, today nearly anything can be seen as

‘materiality’ [...]. This makes it a concept that covers too much and reveals too little" (Spicer et al. 2016, p. 229). Nevertheless, a more practice oriented outlook on organization has grown into something of a 'practice turn' of organization scholarship (Schatzki 2005, Simpson 2009) and fostered a process approach to theorizing organizational reality as flows of activities and events as opposed to conventional variance thinking concerned with relationships between variables (Ann Langley in Gehman et al. (2018)).

Feldman and Orlikowski (2011) summarizes three general tenets for theorizing subscribed to by scholars advocating a practice approach for theorizing. First, that situated actions are consequential in the production of social life. This means that the situated action itself, rather than its outcome is the driver in organizational reality. Second, dualisms are rejected in practice theorizing. An example of this is Orlikowski's (2007) 'sociomaterial practice' which by definition rules out the possibility of anything in organizational reality being only material, or only social inscribing an ontological inseparability of the two, considering them a duality in place of a dualism. The third tenet, summarized by Feldman and Orlikowski (2011) is that relations are mutually constitutive. That the agency producing relationships is also generated by the relationship - that no phenomenon can be taken as an independent of other phenomena, that agency generates structure like Gidden's structuration theory proposes, but also that structure is ongoing agency. Using a more or less deliberate practice approach for understanding organizations has informed the theoretical development of several useful and practically relevant concepts, some of which are of explanatory value for the endeavor of the present thesis and presented in the subsequent paragraphs of this section.

2.3 Some clarifications regarding the term 'self-organization'

Before outlining examples of practice-oriented conceptions of self-organization some clarifications may be helpful on what is meant by 'self-organization' in the present thesis. A central idea is to look for self-organization in the ordinary, everyday organizational practices, as contrasted to the more extra-ordinary but common managerial conceptions of it (e.g. self-organizing teams (Rigby et al. 2016, 2018)). In a similar vein, Cunha and Clegg (2019) formulate a defense of the 'infra-ordinary' improvisation of everyday practice in organizations. They argue that organization theory tends to focus too much on the extra-ordinary and therefore underestimate the fundamental role played by the ordinary and mundane in organizations. In the present thesis, self-organization is not that different from organization in general - Scott and Davis (2007) roughly summarizes what organizations have in common as “social structures created by individuals to support the collaborative pursuit of specified goals” (p. 11) - but for the condition that the social structures are collaboratively created and goals are collaboratively conceived. In other words, the organizing does not take place at a significant distance from the context intended to be organized. One may note that this does not necessarily rule out hierarchy, nor formalization as long as such arrangements are sanctioned and reversible by the practitioners whose practices they are intended to regulate, similar to what Adler and Borys (1996) would consider enabling formalization and hierarchy.

Influential distinctions of what sets self-organization apart from other forms of organization includes principles specified by Morgan (1986) and conditions identified by Takeuchi and Nonaka (1986). The principles are 'minimum critical specification', 'requisite variety', and 'learning to learn', and the conditions 'autonomy', 'cross-fertilization', and 'self-transcendence'.

Together they illustrate self-organization as organization where the involved individuals together have multiple perspectives and competences relevant to the work at hand, they have latitude to handle their work as they see fit but are also to some extent re-defining their goals with the learnings they make along the way. Such descriptions of self-organization usually imply a distinct formal group[1] in which self-organizing occurs.

It should be mentioned that ideas of self-organization has been widely used also with other theoretical underpinnings in organization studies. Among management scholars the historical use of theoretical notions of self-organization have been influential through the school of cybernetics and the cross-disciplinary development of general systems theory in the 1950s (Sköldberg 2002), traditions that have much in common with the widely common network metaphor in organization studies (Scott & Davis 2007). Self-organization in this tradition builds on 'system' metaphorically inherited from servo-machines and natural science (Sköldberg 2002) (e.g. Luhmann (1995) and Sahal (1979)) and 'network' from the point of view of engineering or mathematics, as something that can understood from the outside (Latour 1996). Such metaphors and perspectives contrast sharply to a more practice-oriented theorizing. Actor-network theory has been influential in the turn to practice (Feldman & Orlikowski 2011) and can be brought up as a contrasting example. An actor-network is considered an ontological assumption of the social world, a continuous network that is itself a dynamic actor, as something that can only be done descriptive justice from within, something continuous from which no entity or aspect can be meaningfully isolated (Latour 1996). Although the author does not necessarily adhere to every detail of the thought work of actor-network-theory specifically, the example is indicative of the difference between the more engineering approach to self-organization as seen from the outside, and that of a practice position considering it enacted from within. It is the latter position that is the basis for the following three examples of theoretical conceptions of self-organization.

2.4 Practice oriented conceptualizations of (self-)organization

Early theorizing of the self-managing group.

First, a practice oriented outlook on organization conceived before the practice turn (Schatzki 2005), namely that of Trist and Bamforth's (1951) study of coal miners under changing work conditions. The study by Trist and Bamforth (1951) was about the conditions for workers in a coal mine as the mining method change from a traditional way of working in small cross-functional and 'responsibly autonomous workgroups', to an industrialized 'longwall' method where workers are more specialized and different functions work in separate shifts. The technological changes dramatically alters the contexts for practical work to be carried out, without taking socially and technically intertwined implications into account. They conclude that changes of technology without considering the inevitable need for managing new behaviors and social relations (or lack of such) intrinsic to it leads to problematic and unintended consequences from the individual worker's as well as the organizational point of view. Leonardi (2012) observes that the practices of workers described by Trist and Bamforth (1951) are seemingly equivalent to Wanda Orlikowski's (2007) more contemporary notion of sociomaterial practice.

[1] The plain use of the word team to denote such a group not rarely implies significant alignment with the mentioned principles and conditions for self-organization, e.g. Katzenbach and Smith (1993) and Sewell (2001).

The ontological inseparability of the social and material, which is pivotal for the notion of sociomaterial practice, is present throughout Trist and Bamforth's (1951) study starting with the empirical problem they frame. Namely that technological changes in organizations often suffer from neglecting the fact that organizational reality is sociomaterial (although they do not use the term) and that any technological change in an organization therefore also is a social change with social and material consequences. However, they do not dwell on ontological details and the fundamental assumption of sociomateriality might pass the reader unnoticed while the findings stand out as understandable and seem practically and academically relevant to the time of publication. One of the most enduring and significant marks that the study has left on organization theory and practice is that of the self-managing group (Sköldberg 2002, Lee & Edmondson 2017), although Trist and Bamforth refer to it as responsibly autonomous workgroups. Incubated within the socio-technical systems (STS) research stream Trist & Bamforth's contextual sensibility towards the practical aspects of the work in responsibly autonomous groups have been downplayed in favor of a systems view on the organization as a whole (Leonardi 2012). However, the concept of a self-managing group is largely unchanged within STS and still refers to the workgroups that decide themselves how to carry out work, and that have enough latitude to be able to take corrective measures to handle potential deviations or errors that might occur (Ingvaldsen & Rolfsen 2012).

Community of practice.

A second example of concepts developed from a practice view on organization is community of practice (Rennstam & Kärreman 2020). A community of practice is a group of people who share a common enterprise as well as the knowledge and the competence required to contribute to it (Wenger & Snyder 2000). The enterprise can, but does not have to be an explicit goal but can be more general as the development of understanding and knowledge in a certain area (Barley 1996). Rennstam and Kärreman (2020) study engineers that develop telecommunication technology as a community of practice and Barley (1996) reports on a number of ethnographies covering communities of practice such as programmers, science technicians, medical technicians and radiological technicians. In communities of practice members share an understanding of certain contextual characteristics such as those common to a specific occupational role (Bechky 2003) or those common to a specific area of concern such as the wellbeing of people with a certain illness (Pyrko et al. 2017). Such contextual commonalities support the development of tacit knowledge (Bechky 2003). Similar context of members enable them to enact learnings in practice and therein also develop tacit knowledge that cannot be codified or otherwise be made explicit (Brown & Duguid 2001). Knowledge sharing in such communities involve practice and the sharing of knowledge therefore entail redevelopment of knowledge in an ongoing and collective learning process of 'thinking together' (Pyrko et al. 2017). Hinging on contextual practice, communities in organizations may well overlap in that members of a given community share some practices with members in another (Brown & Duguid 2001).

Generally, organizations encompass different occupations and groups of interest. A challenge for them is to integrate knowledge from distinct communities, a challenge that is particularly articulate in product development (Bechky 2003). The emphasis on practice in the concept 'community of practice' makes the idea of an organization as one community unfeasible. The emphasis on practice infuse heterogeneity to the projection of the concept onto an organizational setting as most organizations demonstrate a variation of habitual practices among their members (Brown & Duguid 2001). The boundaries of a community of practice may be referred to as 'epistemic', and inclusion within such a boundary is depending on whether or

not an individual has the contextual experience and shared learning to be able to understand and engage in ongoing conversations (Pyrko et al. 2019). Indicating such a boundary on a general level, Brown and Duguid (1991) distinguishes between canonical and non-canonical practice where the former is the espoused practice from a manager's perspective, the idea of what practice that is carried out in organizations and non-canonical practice is how it is actually carried out, somewhat analogous to Brunsson's (1989) distinction between formal and informal organization as mentioned above. Rennstam and Kärreman (2020) consider canonical practice the practice implicitly assumed by the organization's managerial control systems and structure whereas the non-canonical practice is thought of as the actual practice, that is enacted in communities of practice. In other words, taking the position of a product developer in a product development organization, the managerial idea of the practices of a product developer and the actual practice of a product developer do not always agree (e.g. Cohendet and Simon (2007) and Munthe et al. (2014)).

Temporary organizing.

Theory on temporary organizing encompasses a third conception of organizational reality that draws on a practice perspective (Bakker et al. 2016). However, temporary organization theory includes both the more action-oriented perspective from inside the temporary organizing, as well that of its external control (Lundin & Söderholm 1995). Burke and Morley (2016) elaborate on the relation between the temporary organization and its permanent 'parent organization'. Such a permanent organization may be largely relying on a permanent structure for temporary organizations (e.g. project-based organizations), or have such frameworks embedded in the organization for the recurrent institutionalized handling of temporary tasks (such as projects in a matrix-organization) or there may be no single parent organization why the temporary organization is entirely dissolved, both in terms of personnel and formal structure, at its termination (e.g. crisis response or film/theatre productions). In the present thesis the relation to a permanent organization is not of primary interest – the focus here is rather like that of Bakker et al. (2016) on temporary organiz*ing*, shifting balance from its more or less formalized structure towards understanding the practices and processes of temporary organizing. This focus includes the more ephemeral organizational equivalents of a 'one-night-stand' (Meyerson et al. 1996, p. 167), temporary task force groups through which more permanent informal networks and communication patterns emerge in organizations (Allen 1995/1977), as well as the temporary groups informally organized in communities of practice (Rennstam & Kärreman 2020)[2].

