Paradox and Quantum Mechanics – Implications for the Management of Organizational Paradox from a Quantum Approach

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Abstract

Organizational paradoxes must first be recognized by managers before they can respond to them. Yet scholars have adopted different perspectives on how paradoxical tensions become salient and engender management responses. Some approaches have focused on the socially constituted nature of paradoxes, and others on the inherent aspects of paradoxes in the environment. We propose an approach that gives ontological meaning to *both* the socially constituted *and* inherent nature of organizational paradoxes. Our approach, which is inspired by quantum physics, opens up new opportunities for engaging with the socio-materiality of paradoxes, how they are measured, and the implications this has on the probabilities of managing organizational responses to paradox.

Key words: quantum approach; socio-materiality; probability; organizational paradox

1 Introduction

Research on organizational paradox has been burgeoning over recent decades (for recent reviews of the paradox literature see Putnam, Fairhurst, & Banghart, 2016; Schad, Lewis, Raisch, & Smith, 2016). More and more scholars conceptualize organizational phenomena and strategies in terms of contradictory yet interdependent demands that appear simultaneously and persist over time. Two major streams within this research area refer to the ontology of organizational paradox (Cunha & Putnam, 2019; Schad & Bansal, 2018; Schad, Lewis, & Smith, 2019) and to individual and organizational responses to paradox (Jarzabkowski & Lê, 2017; Knight & Paroutis, 2017; Lüscher & Lewis, 2008; Miron-Spektor, Ingram, Keller, Smith, & Lewis, 2018).

For a long time, the opposition between two approaches has marked the ontological debate around organizational paradox. This debate in turn has significant implications for understanding the different kinds of responses that actors have to paradox and how they can be organizationally managed. According to the inherent approach, organizational paradoxes exist 'out there' due to the complex nature of organizational systems and irrespective of their recognition by individuals or organizations (Cameron & Quinn, 1988). Therefore, responses to paradox are examined through how actors recognize and identify paradoxes, for example by applying cognitive mindsets that enable them to more readily appraise and interpret tensions (Miron-Spektor et al., 2018). By contrast, the constitutive approach argues that organizational paradoxes have no prior existence to their discursive and social construction of organizational actors (Putnam et al., 2016). Thus, the analysis of responses to paradox focuses on how actors render paradoxes salient and enact responses to paradox through discursive practices (Jarzabkowski, Lê, & Van de Ven, 2013). Recently, we proposed an alternative approach to the ontology of paradox that explains how organizational paradox is both inherent and socially

constructed at the same time (Hahn & Knight, in press). We do so by mobilizing the ontological underpinnings of quantum mechanics, and explore the implications of such a quantum approach for paradox theory and understanding the ontology of paradox. However, we only briefly touch upon the implications of such a quantum approach for the practical management of organizational paradox.

In this chapter, we more systematically develop what follows from a quantum approach for managing and responding to organizational paradox. Most importantly, we focus on the implications of the probabilistic nature of paradox and the measurement of paradox. We unpack how managers curate the socio-material context for the experience and enactment of paradoxes by leveraging the use of material objects, the composition of teams, and the evolution of sensemaking frames. We also develop how managers can develop awareness and preparedness for potential paradox and gain recognition of the socio-material configurations that render salient paradoxes more likely. We highlight how from a quantum approach the response to paradox is highly paradoxical in itself.

By focusing on the management implications of a quantum approach to paradox, we offer insights into how organizational decision makers can adequately respond to the dual, inherent and socially constructed, nature of paradox. Our argument illustrates that from a quantum approach, response to paradox needs to combine the preparedness for the possibility of different paradoxes to emerge with the active management of the socio-material context through which organizational actors enact salient paradoxes. We also reflect on the interdisciplinary experience from developing a quantum approach to an organizational phenomenon like organizational paradox.

In the following, we first sketch out the quantum approach to organizational paradox and its ontological underpinning from quantum mechanics. We then develop the implications of this approach for managing and responding to paradox. We conclude this chapter with a discussion of future research opportunities that follow from our argument.

2 The Quantum Approach to Organizational Paradox

Organizational paradox is commonly defined as "persistent contradictions between interdependent elements" (Schad et al., 2016: 6) in organizational life. These contradictions operate between opposing elements that "seem logical individually but inconsistent and even absurd when juxtaposed" (Smith & Lewis, 2011: 382). At the same time, these opposing elements are interdependent, meaning simultaneous links bind each of the opposing poles (Smith & Lewis, 2011).

While consensus exists on this definitional core of organizational paradox, its ontology is still subject to controversial debate (Schad & Bansal, 2018). This debate has been developing between two main approaches, the inherent approach and the constitutive approach. A key aspect of this debate revolves around the distinction between latency and salience of organizational paradox. Latency refers to the status of organizational paradoxes prior to their recognition by actors. Salience refers to the experience of contradictory, yet interdependent elements by organizational actors. Proponents of the inherent and the constitutive views disagree on the relevance and the role of latency and salience of paradox.

We note that the opposition between the two approaches has been amplified for analytical purposes, and that many of the scholars identified with each of these views, including ourselves, have often sought to actively bridge different perspectives between these approaches. For

instance Smith and Lewis (2011: 388) propose that paradoxes are both inherent and socially constructed in that "opposing yet interrelated dualities are embedded in the process of organizing *and* are brought into juxtaposition via environmental conditions." Nevertheless, we believe this distinction has been fruitful since no approach to date has satisfactorily resolved the underlying ontological and methodological tensions implicated in bridging both views. Our quantum approach to organizational paradox represents an attempt to offer an ontology of organizational paradox that explains *how* exactly paradoxes are both inherent and socially constructed.