Early studies of temporary organizing depart from observations of it as emergent organizing that comes about under certain conditions, namely that multiple different individuals have a common need to get something done, the problem at hand is rather unique and has to be accomplished within a relatively short timeframe (Goodman & Goodman 1976). Scholars also draw on Thompsons (2003/1967) notion of synthetic organization to exemplify temporary organizing (e.g. Meyerson et al. 1996), the type of organization that may emerge following a catastrophe where individuals spontaneously organize to recover and regain some order from a present chaos (Thompson 2003/1967). Goodman and Goodman (1976) considers research and

[2] Rennstam and Kärreman (2020) do not explicitly refer to, or use theory on 'temporary group' or 'temporary organization' but the author's interpretation of their study was verified through personal communication with Jens Rennstam on the 12th of February 2021. An interesting example can be found on page 875-6 of how product developers informally organize temporary groups for the purpose of quality control through peer review.

development an organizational context where conditions tend to be particularly ripe for temporary organizing. Presently, a vivid scholarly discussion on temporary organizing exists (See for instance a special issue of Organization science (2016) Vol. 37(12)) and although there is a rich history of scholarship on the phenomena it was not until quite recently that it was articulated as a distinct category of interest (Bakker 2010).

A theory presented in an article by Lundin and Söderholm (1995) can be considered such an initial articulation of temporary organization theory (Bakker 2010, Burke & Morley 2016). They motivate a need for explicit theorizing on temporary organizing based on the perception of an unproportionately dominating scholarly idea of organization as something permanent, drawing on the rational roots of organization scholarship (Sköldberg 2002, Scott & Davis 2007). Moreover, they note that a focus on decision making and a centrality attributed to goals in permanent organizations is carried over to the conventional study of temporary organization. However, goals explicitly formulated up front as the basis for a formal decision and initiation of a temporary organization (e.g. a 'project') are generally not achieved, but rather renegotiated through practice along the way (Engwall 2002). Additionally, the fact that temporary organizing usually is sparked by a need for action to pursue immediate goals (that will be subjected to revision in action), Lundin and Söderholm (1995) set out to provide theoretical grounds for the study of temporary organizing based on action rather than decision, practice rather than idea.

Just like Thompson (2003/1967) considered the pure focus on effectiveness in synthetic organization to get the job done as contrasting to what he refers to as 'a normal' organization's focus on enabling efficiency (p. 52-54) despite turbulent environments (where the handling of uncertainty, ensuring effectiveness is supposedly instrumental), Lundin and Söderholm (1995) argues that temporary organizing is focused on transition, the change of something, contrasting it to the focus on efficient production in a permanent organization. They conceive a theory of temporary organizing based on three basic concepts, all circumscribed by time. Colored by the attractive feature of starting with the same letter, the concepts are labeled transition, task and team. What binds temporary organizing is less about relations than about doing, i.e. where a lot of social investment would go into building relations in a permanent organization, temporary organizing is bound together by the task at hand (Meyerson et al. 1996). In short, a temporary organizing comes into being for the purpose of 'transition', whereby a 'team' is drawn together to carry out a 'task' (Lundin & Söderholm 1995).

Contrary to the assumption of permanence of organization, temporary organizing cannot hope for a homogeneous culture to develop, nor hope for self-regulation into a stable organizational structure. As such it may be considered an exemplar of what Sköldberg (2002) refers to as the ironic master trope of later organization studies, a trope of contradiction, plurality and a deep grounding in context. Scholars have recently suggested that persisting disorder can be significant to the processes of harmonization and contestation entailed by ambiguities in roles, responsibilities and hierarchical relations in temporary organizing (van Marrewijk et al. 2016). Moreover, the increasing prevalence, and study of temporary organizing may challenge what is conventionally understood as 'managing' or 'organizing', since conceptions attributed to them, such as repetitiveness, reciprocity, development and maintenance, all are anchored in an idea of relative permanence of organizations (Burke & Morley 2016). To realize the potential of the study of temporary organizing Bakker et al. (2016) call for studies that are fundamentally grounded in an ontology of becoming rather than being inherent to process philosophy such as Mead's (1932) consideration of the present as the locus of reality. The priority of 'action' over

'decision' in the theorizing of temporary organization (Lundin & Söderholm 1995) opens up for an understanding of organization as becoming rather than being. With such an understanding, change is not to be considered a property of organization but organization should be considered an emergent property of change (Tsoukas & Chia 2002).

2.5 Leadership, practice and self-organization

Drawing on previous paragraphs, the self-managing group, the community of practice and temporary organizing have in common that they can be accomplished without external management, by individuals who essentially organize themselves. Nevertheless, in each of the three cases external management often has stake in its performance (e.g. Ingvaldsen & Rolfsen (2012) for self-managing group, Rennstam & Kärreman (2020) for community of practice, Thompson (2003/1967) and Lundin & Söderholm (1995) for temporary organizing). Such stake may motivate a permanent organizational framework in which temporary project organizations are embedded (Burke & Morley 2016), the development of management practices to support self-managing groups in their self-management (Manz & Sims 1987), or efforts to control and/or benefit from the development of communities of practice (Wenger & Snyder 2000, Rennstam & Kärreman 2020). In short, it is frequently of interest from an external point of view to control, influence or benefit from the direction taken by the different expressions of self-organizing practice exemplified above.

Giving direction is commonly associated with leadership (Barker 1997), a concept that can, and has been defined in various mutually inconsistent ways and not rarely is studied without any articulation of what it actually is (Alvesson & Spicer 2012). Barker (1997) succinctly contrasts leadership to management by their respective function in organizations. He argues that the function of leadership is to create change, while the function of management is to create stability. Assuming this idea of leadership relative to management, the performance of both leadership and management is of interest both with regards to the workings within a community of practice (Wenger & Snyder 2000) or a self-managing group (Manz & Sims 1987), as well as from a point of view at a distance from the intimate situated contexts of a community of practice or a self-managing group, such as that of higher echelon management in the organization (Manz & Sims 1987, Rennstam & Kärreman 2020).

Although one might consider management as striving for stability, and leadership as striving for change (As Barker (1997) suggests), individuals in organizations upholding the role of manager frequently strive to exercise leadership (Alvesson & Jonsson 2018). The managerial role therein encompasses the expectation of producing both stability and change in the organizational context they are set to manage. However, leadership as exercised by managers has been found to sometimes merely extraordinarize the mundane, in that what is considered normal and good social behavior such as listening, being cheerful and engaging in informal talk among coworkers, is considered leadership when exercised by a manager (Alvesson & Sveningsson 2003). Without saying that such normal social behavior should not be considered leadership one might instead, as Crevani et al. (2010) do, take seriously the idea of leadership as a social process, not necessarily tied to any specific individual or role. Such normal social behavior is essential for how communities of practice exercise internal control (Rennstam & Kärreman 2020) and informal communication among coworkers is central for the self-management in self-managing groups (Barker 1993).

Leadership conceptualized as a process is not new but has often relied on the existence of a distinguishable leader and follower underlying process conceptualizations (e.g. Bass 1974/2008). While such distinctions are feasible in many situations, the way a community of practice attains its direction of work may be through peer reviewing (Rennstam & Kärreman 2020), and a self-managing group may adopt shared leadership among group members (Ingvaldsen & Rolfsen 2012), and in temporary organizing a problem at hand can provide as much sense of common direction for a group as any specific group member (Meyerson et al. 1996). Consequently, a theoretical understanding of leadership that takes such conceptions of organizing into account should explain leadership also in situations were there is no clear leader, nor follower. Considering leadership as a social process, without hinging on a leader or follower, one might struggle to discern, not only what leadership is in practice, but also what it is not. Addressing this issue Crevani et al. (2010) suggest the two concepts 'co-orientation' and 'action spacing' to concretize how to discern the practices in a complex social process that feasibly can be considered leadership. By co-orientation they propose to encircle practices that enhance understandings of the various perspectives and potentially diverging arguments among all the involved parties, and by action-spacing they consider the construction of potentials, limitations and opportunities for individual and collective action in an organizational context.

The study of organizations with a practice approach has to some extent reached its popularity as a contrasting approach to the predominantly rationalistic perspective on management (Barley 1996, Tengblad 2012). The study of managers and their work, in turn, has suffered from a belief in management as a primarily rational and analytical endeavor, whereas in practice it is often quite messy and unpredictable (Tenglad 2012). Feldman and Worline (2016) distinguish between scientific and practical rationality of management stating that the former is only useful when observing management from the outside, which managers rarely do. Spicer et al. (2009, 2016) advocate a critical, yet pragmatically affirmative approach to the study of management, reflecting Crevani and colleagues' (2010) corresponding embrace of leadership, not leaders. Considering Barker's (1997) idea of leadership as the function of change, and management as the function of stability, co-orientation and action-spacing illustrate practices performative of changing direction (leadership) (Crevani et al. 2010). Considering management processually, as the creation and maintenance of stability, one should not "forget the huge amount of work and activity that is required to stay in the same place" (Ann Langley in Gehman et al. (2018, p. 289)). Practicing management is generally far from rational and analytic models prescribed in textbooks and more akin to context dependent situated practice (Tengblad 2012). Inspired by Spicer et al. (2009, 2016), management (i.e. the creation and maintenance of stability) may accordingly be described as circumspect care for the current situated context and a pragmatic search for potential in the present.

3 Organization of product development

3.1 A brief history of product development management theory

In a comprehensive literature study covering research on the organizational aspects of product development between 1969 and 1995 Brown and Eisenhardt (1995) identify three major research streams, each with a common 'model' of product development. Apart from being distinct in their respective research focus the seminal works of the three approaches also follow a chronological order: 'The rational plan model', 'the communication web model', and 'the disciplined problem-solving model'. These three streams of research on product development are essentially concerned with what Brown and Eisenhardt refer to as "the structures and processes by which individuals create products" (p. 343).

The research stream underlying the rational plan model emerged in the early 1970's as management research attention was drawn to product development as an important factor for financial success (e.g. Rothwell et al. 1974). Explorative management studies based on large numbers of firms with single informants from each, resulted in a collection of important factors for product development's positive impact on financial success (Brown & Eisenhardt 1995). These included an emphasis on market pull rather than technical sophistication as determinant of financial success in product development. Later studies endorsed this market perspective on product development emphasizing the need for up-front planning and concept definition by senior management according to anticipated market demands and a swift execution of product development following the plan (e.g. Cooper & Kleinschmidt 1987).