2.1 Inherent vs Constitutive Approach

The inherent approach follows a Platonic tradition and sees paradox as being innate in organizational systems (Cameron & Quinn, 1988) in terms of "real" paradoxes (Clegg, da Cunha, & Cunha, 2002; Schad & Bansal, 2018) irrespective of organizational actors' experience of paradox. Latency captures this inherent nature of paradox since it posits that organizational paradoxes exist 'out there' prior to their recognition by actors. Fundamentally, paradoxes arise from innate characteristics of organizations and their interactions with the organizational environment, irrespective of what organizational actors say or do (Cameron & Quinn, 1988). Consequently, paradoxes exist because of "the core activities and elements of the organization" (Smith & Lewis, 2011: 384).

The essence of salience is rather uncontested between the two approaches in that it captures organizational actors' recognition and experience of a situation as paradoxical, i.e. as comprising contradictory, yet interdependent elements (Putnam et al., 2016; Smith & Lewis, 2011). However, the two approaches differ with regard to the relevance they assign to salience. According to the inherent approach, salience merely represents the recognition of pre-existing

paradoxes by organizational actors. This approach thus emphasizes the structural conditions and cognitive factors that render paradoxical tensions salient.

These two factors (cognition and structure) are key factors to explain responses to paradox from the inherent approach. Smith and Lewis (2011) highlighted contextual conditions of plurality, scarcity, and change, arguing that these prime and reinforce salience by surfacing latent tensions and bringing specific paradoxes to the fore. Therefore, organizational members are more likely to experience paradoxes in turbulent times (Quinn & Cameron, 1988) and responses to paradox hinge on contextual and structural conditions. With regard to cognition, proponents of the inherent approach argue that individuals who use paradoxical thinking—defined as the ability "to effectively embrace, rather than avoid contradictions" (Smith & Tushman, 2005: 533)—are more likely to recognize and experience paradoxes (Hahn, Preuss, Pinkse, & Figge, 2014; Smith & Tushman, 2005). A paradox mindset Miron-Spektor et al. (2018) is thus crucial to understand how organizational actors experience paradoxical tensions and what kind of responses they develop. Following such a representationalist position, for developing adequate responses, managers need the 'right' cognitive templates to see them (Schad & Bansal, 2018) in terms of the ability to embrace paradoxical tensions and live up to both poles despite their contradictions (Smith & Lewis, 2011).

The constitutive approach follows a social constructivist tradition as being constructed through discourse and practice (Knight & Paroutis, 2017; Putnam et al., 2016). In contrast to the inherent approach, according to which paradoxes exist irrespective of organizational actors' recognition or responses, proponents of the constitutive approach argue that paradoxes have no status prior to their recognition by actors (Hatch & Erhlich, 1993; Putnam et al., 2016). Rather, they conceptualize paradoxes are constituted through actors' social construction, i.e. through

their cognition and rhetoric (Putnam et al., 2016), and their ongoing practices (Jarzabkowski & Lê, 2017; Knight & Paroutis, 2017).

Consequently, latency is not a valid or relevant dimension of organizational paradox since paradoxes are constituted only through organizational actors' discourse and practice. Therefore, for the constitutive approach, salience acts as the foundational ontological dimension. Most importantly, the constitutive approach conceptualizes organizational paradox as a product of actors' recognition and experience (Putnam et al., 2016). It emphasizes the mental and discursive processes involved in the construction of paradoxes for explaining salience. Here, paradoxes are instigated "in the moment" as actors construct paradox through specific speech acts and practices (Jarzabkowski, Bednarek, & Lê, 2018).

Consequently from the constitutive approach, the construction of and the response to paradox are inseparable. Jarzabkowski and Lê (2017) show how actors both discursively construct, and respond to, organizational paradoxes through humor during everyday work. The discursive construction of paradox and practices to respond to paradox amplify each other over time. Response to paradox is thus both discursive and practical, for instance by providing "interpretive contexts" that enable organizational members to recognize and respond to paradox (Knight & Paroutis, 2017) or by enabling organizational actors to work through paradoxes through interventive questioning that targeted contradictory elements (Lüscher & Lewis, 2008).

2.2 A Quantum Approach

Recently, we proposed an alternative approach to the ontology of paradox by mobilizing the ontological underpinnings of quantum mechanics (Hahn & Knight, in press). We argue that such a quantum approach can reconcile the inherent and the constitutive approach by explaining *how*

organizational paradox can be both inherent and socially constructed. In particular, we draw on the principles of superposition and measurement from quantum mechanics for explaining latency and salience of organizational paradox.

Quantum mechanics emerged early in the twentieth century and disrupts many fundamental assumptions of classical Newtonian physics. Whilst classical assumptions seemed able to explain macroscopic phenomena, early quantum physicists noted that their explanatory power disappeared for phenomena at very small scales, i.e., the behavior and characteristics of subatomic particles such as electrons or photons (Griffiths, 2005; Polkinghorne, 1984). Since the late 1920s, quantum mechanics has become the dominant theory in physics, and enjoys strong theoretical and empirical support (Oppenheim & Wehner, 2010). Most physicists today believe that reality is ultimately quantum-mechanical in nature.

Our intention in Hahn and Knight (in press) was not to argue that the organizational world operates according to the rules of quantum physics, nor do we seek to make claims about the nature and properties of energy and matter. For this reason, the argumentation in that paper is not based on an analogy to the *physical* world. For clarity, analogies work by providing an alternate basis through which to explore logical relations laid out in an established literature (known as "the grounds"). Analogies are evaluated based on their ability to generate new insights and connections (known as "warrants") to offer alternative conceptual accounts and explanations for empirical phenomena, such as organizational paradox (Alvesson & Sandberg, 2011; Ketokivi, Mantere, & Cornelissen, 2017). Making such a leap would require arguing that organizational paradox is 'like' the quantum physical world.

However, by mobilizing the ontology of quantum mechanics, in our quantum approach to organizational paradox we seek to contribute to the *meta*-physics dealing with the nature of the

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social world, that is, the ontology of social phenomena (Hahn & Knight, in press). Here, the claim is that the meta-physical world of organizational paradox is 'like' the meta-physical world of quantum mechanics. In both instances, concepts and categories that are relevant to a quantum ontology are relevant to the properties and relations that are important in understanding organizational paradoxes, and by extension, how actors and managers respond to them. Specifically, we propose to reconceptualize latency and salience of organizational paradox by drawing on the quantum principles of superposition and measurement, respectively. In doing so, we closely follow the work of other metaphysical social scientists like Barad (2007), who point out that the ontology of quantum mechanics is neither representationalist nor constructivist. According to Barad (2007), quantum mechanics constitutes a novel ontology that acknowledges inherent but indeterminate characteristics of reality in terms of probabilities to experience reality in different ways in a given socio-material context. However, the actual experienced reality is socially enacted in the moment when actors instantiate a specific experience from the possibility room of potential instantiations through the intra-action with their socio-material context. The socio-material context is perceived here as an assemblage where "the social and the material are considered to be inextricably related—there is no social that is not also material, and no material that is not also social" (Orlikowski, 2007: 1437). We mobilize this ontological position to develop our quantum approach to organizational paradox.

2.2.1 Superposition and Latency

The quantum principle of superposition recognizes that position and momentum are not fixed for subatomic particles, as predicted by classical physical rules. Rather, it reflects that prior to measurement, quanta seem to exist in a probabilistic and indeterminate superposition state that

simultaneously holds the *potentiality* of different locations of a particle in its physical motion (Dirac, 1981). In other words, particles do not have discrete physical states at any point in time, but rather carry the probability to adopt a range of different possible states. Hence, according to quantum mechanics, the subatomic world is inherently probabilistic.

The most famous example of superposition is the wave-particle duality of light according to which electromagnetic radiation holds the potential to exhibit particle- or wave-like characteristics, depending on measurement. Schrödinger linked wave and particle properties and described the likelihood of a particle being observed in a certain area or with a certain momentum at a particular point in time (Griffiths, 2005) in abstract mathematical, so-called probability wave functions. Probability wave functions describe the principle of superposition wherein quanta—prior to measurement—simultaneously hold the potentiality of different possible, but indeterminate states (Feynman, Leighton, & Sands, 2010; Rae, 2005). These probabilities do not reflect ignorance or a lack of knowledge, but the indeterminacy that is inherent in the quantum state of superposition unless a measurement is made (Feynman et al., 2010; Wheeler & Zurek, 1983).

Extracting the ontological essence of superposition means that all one can know about the subatomic physical reality are probabilities of observing quanta in a certain place or with a certain momentum. The quantum world does not have determinate properties prior to measurement. Rather, according to the principle of superposition, it is more accurately described in terms of inherent potentialities of different ways to experience physical reality (Ball, 2018).

By applying the ontological underpinnings of superposition to latency of paradox, Hahn and Knight (in press) argue "that latency implies that all possible paradoxical and non-paradoxical situations are inherent in an organizational setting simultaneously, but exist in an

indeterminate state." This argument implies that paradoxes do exist latently and prior to observation, but only in terms of potentialities. Hence, all issues that are inherent in organizational life hold the potentiality to form organizational paradoxes or not. Latent paradoxes coexist in terms of indeterminate potentialities that are inherent in organizational systems. Latent paradox cannot be described concretely but only in probabilistic terms. Organizational issues and systems are not inherently paradoxical in a definitive way but rather hold possibilities for various paradoxical and non-paradoxical situations. Consequently, what might be known about latent paradoxes—similar to the probability wave function that describes potential characteristics of quanta—is the probability of paradoxes being experienced in specific situations.

This argument transcends the positions of the inherent and the constitutive views in that it conceptualizes latent paradox as inherent in organizational settings but at the same time in an innately uncertain and indeterminate state. Latency can be understood as a primordial stage (Dawkins & Barker, in press) where it is impossible to determine which organizational issues will surface as paradoxical tensions. The quantum approach also holds an aspect of the constitutive approach in that latency only captures the potentiality for paradoxical or non-paradoxical situations but that distinct and concrete paradoxes do not exist prior to their enactment by organizational members.

2.2.2 Measurement and Salience

In quantum mechanics, measurement is not an 'objective' observation of a preexisting reality, as in classical physics (Barad, 2007). Rather, measurement instantiates a distinct and observed physical reality from the potentialities of superposition. Consequently, no elementary

phenomenon is a phenomenon until it is measured or observed, and the experience—or in physical terms, the measurement of—phenomena constitutes the discrete and actual physical reality (Ball, 2018). This principle of measurement in quantum mechanics has far-reaching ontological implications.

According to the dominant Copenhagen interpretation of quantum mechanics, any measurement leads to a collapse of the probability wave function by forcing a superposition state into a discrete state (Griffiths, 2005). While one cannot predict the exact outcome of measurements, the probability wave function indicates which observations are more likely to be made with a specific experimental setup.

Depending on the type of measurement, different discrete outcomes result (Feynman et al., 2010; Wheeler & Zurek, 1983). Depending on the experimental setup, the measurement of electromagnetic radiation can yield either wave or particle characteristics. The probability of making certain observations hence chances with the apparatus that is used in a measurement. Therefore, measurement instantiates and constitutes the object by measuring it. The measurement apparatus and the quantum system under observation *together* produce the observed phenomenon. The actual experience of the physical reality is inseparable from the measurement apparatus. Any change of apparatus will also change the probability wave function, and hence the observed phenomenon (Unruh, 1994). Measurement thus occupies a central role for instantiating actual physical reality through observation (Barad, 2007). At the same time, the production of a reality through measurement is not arbitrary, but follows the probability wave function that describes a quantum system and the apparatus used to measure it. The measurement apparatus captures the socio-material context that is used to produce observed phenomena through measurement (Barad, 2007).