The communication web model of product development was initially inspired from studies by Allen et al. (1969, 1970) and Katz et al. (1982, 1985) focusing almost entirely on communication internally in product development groups and communication from members to people external to the group. This included and emphasized communication through informal networks in the organization pointing at the importance of temporary cross-functional projects and task forces that support the development of such networks (Allen 1995/1977). An early emphasis on extensive external communication (Katz & Tushman 1981) was nuanced to specific typologies of communication out of which certain types of communication were of particular importance in specific contexts, such as internal group communication and communication with external parties (Ancona & Caldwell 1992). Dougherty (1992a) further nuanced the idea of product development as a communication web by suggesting that barriers to communication were critical not necessarily to be overcome, but rather how they are related to and managed. Barriers to, and disturbances of communication patterns are even suggested to be a necessary ingredient in constructive new product development efforts (Dougherty & Heller 1994).

In the last of the three research streams, that of product development as disciplined problem solving, communication as well as managerial, team and supplier aspects are brought up. The research stream emerged from seminal works by scholars such as Imai, Nonaka and Takeuchi (1984) who emphasized autonomous teamwork colored by cross-fertilization (information/ communication redundance) and self-transcendence (Takeuchi & Nonaka 1986). Where senior management were attributed with a supportive role in the rational plan model the disciplined problem-solving approach emphasize 'subtle control' as the senior managerial strategy, essentially focused on communicating a clear vision, to maintain creative autonomy for the team while still keeping to a distinct goal in product development (Brown & Eisenhardt 1995).

Takeuchi and Nonaka (1986) bring up leadership aspects in the self-transcendence required from the self-organizing project team as a way of maintaining focus on the goal, complementing the somewhat vague notion of 'subtle control' exercised by senior management. Brown and Eisenhardt (1995) seem to disregard such leadership aspects of self-organizing teamwork and considers later developments of concepts such as 'product integrity' (Clark & Fujimoto 1990) and heavyweight project manager (Clark & Wheelwright 1992) to be clarifications of the notion of 'subtle control' contrasting quite sharply to its description in Imai et al. (1984), and Takeuchi & Nonaka (1986). According to them, subtle control can be described as an indirect managerial approach where managerial interventions are primarily aiming at ensuring appropriate conditions for self-organization, such as to make sure that competent people with relevant perspectives are employed, that iteration pace in development is appropriate, that engineers are encouraged to stay curious while anticipating and tolerating of mistakes. Later developments of the disciplined problem-solving model of product development involves a focus on frequent iterations in development processes (Eisenhardt & Tabrizi 1995, Benghozi 1990).

The trend to focus on frequent iterations in product development was driven by rapidly changing technologies and market conditions, but the character of the new forms of technical work also motivated similar development of product development organizing (Barley 1996). The increasing need for technical expertise put the development of knowledge in groups and organization centerstage. Scholars previously focused on product development organization moved to a focus on organizational knowledge creation (Nonaka & Takeuchi 1995, Nonaka et al. 2008). In a parallel research stream communities of practice emerged as a way of theorizing the emergent organizing of symbiotic knowledge and work (Brown & Duguid 1991) applicable to the self-organizing of product development work (Cohendet & Simon 2007) but challenging, if at all impossible to control and steer from the point of view of a manager (Wenger & Snyder 2000).

All three models of product development presented by Brown and Eisenhardt (1995) consider organizational configuration in relation to its environments and thus follow a contingency logic (Scott & Davis 2007). With the increasing need for continual learning, such a perspective provide little explanatory value to the knowledge intensive practice of product development going hand in hand with organizational development (Dougherty 1992b). While the overview provided by Brown and Eisenhardt (1995) proved an important point of reference for scholars to navigate the literature on product development organization (Krishnan & Ulrich 2001, Engwall et al. 2005) their contingency theoretical perspective also paved the way and emphasized the need for a more dynamic understanding of product development organizing. Drawing on their work, some scholars argued that in such fast-changing environments as product development, organizing should be inspired by jazz improvisation aiming to achieve planning and execution simultaneously (Kamoche & Cunha 2001). Engwall and colleagues (2005) argued that product development literature focused too much on (organization) model design, whereas practical model use would be a more constructive focus. Later studies have shed light on the role of the product (Magnusson & Lakemond 2017), as well as that of product developers as significant organizers of product development (Cohendet & Simon 2007, Bechky & Chung 2018, Rennstam & Kärreman 2020). However, the models provided by Brown and Eisenhardt (1995) provide a neat structure and starting point for understanding the role of self-organization in product development and are employed as such in the subsequent section.

3.2 On practice and self-organization in product development

All three models proposed by Brown and Eisenhardt (1995) have in different ways provided ground for a more practice focused understanding of product development. Scholars under the communication web model focusing on information processing in different forms (e.g. Allen 1995/1977) with their understanding of communication patterns as agnostic to distinction of formal and informal organization (such as that by Brunsson (1989) in section 2.2) were followed by studies that acknowledged the importance of understanding situated context of practice in development work in order to understand and effectively manage it (Dougherty 2008). Similarly, theoretical foundations of the disciplined problem solving model such as the concept of 'Ba' (Roughly translating to situated context in movement (Nonaka et al. 2008)) inspired practice-oriented conceptions of self-organizing product development (Nonaka 1988a) and also provides philosophical grounds for the present interest for situated practice and process philosophy in organization studies (Chia 2014). Additionally, an influential scholar inspired by the seminal works of the rational model of product development (Brown & Eisenhardt 1995), Robert Cooper has lately turned his stage gate system model of product development towards increasingly involving the work of 'agile' self-organizing teams (Cooper & Sommer 2016, 2018), the theoretical foundations of which is based on emergent practice and the works of pragmatist philosophers such as John Dewey (Nerur & Balijepally 2007) who is also a source of inspiration for process philosophers in organization studies (Vo & Kelemen 2014).

The concept 'self-organizing team', or 'self-organizing agile team' is increasingly popular in the management of product development (Rigby et al. 2016, 2018, Hoda et al. 2017). Initially grounded in smaller team based organizations for the development of software (Lindsjørn et al. 2016) it has now gained traction also in the product development organization of manufacturing firms (Cooper & Sommer 2016, 2018). Among its significant influences are the early works in what Brown and Eisenhradt (1995) refers to as the 'problem solving model' of product development such as Imai et al. (1984) and Takeuchi and Nonaka (1986), as well as passages in Gareth Morgan's influential book "Images of the organization" (1986) (Nerur & Balijepally 2007, Hoda et al. 2012). As will be described, such influences parallel several theoretical developments already mentioned in section 2.4. Allen (1995/1977) described the two fundamental challenges of an R&D organization as – (1) coordinating diverse competences, and (2) providing teams with state-of-the-art information in the disciplines needed for the products or services under development. Adding also the relative autonomy or latitude, the space within which developers organize themselves, yields three areas in which parallels between the examples of practice-oriented conceptualizations of self-organization mentioned (section 2.4), and the theoretical underpinnings of the 'self-organizing agile team' can be illustratively described.

Coordinating.

First, the coordination of diverse competences for a specific purpose is a key strength both of temporary organization (Goodman & Goodman 1976, Lundin & Söderholm 1995) self-managing groups according to STS (Scott & Davis 2007) as well as communities of practice (Bechky & Chung 2018, Rennstam & Kärreman 2020). One of Morgan's (1986) three principles of self-organization is that of requisite variety and redundancy of functions. The use of self-managing groups within STS research stream has been based on an argument that redundancy of functions should be preferred over redundancy of parts in turbulent environments (Emery & Trist 1965). Such turbulence may be of various sources, an early and illustrative example is

provided by the faces in the coal mines described by Trist and Bamforth (1951), where the variation in density and material in the face is unpredictable but possible to handle for the responsibly autonomous group due to its diverse set of competences. In less 'turbulent' environments it may be preferable to design an organization so that its simplest elements, parts, are easily replaceable without disturbing the machinery, while in a turbulent environment the redundancy of functions supplies the capability to handle the unexpected (Scott & Davis 2007). Requisite variety in relation to self-organization (Morgan 1986) parallels one of Takeuchi and Nonaka's (1986) three conditions for self-organizing capability, cross-fertilization, the availability of distinct perspectives on the same problem, opening up for alternative solutions to a given problems and the opportunity for individuals to learn in the process.

Informing.

Second, challenge for R&D organizations to provide state of the art information for developers in their respective field of expertise (Allen 1995/1977) has been found to be handled spontaneously by technicians and developers who use informal channels also extending outside the organization to share, acquire and develop knowledge within their area of expertise (Barley 1996). The way this is done is framed within the previously described concept community of practice, also heavily dependent on shared contextual experience among engaged individuals, having similar frames of reference in order enable the stimulation and development of tacit knowledge beyond that which is possible to document or codify (Brown & Duguid 1991, Bechky 2003). Communities of practice are built around the development of knowledge (Wenger & Snyder 2000), or as Morgan (1986) phrases it in one of his principles of self-organization, the community learns to learn. Also informal processes for forming temporary groups in order to gather information for the purpose of immediate problem solving can be found embedded in communities of product development practice (Nonaka 1988a, Rennstam & Kärreman 2020). The sense of a shared purpose or goal that often permeates communities of practice (Rennstam & Kärreman 2020) implies an inherent intrinsic sourcing of motivation similar to another one of the condition for self-organizing capability described by Takeuchi and Nonaka (1986), self-transcendence. This means that individuals in a group with a capability for self-organizing will come up with extremely challenging goals themselves (Imai et al. 1984), in this way making any initial overarching goal handed to them, their own (Takeuchi & Nonaka 1986).

Latitude.

Third, through an extensive ethnographic study of a product development organization Rennstam and Kärreman (2020) find that communities of practice secure necessary autonomy through more or less deliberate mitigation of managerial control attempts. They do this by critically apprehending managerial interventions, translating such interventions into problems that the community can address, and then use peer reviewing to control the work progress as a substitution for managerial control. Similar observations have also been made by Bechky and Chung (2018). Such efforts by product developers to re-interpret managerial interventions into its bare essentials, stripping away any aspects deemed unfeasible to the community resonates Morgan's (1986) third principle of self-organization, that of minimum critical specification, which is also an accepted socio-technical design principle (Cherns 1987). Morgan (1986) also underscores the need for autonomy for self-organization to work. Moreover, autonomy is the third condition for self-organizing capability stated by Takeuch and Nonaka (1986). Considering temporary organization there is a persistent tension between autonomy and embeddedness in a wider organizational history and context in its conceptualization (Burke & Morley 2016). Allen (1995/1977) finds that temporarily autonomous groups, task forces, serve to solve problems on

the one hand, but also develops future informal communication networks in the permanent organization. Autonomy is also a fundamental feature of the STS concept self-managing group, originally illustrated by Trist and Bamforth (1951) in their study of workers in coal mines. The researchers describe how the relative independence of an autonomous group enabled it to make effective use of the different competences and requisites available in it to handle any deviations or unexpected circumstances unfolding at their part of a face, also in line with the STS idea of redundancy of functions over redundancy of parts (Scott & Davis 2007). After a subsequent re-organization of the work organization at the coal faces an orientation towards redundancy of parts rather than functions significantly decreased latitude at the worker's disposal, deteriorating the organizational ability to handle variation in the coal faces (Trist & Bamforth 1951).

Returning to the concept of self-organizing agile team. In a thorough grounded theory study of self-organizing agile teams, Hoda et al. (2012) found three distinct balancing acts continuously practiced by software developers in successful self-organizing teams. The different balancing acts succinctly conceptualize a practical approach covering the three areas described above, namely the balancing of cross-functionality and specialization, of learning and efficiency, and of balancing freedom and responsibility. It has been shown that individuals assigned to work in a team require time working together in order to become a well functioning self-organizing team (Gren et al. 2017). The ways of working indicated as self-organizing according to the aforementioned criteria stated by Takeuchi & Nonaka (1986), principles outlined by Morgan (1986) and practices specified by Hoda et al. (2012) also correspond to the ways of working in communities of practice in product development projects (Rennstam & Kärreman 2020), in temporary groups (Meyerson et al. 1996) and in self-managing groups as described within STS (Trist & Bamforth 1951, Scott & Davis 2007). Individuals organizing themselves in various constellation to collaborate temporarily (Goodman & Goodman 1976) or indefinitely (Barley 1996), to pursue common goals (Takeuchi & Nonaka 1986) or to mitigate common risks (Rennstam & Kärreman 2020) seems to be an aspect inherent to product development organizing (Allen 1995/1977, Nonaka et al. 2008, Munthe et al. 2014).

3.3 Leadership and management in self-organizing product development

In product development self-organizing occurs spontaneously without any managerial intervention temporarily around technical problems (Nonaka 1988a, Munthe et al. 2014) or through the formation of communities of practice (Barley 1996, Rennstam & Kärreman 2020). It may also occur within frames assigned by management, such as self-organizing teams (Rigby et al. 2016) or task forces (Galbraith 1977). In both cases there is commonly a managerial interest external to the self-organization (team, group, community, etc.) both to facilitate and to control ongoing work (Rigby et al. 2016, Rennstam & Kärreman 2020).

Barley (1996) predicted that managers in future technology and knowledge intensive organizations would become mere coordinators, as much of the expertise would rest within communities of practice. Lately, scholars have found engineers in product development respond to managerial control attempts through critically scrutinizing managerial demands, translating them to problems that are workable for the community of engineers and then replacing managerial control with control through peer review (Rennstam & Kärreman 2020). This resonates the idea of product development organizing as being driven on the one hand by senior

management's dreamy visions, and on the other hand by self-organizing product developers transcending visions through cross-fertilizing areas of expertise and uncovering technical possibilities (Nonaka 1988b). This idea is aligned with the management tactic of subtle control (Imai et al. 1984), and rests on a middle management that acts a broker between the two, fostering both bottom up self-organizing among developers and support in the top-down vision translation (Nonaka 1988b). Subtle control can be described as an indirect managerial approach where managerial interventions are primarily aiming at ensuring appropriate conditions for self-organization, such as to make sure that competent people with relevant perspectives are employed, that iteration pace in development is appropriate, that engineers are encouraged to stay curious while anticipating and tolerating of mistakes (Takeuchi & Nonaka 1986).

Subtle control has struck scholars as slightly unclear as to what it means in practice (Brown & Eisenhardt 1995). However, the unclarity as to what management and leadership is (Barker 1997, 2001, Alvesson & Spicer 2012) in practical product development matters is not unique to 'subtle control'. A later study by Eisenhardt and Tabrizi (1995) found that highly effective team based product development hinges on 'powerful leadership'. The construct is there measured in terms of the rank of the project manager in the managerial hierarchy and her corresponding mandate to make formal decisions within the project scope (Eisenhardt & Tabrizi 1995, p. 100). In other words, the extent to which the development project is formally autonomous in relation to the managerial hierarchy in which it is embedded, is important for effective team based product development. How leadership is exercised within the part of the organization (e.g. temporary project organization) that is granted autonomy in relation to the overarching managerial hierarchy in the company, does not come in to the matter. Hence, whether 'powerful leadership' indicates a protective umbrella (Gjerde & Alvesson 2019) for self-organizing practice throughout the project organization, or the establishment of a meticulous hierarchical control system of direct supervision, or any other variation of management and leadership is not clear.

Nevertheless, the study of product development from such a managerial or leader perspective has rendered results similar to how later descriptions of self-organizing teams are best organized for product development (e.g. Rigby et al. 2016), i.e. structured work processes that still allows for improvisation, frequent prototyping and experimentation, and a deliberate and simultaneous management of work in relation to long- and short term perspectives (Brown & Eisenhardt 1997). Still, how managers and leaders should go about in practice to attain such working conditions for product development remains unclear. Later scholarship by Eisenhardt et al. (2010) has outlined the management of micro-foundations of performance to address this and similar issues and come to the conclusion that 'leaders' should use simple rules (described similar to the minimum-critical specification principle of self-organization (Morgan 1986)), should acknowledge that "the balance between efficiency and flexibility can vary within even single organizations" (Eisenhardt et al. 2010, p. 1270) and that they "can manage the cognitive contradiction inherent in balancing efficiency and flexibility by relying on higher-order thinking and expertise." (p. 1270).

Evident from this line of scholarship is that it concerns a higher level of organization where product development is considered one of many functional sub-organizations, but nevertheless the guidance it provides for professionals who identify as managers and leaders in product development may seem intimidating to all but the elite of performers. A similar super-human profile is painted in capabilities of a heavyweight project manager of highly effective and

efficient product development teams (Clark & Wheelwright 1992). Such advice for the management of product development implies an allusion to ideas of the heroic leader, the demystification of which has taken part in motivating the more process-oriented conceptions of leadership described in section 2.5 (e.g. Barker (1997, 2001), Crevani et al. (2010), Alvesson & Spicer (2012), and Blom & Alvesson (2014)).

4 Self-organization in product development - a matter of perspective

Tsoukas and Chia (2002) concisely describe how "the carrying out of an organizational activity simultaneously involves the existence of certain generic rules containing a canonical image of the activity to be carried out (i.e., "If X happens, do Y, in circumstances Z.") and the noncanonical, particularistic practices of the actors involved in it, which are consequences of the inherent open-endedness of the context within which organizational action takes place" (p. 573). Informal non-canonical work and communities of practice have grown important as work grows too complex for standardized recipes and up-front planning can account for (Barley 1996, Munthe et al. 2014). This character of organizations also nurtures corresponding needs for managerial practice to coordinate and control also the tacit and ephemerally situational aspects of the activities taking place in organizations.

Different forms of self-organization are prevalent in product development (as exemplified in sections 2.4 and 3.2). Work under such organization is often characterized as informal rather than formal (using Brunsson's (1989) distinction noted in section 2.2), non-canonical rather than canonical (Brown & Duguid 1991), and often with action preceding decision (Lundin & Söderholm 1995). Still, managers and other individuals expected to exercise management and leadership in product development are left with mainly formal and canonical guarantees of authority by virtue of a formal appointment, but seemingly super-human models to guide their practice (e.g. Clark & Wheelwright (1992), Eisenhardt et al. (2010)), as noted in section 3.3. As less-hierarchical organization (the extreme of which is considered self-organization) becomes increasingly popular from a management point of view (Lee & Edmondson 2017) managers are facing a precarious situation concisely framed by Ingvaldsen and Benders (2020). They consider management a problematic combination of control and coordination. They frame management in terms of coordination and control dualism, arguing for an inherent contradiction in the simultaneous exercise of control and coordination since the exercise of horizontal control frequently works against the exercise of (often laterally exercised) coordination. Rennstam and Kärreman (2020) illustrate how this contradiction is handled unofficially by product developers as they disobey managerial control only to selectively translate ignorant managerial demands to tasks that they can laterally coordinate and control themselves through peer review. However, such a solution to the contradiction of management leaves the formally responsible manager in the dark as to what is actually going on.

Managers are not alone in the dark. Scholars have similarly struggled to understand such emergent forms of organizing and frequently turned to practice and process philosophy to light their way. Scholars have called for a process philosophy grounding of temporary organization (Bakker et al. 2016), acknowledged sociomaterial practice as the roots of self-managing groups (Tsoukas & Shotter 2002, Leonardi 2012), considered process-philosophers to theoretically ground the idea of self-organizing agile teams (Nerur & Baliepally 2007), and found practice-studies aligned and sharing roots with scholarship on communities of practice (Brown & Duguid 1991, Gherardi 2000, Rennstam & Kärreman 2020). In this light, the character of product development organization as creative (Amabile 1998), relying on temporary organization such as projects (Munthe et al. 2014) and task forces (Thompson 2003/1967), employing diverse communities of technological expertise (Allen 1995/1977) and their corresponding practice

(Barley 1996), the general relevance of a practice perspective on product development organization is worthy of consideration.

The theoretical conceptions of self-organization described in previous sections might well serve the purpose of making sense of a seemingly prevalent form of organization in product development, but they are nevertheless likely to be grounded in pre-critically adopted ideas about organizational reality (Sköldberg 2002, Sewell 2001). Self-management and self-organization are implicitly contrasted to the managerial hierarchy (e.g. Lee & Edmondson 2017), the community of practice is made distinct in comparison to canonical ideas of work (Brown & Duguid 1991), and temporary organization is associated with a parent organization of relative permanence (Burke & Morley 2016). Nevertheless, such organizational forms are often formed emergently through practice from the inside out, becoming something that through recurrent practice can be understood from the outside as a group, team, community, or a temporary organization (e.g. Rennstam & Kärreman 2020). Often based on informal social and technical relations (Thompson (2003/1967), Meyerson et al. (1996), Nonaka 1988a), driven by intrinsic motivation and individual curiosity (Amabile 1998) the different forms of self-organization previously described have their parallels in crisis management (Thompson 2003/1967) and play (Mainemelis & Ronson 2006) and may be better thought of as a default form of organization, merely conditioned by externally conceived organizational structures.

Being in a constant state of becoming, such organizing can hardly be understood, nor effectively managed from the outside looking in (Tsoukas & Chia 2002) making its conceptualization a challenge. However, rather than conceptualizing aspects of organization or management in new ways to account for the idea of self-organization as the norm, a mere shift in perspective may provide fertile grounds for both scholarly work and managerial practice. To this end, a metaphorical grip is used in a coming section (7.2) to better position the reader to follow in the shift from an outside managerial perspective on product development, to the inside perspective of self-organizing product development practice.

5 Method

The contribution of the present thesis is mainly conceptual. It aims to reflexively reconsider and reconnect existing theories for the purpose of furthering the scholarly and managerial understanding of self-organization in product development. Conceptual though it is, the work is informed and inspired by the author's empirical fieldwork, some of which is reported on in the appended papers. This section summarizes the methods used in the fieldwork and analysis of empirical material reported on in the appended papers, including how writing the papers have inspired the conceptual argument of the present thesis.