Our quantum approach to paradox highlights the central role of measurement in explaining the salient experience of paradox. We argue that "the actual reality of salient paradoxes is co-instantiated by the organizational system and the 'apparatus' used to observe them" (Hahn & Knight, in press: 27). It follows that the salience of paradox is non-deterministic and non-arbitrary at the same time. Salient paradox comes about through actors' discursive and practical enactment in a given organizational context. This situated enactment instantiates some specific paradoxes from the indeterminate latent state into actual reality while not enacting other potential paradoxes.

The socio-material context that serves as the "apparatus" for this enactment does not act as a lens to recognize pre-existing paradoxes but shapes and enacts the probability to experience specific paradoxes. This instigation of salient paradoxes is not arbitrary either because it follows the inherent probabilities of the possibility space of latent paradoxes. It follows that socio-discursive and material factors co-constitute salient paradoxes. These factors together represent the socio-material "apparatus" and comprise mental templates (Miron-Spektor et al., 2018), socio-discursive processes (Putnam et al., 2016), environmental factors (Smith & Lewis, 2011), and material underpinnings (Schad & Bansal, 2018) and artifacts (Knight, Daymond, & Paroutis, in press; Knight, Paroutis, & Heracleous, 2018). The specific socio-material context shapes the possibility space for organizational actors to enact distinct salient paradoxical tensions.

It follows that salient paradoxes are subjective, pluralistic, and dynamic. Depending on their specific socio-material contexts, individual organizational actors can thus enact different salient realities. A given situation may appear paradoxical to one actor but non-paradoxical to others. Moreover, different actors may see different paradoxes in the same situation. Since organizational actors, organizations and their contexts change over time, so does the apparatus

and thus the probability to enact specific paradoxes. Consequently, multiple viewpoints on salient paradoxical tensions are likely to coexist and dynamically evolve inside the organization. The quantum approach highlights that salience of paradox relies on both material and discursive factors (Gabora, Rosch, & Aerts, 2008). Neither environmental conditions or cognitive frames (Smith & Lewis, 2011), nor discourses in terms of "constellations of language logics and texts in action" (Putnam et al., 2016: 79) are sufficient on their own to account for the salience of paradox.

3 Managing Organizational Paradox based on a Quantum Approach

The ontological position sketched out by our quantum approach outlined above has important implications how actors experience and respond to paradoxes, and therefore how paradoxical tensions within organizations can be managed. In particular, it encourages managers to rethink two key aspects of their everyday work: (a) the social-material context that represents the apparatus through and in which paradoxes might occur within everyday organizational life, and (b) how to deal with the uncertainty that is inherent in the occurrences of paradox. These two aspects are of key importance for the management of organizational paradox since they capture the intertwined nature of inherent and socially constructed factors, as the socio-material context shapes the probabilities of specific paradoxes to be enacted this very context. At the same time, they enable (socio-material context) and constrain (probabilities) the management of organizational paradoxes.

Although the tension between the inherent and constitutive perspectives have historically led scholars to debate the existence (or not) of paradoxes in organizations, a quantum approach goes beyond this kind of question framing. Paradoxes exist when managers "make" them so: that

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is, when they enact a particular set of phenomena as a paradoxical tension, for example between exploration and exploitation, or sustainability and profitability. However, a quantum approach attunes researchers to the socio-material environment within which such perceptions come about. By analyzing such situations, these have direct implications for managers in terms of recreating these same contexts to increase the possibility that other organizational actors may see tensions in a similar light. Since the quantum approach to paradox theory is new at the time of writing and there are no current empirical studies using this approach directly in data analysis and conceptualization, we illustrate our perspective by means of hypothetical examples in organizational life with a view to informing empirical research on paradox going forward.

3.1 Measurement: Curating the Apparatus and Salient Paradoxes

The management of paradox is inseparable from the salience and experience of paradox in organizations. This means that how managers experience paradox shapes how they respond to them and vice versa. From a quantum approach, an important aspect of the management of paradox is the choice of measurement and apparatus. This perspective, taken from experimental physics, can have multiple manifestations in organizations.

As explained above, in a quantum approach, the socio-material context of decision-making represents the apparatus through which managers experience and respond to paradox. At the same time, this apparatus shapes the probabilities to experience and enact specific paradoxes. Managing this socio-material context can thus be used to curate organizational members' experience of and the response to paradox. Since the socio-material context comprises socio-discursive, material, and mental aspects, its management can take different angles. In the

following, we focus on three aspects: the use of material objects, the composition of teams, and the evolution of sensemaking frames.

3.1.1 Material objects in organizing

One way in which management might curate different contexts and setups in organizations relates to how they deploy strategy tools within teams (Jarzabkowski & Kaplan, 2015; Knight et al., in press). Strategy scholarship has made great strides in advancing our conception of strategy as merely 'a plan' to conceiving of strategy a socially constructed activity brought to life through social practices (Spee & Jarzabkowski, 2011; Vaara & Whittington, 2012). However, current research still largely focuses on the verbal discourse of organizational actors (Knight & Paroutis, 2019; Paroutis & Knight, 2019). Whilst this is undoubtedly a crucial component of how meaning is constructed in modern organizational life, it is also an increasingly incomplete picture. Work on socio-materiality highlights the role of artefacts, objects, and matter in explaining and understanding how people make sense of and act in organizations (Leonardi, 2011; Orlikowski & Scott, 2008). The emergence of distributed work with the growth of the gig economy, the intervention of imaging and prediction decision-making tools with the growing sophistication of artificial intelligence, and the capacity to augment everyday organizational work with robotic replacements highlights how "matter" – whether constituted in the form of robots, visual aids, algorithms, or even the humble PowerPoint slide – matters in *how* conversations take place on the frontline of organizing. For example, if the CEO of an airline was to commit to environmental sustainability as an equally important strategic goal as economic productivity, this contradictory yet interdependent tension would need to be managed at the frontline of strategy implementation, from how ground handlers fuel and

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maintain the planes, through to how logisticians optimize flight paths. These frontline jobs invariably rely on decision-making aids, like scorecards, to surface the inherent tensions in their role and make decisions in-the moment.

At present, we do not know how such materials inform paradox salience and management responses. However, other studies have begun to unpack at a micro-level how meaning is getting constituted in these everyday interactions. Knight et al. (2018), for example, found that how strategy consultants depicted tensions to managers mattered to their subsequent interpretation of the key issues, and the issues that became central. Through a visual semiotic analysis, they show three types of visual mechanisms – depiction, juxtaposition, and salience – that were used to evoke particular types of responses amongst managers. For example, using juxtaposition to present information – that is, organizing ideas into relatable but orthogonal categories – generated different types of strategic understanding to using salience – that is, highlighting specific points over others. This insight not only showed how consultants are sophisticated constructors of meaning in organization. It also highlighted the central importance of visual techniques, in the sense of an apparatus, in shaping the flow of a conversation: she who controls the slide writing shapes the socio-material context that shapes the experience and response to paradoxical tensions and ultimately controls the strategizing.

Visuality is just one kind of 'matter' that might matter (Meyer, Höllerer, Jancsary, & Van Leeuwen, 2013). Paradox scholars will need to attend to a more comprehensive socio-material perspective to illuminate the kinds of matter that are important for managers of paradoxical tensions (Aoki, in press). However, the analytical interest will likely be in the disjuncture between what is seen, what is heard, and what is understood. Knight et al. (2018) deliberately use visuality by consultants to probe those aspects of the strategy where opinions were divided or

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unclear. Visuality therefore allowed tensions to become salient, in order for them to be better

discussed and eventually resolved or managed. The ability for materials to be constructed in this

dynamic way is therefore an important tool of strategic management and one that is being

increasingly used as management enters the age of automation. Uber workers, as an example, are

largely directed to do their work through a screen. How then, does this mechanism of visual

management allow Uber to achieve its paradoxical goals – of being both ubiquitous and private

at the same time? The design of, and reliance on, specific material devices hence shapes the

perception and experience of organizational issues and routine and thus also the salience of

paradoxes. Using and designing artefacts and materials to shape the probability of paradoxes to

become salient thus represents one possibility for managers to actively influence the experience

of and response to organizational paradoxes, be it to help actively curate the salience of certain

paradoxes or that the use materials unwittingly makes specific paradoxes salient that in turn

require managerial attention and responses.

3.1.2 Composition of organizing teams

A second way in which a quantum approach may enhance the management of the

experience of and response to paradox relates to the socio-material construction of paradoxes by

particular teams within the organizations. This aspect takes into account that the apparatus is not

just the tools that organizational actors use, but also the attributes of the organizational actors

themselves. Organizational theory has highlighted the importance of diversity within

organizations. This reflects the importance of *who* is within a particular team. Research has

considered of inherent attributes of who is in a team, such as an organizational members'

background (Barker & Mueller, 2002), expertise (Chaganti & Sambharya, 1987), or risk

tolerance (Gupta & Govindarajan, 1984). Studying strategists, for example, scholars have found that functional background influenced the kinds of strategists they were disposed to deploy (Helfat & Peteraf, 2015). It also matters to how these organizational members construct their background, through the way they talk about their occupational context and how they bring that to bear on their work (Brown, 1998; Maclean, Harvey, & Chia, 2012).

Despite this attributional perspective in the literature, less has been examined about how these characteristics feed into the experience of and response to paradoxical tensions within organization. Particular organizational members may be able to influence others' perception of the tensions within the organization. Their perceived background, influence, and way of communicating may all shape how a message is received and interpreted (Brown, Stacey, & Nandhakumar, 2008; Gabriel, 2000). In this same way, then, the prevalence or absence of these organizational actors in how messages are disseminated through an organization may matter. In other words, organizational actors with their individual background and characteristics shape the apparatus of enacting paradoxical tensions. The composition of teams thus represent an important element of shaping and managing the socio-material context through which paradox is managed.

Mirabeau and Maguire (2014), for example, showed that messages were much more easily disseminated through the organization when they were carried by the same middle managers operating at the far peripheries of the organization, rather than by the senior managers themselves. This was because of the enhanced status they had within the organization, and the legitimacy it afforded the strategy agenda by it coming bottom-up rather than top-down. Paradox scholars have an opportunity to think more specifically about further attributes in the social construction of a paradox that might matter in how paradoxes are experienced. From a quantum

approach, surfacing sustainability/profitability tensions by all-white, middle aged engineers will arguably be perceived differently than culturally diverse, young engineers. What are these differences and how do they influence how tensions are perceived and managed in a recurring way?

A quantum approach, therefore, brings socio-material attributes into central consideration in research analysis and management practice. To render a common experience of and response to paradox across an organization, managers might seek to manage the socio-material context by disseminating messages in similar kinds of contexts in terms of team compositions. On the other hand, noticeable differences across types of teams will also sensitize managers to differences in how paradoxical tensions might be perceived. In each case, managing paradoxical tensions requires managers to be alert to these differences and mindful of the different ways in which a message is interpreted and spread through the organizations as a function of team composition and focal organizational members.

3.1.3 Evolution of managerial sensemaking frames

A third way in which the apparatus might matter in the experience of and response to paradox relates to how organizational actors themselves may change over time, as they gain more experience or skills, or change their outlook in some fundamental way. As already detailed, the individual characteristics of organizational members are an important part of the socio-material context through which actors "measure" and enact paradoxical tensions. Yet, managers themselves may change their personalities, character, skills, or experience over time. For example, how an actor as a fresh graduate experiences explore/exploit tensions may differ from how that same graduate will experience those same tensions four decades later when she is the

CEO. Thus, clearly tools and personnel are not determinative of how paradoxical tensions are experienced and managed. The sensemaking frames are important and can evolve over time.