The empirical contexts are large product development organizations with developers counted in their thousands. During the work underlying the present thesis the author has done participant observation one day per week during one and a half year in the mechanical integration department of such a product development organization in the automotive industry. During this time the organization was undergoing a change initiative towards increasing reliance on self-organizing agile teams for organizing development work. Most of the fieldwork is based on participant observation. Barley (1996, p. 416) refers to participant observation as a collection of methods involving taking fieldnotes that one expands after a days' fieldwork, the study of archival material from the site, socialization with informants off duty and focused interviews with informants that occasionally are recorded and transcribed.

As a participant observer the author was also observed by the observed (Czarniawska 2014) and otherwise had an impact on the context studied while studying it, what Burawoy (1998) call the ethnographers' predicament. What a researcher brings from the field is conventionally referred to as data collection where the word 'data' may be translated to 'the given' (Brinkmann 2014). But considering the mentioned predicament, empirical material such as fieldnotes are better thought of as constructed rather than given and collected (Alvesson & Sköldberg 2017/2000). Researchers may chose either to try to minimize their own imprint in the context they study, or to maximize its usefulness for exploring the context (Burawoy 1998). The author has chosen the latter and has for exploratory purposes occasionally been deliberate in affecting the ways informants organize, an example of which is described in the appended paper MP. Collaborative approaches to fieldwork are emerging as researchers engage as participant observers in complex organizations (Garsten & Nyqvist 2013), and in such engaged dialogue between researcher and informants a grounding in theory may serve the researcher as a crutch mitigating the destabilizing effect of the ethnographers' predicament (Burawoy 1998).

Not to be blinded by theoretical preconceptions in fieldwork, the author has actively questioned and problematized his theoretical crutches in relation to his experiences from fieldwork and other empirical materials (Alvesson & Sköldberg 2017/2000), a process that recurrently has sparked interest in alternative theoretical approaches. Such an approach to theory is particularly relevant for the purpose of the present thesis, reflexively reconsidering and reconnecting existing theories rather than generating new (Burawoy 1998). This relation between theory and fieldwork in terms of crutches and sparks will be exemplified and elaborated on in section X, following a note on the author's approach to fieldwork.

5.1 Doing fieldwork

Plunging into an organization to do fieldwork means to become part of a development over time, a process. Considered as part of a research process leading up to this thesis, the author plunged into the field early in his doctoral studies and the method for doing fieldwork has been emergent along the way. Generally, each day in the field the author took field notes, usually a few minutes after something that stood out had happened or whenever an opportunity occurred to scribble them down. Prioritization was given to being in the moment as a participant in the events rather than taking notes as it happened. The author's initial relation to fieldnotes was inspired by Van Maanen's account of impressionistic fieldwork, that the field-specific interpretive skill a fieldworker develops over time "is perhaps more akin to learning to play a musical instrument than to solving a puzzle" and that the great dependency commonly claimed to exist between fieldnotes and fieldworkers is not and cannot be so very great at all" (Van Maanen 2011/1988, p. 117-118). The direct, explicitly traceable empirical grounding seemed inherently limited or impossible. This led to a disbelief in the prospect proposed by Denny Gioia in Gehman et al. (2018), that a codified data structure can show the progression from empirical material to theory. On the other hand, such fruit of a grounded theory strategy might not necessarily illustrate the road to knowledge at all, but merely be indicative of how empirical material was created and interrogated (Charmaz 2008a).

From how Martin and Turner (1986) instructively describes the art of writing notes the author's field notes are comparable to "notes taken on the spot" (p. 145) with the primary aim of supporting the author’s memory, both regarding the event as such, and the glimpse of an idea it produced in the author's mind. The author made a habit of keeping a field diary, a post in which could be comparable to producing "a full set of notes" (ibid p.145) to make sense of scattered notes from a fieldwork session. However, perhaps exaggerating the difficulties of making any objective justice to what had happened in the field, the author's goal with this diary was to facilitate his own retrospective understanding of the learning process rather than a standalone account of events. As such it was committed to a social constructionist, rather than a positivist idea of fieldwork (Charmaz 2008a).

Allowing the emerge over time helped the author to pursue what could not have been anticipated (Charmaz 2008b). The fundamental idea that organizational reality to a large extent is socially constructed did not lead the author to believe that it is feasible to "capture the organizational experience" (Denny Gioia in Gehman et al. (2018, p. 286)), but like Kathy Charmaz kept to George Herbert Mead's idea about the present as arising from the past but with new properties (2008b). Focusing on the present as the locus of reality (Mead 1932) any effort to adequately 'capture organizational experience' seemed vain regardless of the level of detail of presently unique properties that could be documented. The author's conclusion was that organizational reality is immensely complex and in its emergence does not lie still for observation, why its imprints on the fieldworker as a researcher (and person) is the most real depiction of it that can be brought from fieldwork (Helin et al. 2014) to future presents, e.g. for writing up.

5.2 The use of theoretical crutches and sparks

Self-organizing product development work and its management can be addressed using a multitude of theoretical approaches. This has led the author to sample different ones, as can be

seen across all appended papers, each rather eclectic in its theoretical underpinnings. Said eclecticism has given the author an opportunity to try various lenses and metaphors and to see similarities and differences among theories and the aspects of organizational reality they claim to model. The appended papers thus serve an additional purpose for the present thesis apart from providing empirical illustrations of self-organization in product development. They also serve to illustrate the thought work that has produced the conceptual argumentation of the thesis. Each paper serves this purpose in two ways. First, in each paper certain theoretical frames are used to interpret the empirical material. This may be thought of as theoretical crutches. Second, the experience of selecting and using theoretical crutches to support the empirical investigation also gave the author clues for how to further his theoretical understanding of self-organization in product development. The author refers to this as theoretical sparks. To express it metaphorically: Using crutches can spark ideas for how they may become more supportive in future ventures into unknown fields of play. This dual role of theory will be briefly exemplified for each appended paper below, awaiting a slightly more extensive summary of the appended papers in sections 6.1-4.

In the fieldwork underlying paper CN, theory on team communication and concepts such as competence diversity and task interdependence serve as theoretical crutches for two months of participant observations in visual planning meetings. However, a spark came from seeing how communication needs, rather than enacted communication seemed to drive local development of the visual planning method. It contributed to direct the authors interest towards the antecedents of that which can be observed, the potential in the present for that which is about to happen, e.g. towards looking at organization through the lens of organizational becoming (Tsoukas & Chia 2002).

Paper MP concerns two months of participant observation in a temporary group where the 'mirroring hypothesis' and Nonaka's (1988a) process description of self-organizing problem solving serves as theoretical crutches to interpret empirical material. A spark came from seeing how temporary organization theory (Lundin & Söderholm 1995, Meyerson et al. 1996) and theory of self-organization such as Takeuchi and Nonaka (1986) and Nonaka (1988a), had similar explanatory potential. The latter is associated with group maturity (Hoda et al. (2012), Gren et al (2017)) while the former is distinctively not. This facilitated the author's understanding of self-organizing work as not necessarily tied to a specific form, such as a mature group or team. Loosening the connection to specific forms, self-organization could more readily be considered an aspect of the ordinary and mundane in product development.

Empirical material that paper LE relates to is based on both interviews and participant observation. It draws on both the author's as well as a co-author's respective fieldwork. The theoretical crutches consist of Crevani and colleagues' (2010) conceptualization of leadership in terms of co-orientation and action spacing, as well as the idea of patterns inspired by Alexander et al.'s (1977) pattern language. A spark came from considering individuals concerned with leadership while simultaneously regarding leadership as relational rather than individually accomplished, i.e. trying to consider the relational from the point of view of an individual. This sparked the author's interest for the manager's (individual) management of the self-organizing (relational), drawing close to the problematization motivating the present thesis.

In paper BM the author primarily contributes with the conceptual work. Empirically it draws on the fieldwork of a co-author. The theoretical crutches are eclectic but mainly consist of

institutional theory, institutional work and leadership theory similar to that used in paper LE. Two approaches to product development are considered, and how a change could come about, from one to the other (i.e. the institutionalization of a new model of product development). Such a change takes time and builds on various forms of work (i.e. institutional work). The theoretical spark came from considering a particular aspect of such work, a change that may occur without significant passing of time. That of changing perspectives. A curiosity of how models for product development may entail different interpretations of the same aspect of organizational reality, depending on the perspective one has.

5.3 Stories and metaphors connecting field and desk

While stories and metaphors may be conceived based on observations, creativity and logic, it may also be reasonable to assume that stories told, and familiar metaphors lay the foundation for observation as well as creativity and logic. Sköldberg (2002) argues that metaphorical and dramaturgical thought styles guide the way organizations are thought about and approached. Considering it a useful vehicle for advancing empirical material, including the imprint that fieldwork has made in himself, the author has made extensive use of stories and metaphors throughout the research process from field to desk.

Stories and metaphors were used in fieldnotes as well as more extensive accounts, and they were used early as well as later in the analysis and writing processes. Early on it could be in the form of short notes or drawings to account for events and episodes, but stories have also been written by the author to understand the historical context of the setting in which fieldwork was conducted, serving as a living account to be revised and developed by the researcher and informants. This approach was extensively used in fieldwork leading up to paper CN. Later in the process empirical material could be structured as a story, such as in paper MP, and metaphors used to render findings resonant for a reader, such as the metaphorical personas in paper BM. In the analysis process leading up to paper LE short stories of situations and events drawn from interviews and fieldnotes were considered patterns of practice structured as the path from conception of a problem (something inhibiting co-orientation or action-spacing in the group) to its resolution.

5.4 A note regarding the appropriateness of the methods used

Positivist assumptions underlie much of the evaluation of qualitative research on organization and management (Symon et al. 2018), assumptions anchored in criteria such as internal validity, external validity, construct validity. Such assumptions hold that research should be measured according to truthfulness with respect to some 'objective reality out there' and as such they have been heavily questioned in the evaluation of constructivist research (Alvesson & Sköldberg 2017/2000). In the work leading up to the present thesis the author has taken a social constructionist position, in the sense of assuming organizational reality to be relational and that relations are mutually constitutive, that the agency producing a relationship is also generated by the relationship (Feldman & Orlikowski 2011). It follows that no aspect of organizational reality can be made justice as considered without its situated context. On a more personal note, the author has taken such convictions seriously to the extent of doubting any possibility of doing observations justice through note taking. That which he may put in words accounts for a fraction

of the experience of being there. Considering the tacit aspects of organizational reality the interesting and relevant ones, that which can be made explicit through words may misrepresent an event and ironically direct a reader's attention away from the most relevant aspects of an event. This has led the author to consider his own experience from being in the field (i.e. the imprints it has made in him (Helin et al. 2014)) the primary empirical material drawn from fieldwork. After all, the author was part of the situated context of the events observed.

Defining variables and studying their variance becomes less feasible under constructionist assumptions as the variables are compared detached from their situated context. It is more plausible then, to study situated events and processes embedded in their organizational context, i.e. doing process research (Langley 1999). The empirical work of the author largely draws on a processual approach. As such, empirical material is constructed as events and developments over time, rather than variables for the study of variation among them (Gehman et al. 2018). In such research narrative structuring of empirical material is fundamental and may for constructionist researchers serve as the end product of a study (Langley 1999) such as ethnography. Narration is drawn on in the empirical work related to present thesis as a vehicle to share empirical material (as part of the appended papers LE, CN and MP, or as the basis for interaction with informants, notably in paper CN and MP).

Process research often builds on an abductive approach to fieldwork, exemplified by Ann Langley describing how "we go into a site with some vague idea about the kinds of concepts and ideas that we are interested in. We collect some data that make us think about some other angles that might be interesting, and then we go to the literature and search for theories that would be relevant" (Gehman et al. 2018, p. 297). The empirical work that inspired the work with the present thesis followed the same approach. However, turning back to the literature it seemed strikingly relevant to explore and clarify underlying and seemingly unarticulated assumptions in existing literature regarding self-organization in product development. As such, a large part of the work underlying the present thesis became conceptual. Striving to make a knowledge contribution through the articulation of previously non-articulated implicit assumptions of established theory requires selective careful reading and creativity, and importantly maintaining a sense of, and a connection to the aspect of organizational reality that one addresses (Alvesson & Sköldberg 2017/2000).

6 Appended papers

6.1 Paper CN: Communication needs in R&D teams – Investigating the impact of task interdependency and competence diversity

Among the first observations of product development organization that the author made were of cross-functional groups of developers engaged in visual planning. This form of planning is centered around a visual board where all individual group members short and long term plans are collected visually for all to see (Lindlöf 2014). The frequency and form of meetings around the board, as well as the visual layout of the board can vary between contexts and over time (Ibid.). As such it constitutes a platform both for organizing product development work on the group level, and also an arena where transformation of the way of working becomes visible in changes of the configuration of layout and meeting form and frequency over time.

The understanding of the empirical context is grounded on a retrospective interview study of the infotainment department and its early use of the visual planning method that ran in parallel with real-time observation of visual planning in various groups. Six groups were followed over a period of two months in their various ways of using the method. The choice to study communication needs was based on the prospect of being able to discern how group communication best can be supported. Underlying individual communication needs were investigated and categorized based on the situated social context in which the visual planning took place. This context was analytically rather coarsely categorized based on task interdependence and competence diversity among the individuals present.

Observations from the study indicate that contextual lack affordance to satisfy perceived needs of communication forego efforts to change the context, to (self-) re-organize the visual planning format. The present potential for developers to satisfy their perceived communication seemingly stand out as critical for product developers in order to carry out cross-functional product development work. Consequently, mangers' attention to, and understanding of such present potential might be thought of as central to management if it is to deliberately depart from a focus on development practice as it unfolds in the present.

6.2 Paper MP: Self-organization of the product and organization relationship – A processual perspective on the mirroring hypothesis

Paper MP takes a micro perspective on the relation between product and development organization, a relationship which is referred to in terms of the mirroring hypothesis. This hypothesis assumes that the product and organizational structure mirror one another in product development. The empirical account in the paper tells the story of an episode of mechanical integration where a group of developers who otherwise do not work closely together solved a technical problem that they temporarily had in common.

The author played a minor but significant role in suggesting the format for such meetings thus taking a participant observers role in the study. A specific integration engineer also played an important initial role in the process, drawing the various developers' attention to the problem at hand, suggesting a way for them to meet regularly. The enabling role of the integration engineer, resulting in leadership being exercised by the group in a more distributed fashion drew

the authors attention to practices that individuals can engage in in order to support the enactment of leadership and management in a collectively among developers (This paved the way for the later study of individuals routinely engaged in such practice, reported in paper LE).

The empirical study lasted for two months, out of which the first month consisted of three 15 minutes long meetings per week to maintain a common view among ten developers from different engineering groups. They usually did not work together and many of them had not met before, but the respective parts that they worked on were all technically interdependent, which was the cause for the integration engineer to propose their participation. Normally, as they did not work together, communication about integration problems went through the integration engineer. After the first month the integration engineer sensed that the group would need a clearer purpose for the meetings in order to maintain participation a priority. The integration engineer proposed such a purpose in terms of a specific integration problem in which all were needed to contribute. At a longer meeting, the problem was partitioned into sub-issues to be handled, and the three-meetings-per-week routine from the previous month was kept up during the coming two weeks where participant discussed progress of their respective work. The integration engineer was present at the meetings on the same terms as the others, but often acted a facilitator.

The two weeks of work gave good results comparing with normal ways of handling similar integration problems (i.e. longer but less frequent meetings). The group decided to keep up the meetings bi-weekly for two more weeks to finish the remaining work on the problem, but during these weeks, the integration engineer went on vacation. Work proceeded and the problem was essentially resolved by the end of the two weeks. After these two months the participant drew their principle communication patterns during the work related to the integration problem, indicating a significant increase in communication among participants compared to the initial communication structure that had the integration engineer as a communication hub. Participants' communication better resembled their corresponding technical interdependencies after the two months of regular short meetings.

Theoretically, the paper uses Nonaka's (1988a) process description of how organizational order is created out of chaos to illustrate how initial uncertainty as to how the technical problem should be solved sparks emergent communication patterns answering to the technical dependencies to be managed. It indicates that the needs for communication sparked by technical inconsistencies in ongoing product development are generative of organizational structuring and the sociomateriality of self-organizing in product development. Similar to paper CN the communication needs of individuals drive organizational structuring analogously to how Thompson (2003/1967) describes the initial dynamics of synthetic organization, where individuals strive to put their abilities to use in order to make a chaotic situation more orderly.

The empirical study confirms Nonaka's (1988a) process description of self-organizing development work, particularly the last two weeks when the integration engineer was not present. It also confirms the idea of swift trust built in temporary groups (Meyerson et al. 1996) and the simultaneous creation of technological and social order through problem solving proposed in Nonaka (1988a).

6.3 Paper LE: How to enable leadership among self-organizing developers

Paper LE reports on a study that draws on empirical material from interviews and ethnographic fieldwork in two product development organizations, each developing complex products involving both hardware and software. In both organizations the authors have identified ongoing self-organizing work and individuals who are mainly concerned with facilitating for the self-organizing of others. These individuals are not formally superior to the developers whose self-organizing work they facilitate. They are not leaders in the sense of giving direction but they are directly engaged in making sure that cross-functional groups of developers exercise leadership. Such individuals are referred to as leadership enablers (LE). In one of the cases LE were identified that are formally responsible for the integration of work coming from developers at different departments. This led to a need to draw together temporary cross-functional groups and to help them to collaborate effectively. Paper MP can be considered an account of such a temporary group where the integration engineer is a LE. In the other case LEs were found in the form of individuals acting as appointed facilitators for self-organizing workgroups known as scrum masters.

The study draws on Crevani et al. (2010) and their theorization of leadership as 'co-orientation' and 'actions spacing' (see section 2.5) and also on Alexander et al. (1977) for the conceptualization of patterns of practice that are characteristic for the work of LEs. Patterns are exemplified based on practical problems and corresponding solutions that were found to be common to both cases. Generally, such patterns started in attentiveness to group dynamics, or the absence of such, to enable discussions and draw attention to potential issues (Co-orientation). Then followed practices aimed at making sure that every relevant perspective is on the table, supporting perspectives that for some reason or other are not voiced (e.g. temporarily absent developers or developers less inclined to make their voice heard) (Action spacing). Subsequently, as the various perspectives are on the table, focus is again supporting the group to co-orient, but now around potential solutions to the problem. Finally, LEs act a collective memory and coach the group to remember and sustain what they have collectively come up with as a solution to the problem.

6.4 Paper BM: The blind leading the mute – Formal leaders' potential to facilitate institutionalization of the agile myth

Through a description of a contemporary trend in product development organization, paper BM concretely exemplifies the shift of perspective illustrated in the theatre metaphor. On the one hand there is the original metaphor, where product development organization is a drama in which the protagonist is a formal manager that contrives a plan and a formal organization under which informal organization may play a secondary enabling role. This is described as plan-driven product development such as the organizational systems developed by Cooper (1990) which has come to dominate manufacturing companies in their organization of product development (Sommer et al. 2015). On the other hand, there is the inverted metaphor represented by agile product development, an organizational approach that was emergently developed by small groups of software developers (Lindsjørn et al. 2016) and that put self-organizing product developers in the center of product development organization (Stray et al. 2018). Presently, many product development organizations that until now have relied on a plan-driven approach to organizing product development, now turn to agile product development in

efforts to invigorate their product development to embrace both software and hardware and simultaneously increase the speed of product development, while maintaining the possibility of change along the way (Sommer et al. 2015, Rigby et al. (2016, 2018)). Considering both the original metaphor, and its inverse, the study sheds light on the tension between them, and more importantly, sets the stage for analyzing potential shifts in perspective that enable constructive management in the presence of such tensions.

Brunson's (1989) distinction between formal and informal organization (see section 2.2) is used as a theoretical vehicle to outline a fundamental difference between plan-driven, and agile product development. In the former, the formal organization in terms of plans and formal roles and processes is considered the primary guide and driver of product development organization, while the informal organization is a secondary but necessary enabler. Conversely, in the agile approach to product development the informal organization is considered the origin and driver of product development organization while the formal organization is a secondary and necessary enabler. The tensions between the two approaches are illustrated with inspiration form an empirical case of agile transformation in the product development organization of an automotive company.

To illustrate the potential practical consequences of efforts to transform an organization from plan-driven to agile, two personas are conceived. One that represents the origin of the agile approach to organization, 'The Mute', namely developers organizing around practical problems as they emerge. The other persona, 'The Blind' represents the formal managers and leaders that are responsible for plans and formal processes. The Mute cannot explicitly articulate its ways of working because of its tacit and relational character, and because of the same characteristics the Blind cannot see the self-organizing practice that is going on in the organization. Consequently, to the extent that the Blind drives reorganization to agile development, there is a risk that the introduction of a new way of working disregards existing self-organizing practice and overrides it with new formalization that is ironically intended to support self-organizing work.

The proposed tentative put forward in the paper is inspired by the recent development of critical performativity (Spicer et al. (2009, 2016), Alvesson & Spicer (2012)). Critical performativity encourages a critical outlook on management and leadership observing situational circumspection in its exercise, as well as a pragmatic stance taking existing potential in the present situation the primary point of departure (Alvesson & Spicer 2012, Spicer et al. 2016), rather than bold ideas of a future state. Circumspection of managers in relation to product development practice serves as an acknowledgement of a backstage role and the need to listen and encourage actors, whenever they get off stage and have a break, to voice their reflections on how the performance unfolds in practice. In this way, the blind can get a vision that helps her to make the most out of the present potential that the ensemble has at hand.