Knight and Paroutis (2017) study of explore/exploit tensions within a media organization offers one such example. In that case, senior managers sought to shape the 'interpretive context' within which other managers experienced paradoxical tensions. These frameworks were defined in terms of instrumental, relation, and temporal contexts. Even as the organization evolved and top managers developed, they returned to these same frames in order to retain focus on an exploration objective: the launch of a digital newspaper.

However, this case study captures a relatively thin snippet of an organization's history. Some years after this case ended, the CEO departed the organization and it was unclear whether the same attention to paradox persisted as the organizational got recalibrated to a new leader. This is a fundamentally important question for paradox scholars to examine, given that the benefits of managing paradoxes are envisaged as long-term and underwriting the organization's viability. Yet, analyzing this further requires a means of understanding the socio-material construction of paradox as organizational actors change and evolve to their changing circumstances. Herein lies another way to conceive of the changing apparatus of the organization.

Overall then, we argue that a quantum approach offers valuable insights into how managers experience and respond to paradox because it sensitizes them to new issues that have the potential to derail or de-sensitive organizational members to the strategic issues facing the organization. It also shapes how researchers should approach the phenomenon in interest and the kinds of research questions that get asked to advance the literature. The socio-material context matters, whether it be constituted through the objects in use, the personnel deployed, or the

interpretive frames that get communicated. In each case, variance across the socio-material apparatus is likely to yield different experiences and responses to paradoxes in the same organizational situation. In turn, actively managing the socio-material context of organizational members offers the potential to enhance consistent experiences of paradoxes and to increase the likelihood of similar responses.

The socio-material context can be thought of as a multi-dimensional configuration through which organizational members and leader experience and enact salient organizational paradoxes. At the same time, the socio-material context also shapes the likelihood for members and leaders to experience and enact different paradoxes. Our quantum approach suggests that managing organizational paradox is inextricably linked to managing the configurations of material, mental, and discursive factors that constitute the socio-material context of organizing. Managing such organizational configurations (Short, Payne, & Ketchen, 2008), on the one hand, enables managers to actively influence the salience of paradoxical tensions, since different settings render different paradoxes more likely. As Zimmermann, Raisch, and Cardinal (2018: 739) found, frontline managers deploy "configurational practices […] to constantly adapt and align their initiatives' organizational contexts, which allowed them to cope with persistent exploration-exploitation tensions." On the other hand, however, the socio-material context also constrains the management of paradox in that it innately defines the possibility space of the probabilities to experience and enact paradoxes in a given socio-material context. This is why we next turn to the management of probabilities as the second key aspect of managing paradoxes through a quantum approach.

3.2 Managing Probabilities: Managing What You Do Not Measure

The quantum approach raises a second important aspect of managing paradox: the management of probabilities. Managing probabilities is crucial from a quantum approach for two reasons: First, latent paradoxes are innate in organizational systems in terms of the potentiality and probability of different paradoxes to be enacted. Second, the likelihood of the enactment of a specific paradox is shaped by the socio-material apparatus through which it is "measured". Consequently, managers need to prepare for the probabilities of different paradoxes and different responses. We suggest that from a quantum approach, the kind of uniformity in managerial responses that characterizes the current literature deserves further scrutiny. Organizational members differ, tools have meaning in different contexts, and interpretive frames shift over time. However, responding to paradox through managing the apparatus i.e., the socio-material context is bound to, and shapes, the probabilities of different paradoxes that are inherent in every socio-material context. This probabilistic nature of paradox gives rise to an additional question: how can managers respond to the potentiality of different paradoxes to be experienced by organizational members? We highlight two central aspects for managing the probabilistic nature of paradox: (1) the creation of awareness and preparedness for latent paradox and (2) the recognition of configurations that render different paradoxes salient.

3.2.1 Creation of awareness and preparedness

The first aspect of managing probabilities refers to a heightened awareness of, and preparedness to, different potential outcomes in terms possible paradoxical tensions to tackle the inherent uncertainty of latent paradoxes. Lord, Dinh, and Hoffman (2015) have highlighted the importance of backward induction for managers to prepare for managing potentialities. They suggest that organizational members can forecast the future and use scenario planning to prime

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their thinking for conditions of inherent indeterminacy. Since paradoxes can only be defined ex-post, managers who rely on counterfactual thinking and prospecting are more likely to have the cognitive and behavioral complexity necessary to succeed in unexpected situations (Smith & Lewis, 2011).

This strategy goes well beyond the dynamic decision-making model (Smith 2014) envisaged by the dynamic equilibrium model wherein managers switch between paradox poles in a relatively predictable and equi-balanced way. Smith (2014) found that senior leaders routinely moved between differentiating and integrating practices as a matter of course to cultivate strategic paradoxes over time. However, this model does not explain how managers respond to the probabilities of different paradoxes to be enacted throughout the organization drawing from the latent possibility space of multiple potential paradoxes. The quantum approach highlights that responding to paradox involves managing scenarios that are more dynamic and less predictable.

As explained above, latent paradoxes are understood as potential paradoxes from the viewpoint of the quantum approach. This view also implies that one cannot precisely describe and characterize potential paradoxes, since doing so represents an enactment and measurement that renders a specific paradox salient. The managerial challenge of managing latent paradox, i.e. the probability and potentiality of paradox, consists of creating a sense of awareness and preparedness for different potential paradoxes. While the apparatus plays an important role in shaping the probability of certain paradoxes to the experienced and enacted, the task at hand here is a larger one. As organizational environments and socio-material conditions become more pluralistic and change over time, the management of paradox needs to reflect the different potential paradoxes that these changing conditions hold and gauge the likelihood that different

paradoxes from this changing possibility space might be actually enacted and experienced. Therefore, in a quantum approach, managing the probabilistic nature of paradox goes beyond creating awareness and preparedness but involves a better understanding of different configurations that are likely to render certain paradoxes salient.