7 Discussion

Drawing on the theoretical background provided in sections 2-3 and its subsequent synthesis in section 4 some insights from the appended papers are discussed in the following subsection to illustrate managerial practice that acknowledges the inside perspective of self-organization in product development. Subsequently, a metaphorical grip is used to better position the reader to follow in the shift from an outside managerial perspective on product development, to the inside perspective of self-organizing product development practice. After that the different metaphors used in the thesis are consolidated and some further implications are discussed.

7.1 Management with respect to the inside of self-organization

The social, the material and the present.

As exemplified in paper MP, as well as paper LE, product development is simultaneously a matter of social- and technical problem solving. But although the social and material may be ontologically inseparable (Orlikowski 2007) said inseparability is of little relevance to the present thesis so long as theorizing adequately accounts for practically relevant consequences of it. In the case of Trist and Bamforth (1951) the relevance was to be found in the organizational capability to handle natural variation in the faces of a coalmine. A capability shown to rest intrinsically in the way close social relationships, and elaborate craftmanship using simple tools enabled individuals to handle complex and demanding problems of varying kinds. It is the constructive management of such organizational capability that the author wishes to shed light on, taking seriously the risk of losing it if not taking into account that it is in fact the performance of sociomaterial practice (Trist & Bamforth 1951, Tsoukas & Chia 2002, Leonardi 2012).

Imai et al. (1984), as well as Takeuchi and Nonaka (1986) do take this into account but like Trist and Bamforth (1951) they do not dwell in the ontological details underlying their recommendations for how to organize product development. Contingency theorists have since found it difficult to pin down how their subtle management and self-organizing teams actually come together as a functioning whole (e.g. Brown & Eisenhardt 1995), but like Trist and Bamforth (1951) have found retroactive theoretical support in the later development of practice theory (Tsoukas & Chia 2002, Leonardi 2012), so does Nonaka (1988a) seem to rely on similar philosophical grounding in his conceptual outline of self-organizing practice in product development[3]. Given the openendedness of such practice it may be best understood as organizational becoming (Tsoukas & Chia 2002) and its management is accordingly to be grounded in the present, not as a present state, but as an openended becoming (Helin et al. 2014). Therefore, similar to good improvisation theatre (Vera & Crossan 2004), the focus of management should not be on outcomes, but on the process of their making. Focus on outcomes may neglect much that is relevant for practice but that cannot be explicitly traced and connected to outcomes. Turning back to paper MP, focusing more on the present, how the improvisational theatre played out at the meetings, the integration engineer sensed that a clearer purpose would

[3] Philosophical groundings compatible with organizational becoming (Tsoukas & Chia 2002) can be found in the philosophical concept of 'Ba' drawn on by both Nonaka et al. (2008) and by Robert Chia (2014) in The Oxford handbook of process philosophy and organization studies.

help the group to get a momentum in discussions at the meetings. The purpose or goal was in this case instrumental to the process of working together.

Organizational becoming.
A contingency logic would configure an organizational design according to contingencies affecting the intended operations given the state of its present environment (Scott & Davis 2007). By the logic entailing organizational becoming there is no present state of contingencies to which one may configure an organizational design (Tsoukas & Chia 2002). Instead, contingencies and organization are to be considered becoming in the present yielding an inherent openendedness to organizational practice and structure, where one cannot have an impact without oneself becoming with the organization (Helin et al. 2014). In a product development context, the product(s) are generally in the process of development, they are openended. While developers are guided by awareness of where they are, and their idea of where they are going, their practice is enacted in the uncertainty between the two. Consequently, the potential in the organizational reality around them, to answer to their needs (e.g. communication needs as in paper CN) is a highly relevant concern as it constitutes a direct support in the uncertainty of practice. To configure such potential, such as arenas for relevant communication (e.g. Visual planning in paper CN and the stand-up meetings in paper MP) is not just a managerial matter of concern for managers, but one that developers engage in as well. Paper CN and paper MP are examples where such managerial engagement is shared between managers and developers. Brunsson's (1989) distinction between formal and informal organization as rather loosely coupled can be seen as an illustration or caricature of the opposite - where managers handle the uncertainty through formalization and canonical ideas of practice, and developers finding little use in such formalizations, develop their own non-canonical supporting structures.

On the formal and informal.
In paper BM the extent to which formalization is the origin or considered an enabler determines whether or not self-organizing practice is given a central role in the organization. This reflects Adler and Borys (1996) nuancing of the conventional dualism of the mechanic and organic organization by introducing the distinction between coercive and enabling formalization. Just like a coercive formalization is crafted with the intention that practice is controlled and steered through it, a plan-driven product development presumes that practice will adhere to the plan, as described in paper BM. Conversely, enabling formalization is crafted with the intention to support and facilitate practice as practice unfolds. The craft of enabling formalization therefore requires intimacy between the practice to be supported, and the ones designing formalization (e.g. through self-organization as described in section 2.3) in order to allow for adequate adjustment. Enabling or coercive formalization as described by Adler and Borys (1996) correspond rather well to how formal structure is described as either the origin (coercive formalization), or an enabler (enabling formalization) of product development in paper BM.

As indicated in paper BM, an origin in the informal does not rule out the usefulness of the formal and vice versa, rather the usefulness of the respective counterpart is considered indispensable. In this regard it supports a practice orientation of rejecting dualisms in favor of duality (Feldman & Orlikowski 2011). Rather than opposite poles, paper BM suggests they should be considered co-existing aspects of organization. Similar to how neither plan-driven nor agile development are based on strictly formal or strictly informal organization, self-organization and organization through a managerial hierarchy are not one or the other either.

Formalization and hierarchy, just like the informal and self-organization may take both coercive and enabling functions (Takeuchi & Nonaka 1986, Barker 1993, Adler & Borys 1996). Nevertheless, the search for organizational solutions based on self-organization is motivated by increasing complexity and dynamics both in organizations and society at large (Lee & Edmondson 2017). This may lead to dubious associations of self-organization as a purely informal dynamic phenomenon as contrasted to stability and structure associated with formalization and bureaucracy.

Management may be associated with a strive for stability (Barker 1997), an association that is feasible both for self-managing groups (Barker 1993) and top-down management by means of a managerial hierarchy (Lee & Edmondson 2017). Yet, while highly formalized bureaucratic organizations are considered more structured and stable (Adler & Borys 1996), organizational fluidity is associated with less-hierarchical organizing and self-management (Lee & Edmondson 2017). This slight contradiction may be solved if assuming that stability and structure are as fundamental to Thompson's (2003/1967) 'synthetic'-, or self-organization as they are to his 'normal' efficiency oriented organization attributed with the tradition of managerial hierarchy (Lee & Edmondson 2017). However, in case of the former, all involved share relevant contextual experience and therein may rely on shared tacit understanding (Bechky 2003) to maintain structure and stability. Consequently, there is less need to formalize and otherwise codify the organizational structure. It may well be that in more turbulent environments, that which is stable and structured is hidden from (outside) view due to its informal non-canonical character, embedded in communities of practice and tacit routines for setting up temporary groups (Rennstam & Kärreman 2020). To have such self-organizing practice (i.e. the way people quite ordinarily solve problems and learn) aligned with the canonical and formal organization would be beneficial for a product development organization (Brown & Duguid 1991, Cohendet & Simon 2007) and the resulting performance may strike an outside observer as extraordinary (e.g. Rigby 2016, 2018).

Managerial engagement with self-organization.
To tap into, and align with the self-organizational assets that the formal organization (Brunsson 1989) and canonical practice (Brown & Duguid 1991, Tsoukas & Chia 2002) are blind to, managers may need to attentively participate in the uncertainty of product development practice. That is not necessarily to say participate in practice, but to participate in the uncertainty and inherent open-endedness of practice (Tsoukas & Chia 2002). This means that product development managers may need to complement the traditional strive to minimize uncertainty (Munthe et al. 2014) with the courage to embrace it as a source of emergent structure (Feldman & Orlikowski 2011) and a space for present potential to be realized if attentively tended (Alvesson & Spicer 2012). In paper CN it is argued that managers should be attentive both to the need for communication that their subordinates may experience, and the organizational affordances in place to facilitate for them to satisfy their needs. This requires a manager to inquire how work is carried out in practice, to empathize with subordinates, and simultaneously to assess the conditions they face in their work. This places the manager in a facilitating and coordinating role, rather than that of a controller and decision maker, much like Barley (1996) predicted.

Nonaka and colleagues (1985, 1986, 1988a, 1988b, 2008) suggest managerial approaches to product development that are compatible with the view of self-organizing work as exclusively comprehensible and controllable from the inside, and embraces the distance between senior

management's vision and the self-organizing practice to realize something inspired by the vision[4]. The distance between vision and practical realization yields autonomy necessary for self-organization but also underscores the middle managers' roles in the drama as backstage to both senior management and the practical development dramas. Both the interpretation of managerial vision into conversation about practical problems of its realization with developers, and the interpretation of practical challenges back into the visionary terms of senior management falls on middle managers. Nonaka et al. (1988b, 2008) refer to the work as the deductive set up of models based on senior management's vision to be tested in trial through self-organizing product development practice, which in turn yield inductively generated knowledge to be fed back into the models of the senior managers' vision.

Although holistic, the view presented by Nonaka and his colleagues resonates the rational idea of organization (Scott & Davis 2007), as a problem to be analytically solved, with the optimistic outlook on organization that Sköldberg (2002) refers to as the "comedy of the self-regulating system" (p. 116). The author has also noticed, in himself, the hollow sense of satisfaction when studying systems oriented theory of self-organization such as Niklas Luhmanns social systems (1995) and Sahal's (1979) unified theory of self-organization as giving descriptive sense to the idea of self-organization, but no hint of or association with the experience of being part of the self that is organizing. Sköldberg (2002) argues that both general systems theory and cybernetics are essentially content free when applied to organizing, that their justification draw on sensuous sources of analogy in the realm of natural sciences, while rendered purely conceptual in their application to the social sciences without being reducible to sensuous verification. This reflection applies also to the self-organizing process outlined by Nonaka (1988a) that is used in paper MP, and while related work by him and his colleagues seem to be compatible with self-organizing as the basis of product development work, the self-organizing team is still largely a mysterious black box from a managerial point of view (e.g. Brown & Eisenhardt (1995)). Although its internal doings have been made sense of when studied in practice (e.g. Hoda et al. (2012)), the managerial control and coordination of self-organizing teams remain puzzling (Spiegler et al. 2019).

The metaphors one uses to understand organization matters, as Morgan (1986) made clear, and although a particular type of metaphor is only dominating for so long, its influence linger long after alternative metaphors come in and out of fashion (Sköldberg 2002). The origins of formalization lies firmly with scholars like Weber (Adler & Borys 1996) and to the extent that formalization still plays a conceptual role in organization and management research the machine metaphors nurtured by rational ideal and popularity of natural sciences and engineering of the early 1900s is still present (Sköldberg 2002). Regardless of other metaphorical vehicles used to understand organizational reality the point of departure, the metaphorical origin of thinking about organization matters for what one is able to see and relate to, what one is able to deliberately manage. This point can be made particularly clear considering self-organization in product development.

[4] This line of thinking presupposes a congruence between developers' and senior managers' goals, that the vision to some extent is worth pursuing according to the ones who will realize it in practice (Adler & Borys 1996, Ingvaldsen & Benders 2020).

7.2 Staging a change of perspective

In organizations generally, and in product development organizations in particular, individuals collaborate and organize themselves in situationally unique ways based on particular problems (e.g. Nonaka 1988) or on the basis of mutual interests (e.g. Brown & Duguid 1991), temporarily (e.g. Goodman & Goodman 1976) or for indefinite time periods (Barley 1996). Self-organization seems to be the indispensable backstage work and backdrop for any managerial drama of product development (e.g. Galbraith 1968, Sosa et al 2004, Munthe et al 2014) with or without heavy weight project managers (Nonaka 1988a, 1988b, Clark & Wheelwright 1992) or up-front planning (Eisenhardt & Tabrizi 1995).

Paraphrasing Brunsson's (1989) distinction of formal and informal organization (see section 2.2) the drama on stage follows dramaturgical (institutional) norms that are easily changed between shows following the latest fashion by strokes of a pen in a manuscript, but backstage a less directed organizing follows few rules but 'the show must go on'. Some scholars enter product development backstage to study the backdrop more closely and how it relates to the play of managerial actors (e.g. Rennstam & Kärreman 2020). Some practitioners do without casting managers for central roles in the drama and rely mainly on self-organizing developers (Stray et al. 2018) to perform improvisational theatre although it has proven a challenge to maintain a coherent narrative in dramas of epic scale (Rolland et al. 2016).

As the backstage micro foundations of the drama get more and more limelight (Eisenhardt et al. 2010), and the work backstage is brought forward as key to the play (Rigby et al. 2016, 2018), the metaphor seems better off inverted. Just like Barley (1996) predicted, managers seem to play less central roles, facilitating the work of autodidact or formally educated but highly skilled technical protagonists in contemporary drama of product development (e.g. Barley (1996), Blom & Alvesson (2014), Munthe et al. (2014), Rennstam & Kärreman (2020)).

How can product development organization be usefully theorized if assuming the situated practices of product developers to be the main act of the show? Rather than elaborating on theoretical models of less hierarchical organization (e.g. Lee and Edmondson (2017)), one may consider conventional product development organization with managerial hierarchies, but switch the lens, acknowledging the existing self-organizing practice among product developers as an alternative point of departure for understanding the management of product development. Placing the formal organization, canonical practice and individuals with primary focus on management and leadership backstage in the product development drama entails deemphasis on any aspect of such backstage work that does not have a noticeable effect for the drama on stage enacted by self-organizing developers. As Rennstam and Kärreman (2020) indicate, managers' managerial intentions and product developers' practice may be quite loosely coupled. Rather than being leaders or managers, individuals who want to realize leadership and proper management of product development may be better off considering themselves enablers of leadership and management as performed collectively among product developers (Crevani et al. 2010, Bäcklander 2018). Potential patterns of practice of such enablers of leadership are exemplified in paper LE.

Inverting the metaphor is not without consequence for someone intending to study the drama. With formal roles, canonical procedures and organizational echelons less articulate for the audience, the interpretation of what happens on stage is the more dependent on what actors, backdrop and other material requisites on stage perform through practice in the present. The

intimate situatedness of practice in sociotechnical relations is accentuated with the prevalence of modern information technology in organizational life (Orlikowski 2007) but has nevertheless been crucial in order to understand work organizations in practice at least since the coal mine studies published by Trist and Bamforth in 1951 (Tsoukas & Chia 2002). The focus on practice in organization studies entail focus on relations among both social and material agents and acknowledges aspects of events that does not necessarily endure over time (Simpson 2009, 2014). Such ephemeral aspects are not captured by codes, concepts or categories but are nevertheless critical for the understanding of events in organizational reality (Tsoukas & Chia 2002, Helin et al. 2014). From this perspective variance thinking on the basis of defined concepts need to step back to give way for a processual understanding of organization (Gehman et al. 2018, p. 289), understanding the development of practices over time considering its contextual embeddedness and inherent open-endedness (Tsoukas & Chia 2002). In other words, from a practice perspective measurable outcomes get less limelight than the process leading up to them.

Similar to how workers may be more concerned with constructions of hierarchy for the purpose of coordination of ongoing work than for control of its expected outcome (Ingvaldsen & Benders 2020) "good improvisational theatre arises because its main focus [...] is more on the process of improvising and less on the outcomes of improvisation" (Vera & Crossan 2004, p. 727). Consequently, anyone responsible for outcomes, while still relying on self-organizing work for its realization, may benefit from embracing the uncertainty of practice as it unfolds in the present in order to positively affect outcomes.

7.3 Consolidating metaphors

Putting the Blind and the Mute from paper BM in relation to the theatre metaphor causes noteworthy friction that may be used to spark illuminating distinctions between the self-organizing as seen from the outside, and as experienced from within. The Blind can be translated into the manager, and the Mute can be translated to the product developer. Placing the self-organizing developers on stage metaphorically engaged in improvisational theatre, then representing them with a persona named 'the Mute' calls for further elaboration. The blind-, and muteness in their respective names relate to their shortcomings with regards to self-organizing going on on-stage. In other words, while the manager may see the effects of the theatrical performance by looking at the audience, the relations, emotions and physical practices mobilized for its performance cannot be perceived. Such invisible assets are lived by the ensemble on stage, much of which is tacit and relational why it cannot be comprehensively put in words by the actors, by the Mute. That is, the Blind is blind to self-organization by virtue of being outside of it. Considering that self-organizing product development is embedded in practice and relying on tacit knowledge it cannot be fully articulated and described by its practitioners, even if they would step back and get an overview. In this sense they are mute.

From a manager's point of view this means that while self-organization is expectedly fundamental to any product development organization, making deliberate use of it requires either the acknowledgement of blindness as a non-participant, or the participation in it. The former means to participate in the uncertainty of practice and acknowledging a loss of control and the necessity for acute attentiveness in tending to the needs of the self-organizing. Participating in it also means a loss of control and to take part in the situated context of practice of product development, essentially ceasing to be a manager and becoming part of a self that

organizes and self-manages. Both options may seem radical if the manager is considered the protagonist in the drama of product development organization. With such a perspective on product development neither option is necessarily needed, as self-organization is likely to be ongoing backstage anyway although not necessarily aligned with canonical practices and the formal organization espoused by a managerial hierarchy (Brown & Duguid 1991, Rennstam & Kärreman 2020). However, if the manager moves backstage in the metaphor, and self-organizing product developers enter the stage as protagonists of the drama the managerial perspective on self-organization in product development calls for a choice between the two options: The acknowledgement of blindness as a non-participant, or participation in practice.

The current managerial and scholarly curiosity in self-organization does not necessarily mean a need for radical change in the way organizations are formally structured. A change in perspective, or metaphor, may prove equally radical in effect, making more use of existing self-organizing potential in product development organizations. Given that self-organization is already ongoing in product development practice, organizational changes may well risk being counterproductive to intentions of empowering self-organizing work. The designation of self-organizing teams is not likely to introduce new forms of organizing work in a product development organization, but merely espousing what previously was self-organized through non-canonical practice. However, suggesting formalization of the previously informal imposes a context on the latter with which it has not emerged and consequently espousing the informal through formalization also risks disrupting it. Rooted in situated practice, self-organizing is not that unlike conversation - it takes empathy, sensitivity and tact to have a deliberate impact on where it is going, especially if you were not in it from the start and you want it to go on in a spirited way after you leave. Similar to suggesting a new topic or twist in an ongoing conversation, introducing a new form for self-organization requires awareness and acknowledgement of what is already ongoing, or reorganization may end up disrupt, more than support, self-organizing work.

The change in managerial perspective proposed in the inverted theatre metaphor encourages managers and management scholars to reconsider ongoing organizing of current product development. Areas of particular interest may be the ways in which employed experts organize themselves to maintain and develop their expertise and how they solve unforeseen problems. Also, the ways in which processes are handled where formal procedures are non-existing or have lingered for a long time without update. If a manager choses to maintain a distance, such considerations do not entail a detailed mapping or control of such ways of working, but a deliberate awareness of their existence, and an attentiveness to how they may be supported.

8 Conclusion

The ambiguity of self-organization in product development can be explained by the difference in perspectives through which it is considered. From the point of view of a manager who is not herself engaged in the self-organizing work a full understanding and effective control is unattainable by virtue of being outside of it. Similar limitations also apply to scholarly work taking a manager's perspective on self-organization in product development. Understanding and control of self-organization in product development primarily resides in its situated practice embedded in shared experience and tacit knowledge of its practitioners and contexts. As such it cannot be fully explained to someone outside of it.

Acknowledging this accentuates the managerial challenges implied by a strive for new organizational forms based on self-organization in product development. It also sheds light on a choice that deserves deliberate consideration by product development managers that are interested in the potential of self-organization, and scholars who wish to understand it. Either to embrace the position of an outsider, or to become an insider by engaging in it as a practitioner. The former implies sacrificing the possibility to pin down the detailed tracing from management cause to development effect and prescribes subtle management (Imai et al. 1984, Nonaka & Takeuchi 1986), coordination and facilitation rather than control and decision making, aligned with what Barley (1996) predicted. A more direct engagement in effective leadership and management, or the study of self-organization in product development requires sharing the experience and situated practice of ongoing processual management and leadership among developers.

Contingency theorists such as Thompson (2003/1967) have considered the formally structured aspects of organization to characterize the 'normal', setting the manager center stage as the main actor of the organizational drama and the self-organizing developers as indispensable backstage. Since then, this perspective has echoed in literature on product development organization, including such that covers self-organization (Brown & Eisenhardt 1995, Dougherty 2008, Rigby et al. 2016, 2018). In the present thesis, the author suggests an inverted theatre metaphor if the management of product development is to more extensively rely on self-organization, aligning it with the formal organization of product development. Then product development practice should be considered the improvisational theatre center stage, with managers as indispensable coordinators and facilitators backstage. This implies significant latitude to the developers on stage, and an acute attentiveness by the managers in their backstage work.

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