3.2.2 Recognition of configurations

As the socio-material context shapes the probabilities of latent paradoxes to get enacted, the recognition of socio-material configurations that are increasing the likelihood of rendering specific paradoxes salient represents a second key aspect of managing the probabilistic nature of organizational paradox. In this context, we suggest that recent developments in artificial intelligence may offer promising options for managing the probabilistic nature of paradoxes. Indeed, one of the great limitations of paradox theorizing at present is that it assumes that organizational actors maintain the human intelligence, judgement and agency to adjudicate between alternate poles. However, this need not always be the case. The introduction of artificial intelligence and machine learning offers novel opportunities to identify configurations of socio-material conditions that rendered specific paradoxes salient in the past.

In the exploitation domain, for example, machine learning offers the prospect of historical data being used as the basis for superior and more efficient allocation of resources. These techniques are already being deployed in people management. Artificially intelligent technologies like People Analytics manage large, automatic workforces in the gig economy, such as Uber drivers and delivery workers. On the other hand, generalized artificial intelligence highlights the extent to which algorithms can learn from feedback, thereby enabling exploration.

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In finance, for example, general artificial intelligence can be calibrated to take on greater risk and expand outputs in the environment that have been previously under-examined.

Artificial Intelligence may enable managers to recognize configurations of socio-material conditions that rendered different paradoxes salient that may not be accessible to human intelligence alone. However, artificial intelligence and machine learning should not be mistaken as a tool to actively manage paradoxes. Rather, they may inform and enhance managers' awareness of the probability of different paradoxes to be enacted. An uncritical and inconsiderate reliance on artificial intelligence may well be detrimental. For instance, the efficient exploitation of labor through artificial intelligence may obscure tensions because of inherent biases in historical datasets that may for instance exclude people of color, or workers with backgrounds that have not constituted the historical workforce in an industry (Kellogg, Valentine, & Christin, in press). Likewise, extreme financial exploration based on artificial intelligence has arguably contributed to its own kind of excess, as witnessed in flash financial crashes (Kirilenko, Kyle, Samadi, & Tuzun, 2017). The potential of artificial intelligence to create awareness of potential paradoxes needs to be complemented and balanced with a critical reflection of the underlying assumptions and biases of algorithms (Kellogg et al., in press).

Hence, managers of paradoxical tensions face new questions in how to augment human intelligence and judgement to manage the unpredictable and potential. Central, in a quantum approach, is the interface between human and non-human intervention so that managers can manage situations where unexpected social constructions emerge, resulting in challenges can threaten to destabilize an organization. This is likely to become more possible as the material elements empowering the social construction of organizations – such as connected communication through the internet and social media, and multi-modal that accelerate

disconnects between messages (Knight & Tsoukas, 2019)– become more prolific within the field of organizational management.

These questions are largely unexplored empirically by paradox scholars but offer a rich vein for future research. One possibility avenue for theorizing could be the way in which the shift from probability to actuality changes the role of the manager over time. When paradoxes is merely a possibility, i.e. they are latent, managers may focus on creating awareness and preparedness within their team or organization. When a paradox is rendered salient and responded to positively, the manager's role might shift to one of oversight. Most crucially, it is at the junction of latent and salient paradox where the manager's role shifts to one of intervention by actively shaping the socio-material context in terms of curating configurations of material, mental, and discursive factors that shape the probability of latent paradoxes to be experienced and enacted by organizational members. In this way, we can begin to see how recognizing the potentiality of paradox changes the roles and response that managers adopt as well as related research questions and analyses that come into focus. Rather than operating in a predictable way as envisaged by a dynamic equilibrium model (Smith & Lewis, 2011) a quantum approach is better equipped to explain how paradox theory operates under disequilibrium or in unpredictable environments. These settings, which have been outliers in prior research, might move to the center as the paradox research program develops.

4 Discussion and Conclusion

4.1 Implications for Responding to Paradox

Managing paradoxes is a demanding task for organizational leaders. Recommendations from the management literature on how to respond to paradoxical tensions strongly differ depending on

the ontological position that different scholars adopt (see Table 1 for a summary). From the

inherent view, management of paradox consist of a task of developing pertinent cognitive and

organizational approaches to identify and adequately respond to the paradoxes that are inherent

in organizational systems. The main challenge from this point of view is to develop individual

and organizational skill to deal with paradox in terms of suitable cognitive (Miron-Spektor et al.,

2018) or organizational (Smith, 2014) resources and responses. The argument here is that the

failure to recognize paradox and to develop adequate response capabilities will result in vicious

cycles and detrimental organizational outcomes (Smith & Lewis, 2011). From the constitutive

view, the response to paradox is inseparable from its construction. The main task here is to

understand and manage the discursive and practical processes through which organizational

actors construct and respond to paradoxes (Jarzabkowski et al., 2018; Jarzabkowski & Lê, 2017;

Knight & Paroutis, 2017). Responding to and managing paradox thus translates to the task of

managing the practices and discourses through which organizational actors enact organizational

reality.

Insert Table 1 about here

The quantum approach to organizational paradox does not reject these two prior positions

from the literature. Rather it seeks to refine and reconcile both perspectives. Hence, the

implications of the quantum approach for the management of organizational paradox relies on

elements from both prior approaches but adds a better understanding of their respective

relevance and role. Managing socio-material context (i.e., the apparatus) helps decision makers

to curate configurations in which organizational members are likely to develop similar

experiences of and responses to organizational paradox. In this context, the quantum approach goes beyond the constitutive approach in that it highlights that the construction and experience of paradox does not only rely on actors' discourse and practice but that the socio-material apparatus through which paradoxes are enacted also comprise individual psychological and biographical factors and, most importantly, also material aspects, such as artifacts.

At the same time, the quantum approach acknowledges that the experience of and responses to paradoxes are not independent from the organizational setting. While it does not posit the task of managing paradoxes is to recognize pre-existing paradoxes that are inherent in an organizational system (as does the inherent view), it highlights the probabilistic nature of paradox in that organizational systems hold the potentiality for many different paradoxical tensions. Managing this inherent potentiality requires the creation of an awareness of, and preparedness to, the likelihood of different paradoxes to be enacted. This management task thus necessarily requires the ability to deal with uncertainty and indeterminacy, a task that will most likely demand more than rational reasoning but also intuition (Calabretta, Gemser, & Wijnberg, 2017).

Most importantly, the quantum approach highlights that the probabilistic nature of paradox and the socio-material context in which paradox is enacted are intertwined. The probability of enacting a specific paradox is inherent in, and shaped by, the socio-material context of organizational actors. Consequently, the quantum approach to paradox offers novel perspectives for empirical studies of individual and organizational responses to paradox. Such future research can address how the management of the probabilistic nature of paradox and the management of the socio-material context are related. For doing so, it appear promising to adopt a configurational approach (Misangyi et al., 2017; Short et al., 2008; Zimmermann et al., 2018)

for at least two reasons. First, configurations can capture the multiple dimensions of the socio-material apparatus that shapes the probability space of latent paradoxes and through which salient paradoxes are enacted. Therefore, understanding such configurations is essential for creating an awareness of and preparedness for latent paradoxes in terms of grasping what paradoxes are more likely to get enacted under different socio-material configurations. Second, shaping socio-material configurations offers a means to actively managing the enactment of paradoxes and related responses throughout the organization.

4.2 Implications for Interdisciplinary Inquiry of Organizational Paradox

Our argument results from an interdisciplinary inquiry of organizational paradox. Our experience in developing work based on interdisciplinary integration was both challenging and exciting. In hindsight, it was important to maintain a distinction between our primary literature (where we wanted to foreground our contribution) and our secondary literature (where we drew inspiration to advance our primary literature). In our case, our primary literature was organizational theory and paradox, and it was very helpful to have this clearly in mind throughout the process. Second, it was important that there was paradigm incommensurability between the two literatures we brought together, even when they operated between different disciplines. Kuhn (2012) has argued that scientific revolutions occur when disciplines face paradigm incommensurability: that is, there is an inherent difference of opinion about what is knowable about a phenomenon. We identified this tension within the paradox literature between the inherent and constitutive views. However, as we reached out to new disciplines for insights, it was important that there was paradigm commensurability between our primary and secondary literatures. This allowed us to make a logical connection and justification for our theory extension (based on a common view

about meta-physics) rather than trying to compare un-like paradigms (Shepherd & Challenger, 2013). Finally, we felt our approach was most needed when the problems within the primary literature were well-defined and the secondary literature from a different discipline had addressed the same kinds of problems.

Conversely, falling outside these conditions made working in an interdisciplinary context very challenging. The highly technical and formal nature of the physics discipline often made it difficult to discern the fundamental insights that would help our advancement of organizational paradox. Moreover, it took time to appreciate why quantum mechanics was uniquely placed to help address issues in paradox rather than other disciplines.

Interestingly, stepping outside the realm of organization theory to seek inspiration and insights from other disciplines, in our case physics and quantum mechanics, has helped us to understand the paradoxical nature of the ontology of, and responses to, organizational paradox itself. Our quantum approach suggests that the ontology of paradox can only be fully understood by accommodating inherent and socially constructed elements without resolving their differences, and thereby highlights the paradoxical nature of the ontology of paradox. This paradoxical nature of a quantum ontology may well apply to a wide range of organizational phenomena beyond organizational paradoxes, lending support to paradox as a metatheory (Lewis & Smith, 2014). At the same time, our quantum approach highlights the paradoxical nature of managing paradoxes. In a quantum approach, the socio-material context is at the heart of managing organizational paradox represents the apparatus of experiencing and enacting salient paradoxes. However, managing the socio-material context to respond to paradox is paradoxical in itself. On the one hand, recognizing different socio-material configurations that are related to heightened probabilities for the enactment of different paradoxes helps to increase awareness and

preparedness for the potentiality of latent paradoxes. On the other hand, actively curating the socio-material context in order to the enactment of, and response to, salient paradoxes in turn shapes and alters the probability of paradoxes to be enacted.

The dual probabilistic and socio-material ontology of paradox hence calls for managerial responses that simultaneously embrace the indeterminacy and the situatedness of paradox. Such responses need to be holistic and pragmatic at the same time. Future research on responses to paradox might therefore seek inspiration from the notion of robust action (Ferraro, Etzion, & Gehman, 2015). With robust action, managers combine competing responses to paradox in an iterative and reflexive manner with the aim to address salient paradoxes without compromising the flexibility and preparedness to respond to the potentiality of latent paradoxes. Our quantum approach highlights how managing paradox plays out at the junction of inherent indeterminate probabilities and concrete socio-material enactment. Because the probability of the experience and enactment of paradox is inseparably tied to the socio-material context in and through which it is enacted, and vice versa, managing paradox involves both understanding the possibility space of the array of potential paradoxes and curating the enactment of specific paradoxes.

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Table 1: Different management approaches to organizational paradox

	Inherent Approach	Quantum Approach	Constitutive Approach
Ontological position	Paradox is 'out there' and management's task is to identify and respond to paradox adequately.	Salient paradoxes are enacted and managed through specific socio-material contexts from the possibility space of indeterminate latent paradoxes	Management of and response to paradox is inseparable from its construction
Management rationale	Recognize and address paradoxes in organizational systems through adequate cognitive or organizational skills and resources	Understand and manage the socio-material context of the organization to create preparedness for latent paradox and curate the experience of salient paradox	Understand and manage the discursive and practical processes through which organizational actors construct and respond to paradoxes