RESEARCH PAPER

The repression of *mètis* within digital organizations

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ABSTRACT

Numerous organizations are placing great emphasis on such techniques as evidence-based protocols to automation and artificial intelligence (AI) with the aim of improving efficiency and maximizing profitability. Such instrumental techniques attempt to formalize all manner of environmental phenomena through abstraction and categorization. They have also reduced organizational capability to deal with dynamic environmental complexities, uncertainties and ambiguities. The aim of this paper is to examine organizational approaches relying heavily on formalized/automated protocols in aviation, medicine and other professional domains targeted by AI development. Such approaches repress the human capability known as *mètis*, which organizations require to deal successfully with dynamic ambiguities in the form of unexpected emergencies. *Mètis* is briefly explained, and examples of organizational barriers preventing its manifestation are given.

Introduction

Historically, robots and computers were used to eliminate cognitively monotonous, physically demanding, repetitive and/or dangerous jobs (Wallén, 2008). But advanced reasoning under the broad category of *techne*, involving formalized knowledge of making, producing or taking action towards an end or goal (Scott, 1998), can now be adequately codified in algorithms (Lowrie, 2017), resulting in machines outdoing humans in terms of speed and performance in a variety of tasks (Autor, 2015). For tasks involving tacit knowledge (that is, where engineers are unable to initially define and codify instructions for the task in question) machines can, in certain cases, master the task through a process of exposure, training and reinforcement – known as machine ‘learning’ or ‘deep learning’ (Autor, 2015). Machine learning techniques involving image recognition, ‘a process that is difficult to explicitly articulate and explain but that we, as humans, develop through experience, can now discriminate with an accuracy that surpasses our own’ (Faraj, Pachidi and Sayegh, 2018, p.65). The overall quest for continued cost reductions, in not only monotonous tasks but in more complex professional tasks requiring elaborate analysis, calculations and certain levels of tacit knowledge, is being pursued not only across reduced labour costs, but also across productivity improvements via increased speeds and efficiencies (Autor, 2015).

Yet many professional tasks currently being considered as replaceable by learning algorithms still require punctuated interventions by human professional experts when dealing with situations involving weak and ambiguous signals (Faraj *et al.*, 2018). The aim of this paper is to show how over-emphasis on automated formalizations and protocols targeted by AI developments can paradoxically lead to decreased organizational capabilities in dealing with dynamic environmental complexities, uncertainties and ambiguities. Towards this objective, this paper first draws upon the domain of responsible research and innovation (RRI), where we conduct a hermeneutical

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critique of dominant imaginaries based on the notion of efficiency and maximization. Here, we shall establish clear associations between recent/ongoing developments within the workplace and flawed epistemological strands as discerned by James (1950) and Dewey (1929). We then critically examine specific discourses on artificial intelligence (AI). We shall argue that learning algorithms are unable to deal successfully with situations of uncertainty and ambiguity (Kahneman and Klein, 2009; Dejoux and Léon, 2018): expert knowledge workers have the potential to do so through the mobilization of what is referred to as *mètis* knowledge and skills (Baumard, 1999). *Mètis* is a mutable ambiguous entanglement of knowledge, knowing, practice and state of mind (Baumard, 1999; Scott, 1998; Dolmage, 2009). Examples of organizational barriers to *mètis* will also be presented. Finally, we propose a performative material-discursive perspective to help both scholars and managers to comprehend and to become more vigilant towards such barriers (Barad, 2007; Orlikowski and Scott, 2015).

A few words on methodology

Our approach initially draws upon RRI. We first conduct a hermeneutical critique of existing dominant imaginaries (Groves *et al.*, 2016). Social imaginaries influence the way people make decisions. If individuals define situations as real, they are real in their consequences. The concept of imaginaries in the socio-technical sense involves ways in which dominant visions of societal futures centred around certain types of technological developments have effects on what happens at present – or as Jasanoff and Kim (2009, p.120) explain, such dominant imaginaries involve 'producing authoritative representations of how the world works – as well as how it should work'.

Critical studies of socio-technical future imaginaries for RRI allow for the assessment of assumptions underlying social priorities which have helped to shape possible (and actual) technological pathways (Groves *et al.*, 2016). Such studies allow for the exploration of more desirable social and material worlds, which can emerge around given socio-technical arrangements (Macnaghten and Szerszynski, 2013). Furthermore, across the 'hermeneutic turn', the emphasis of technology assessment is placed on future societal developments (and respective social priorities) *with* technology, as opposed to future developments in technology alone (Grunwald, 2014). Our initial hermeneutical assessment will attempt to uncover how the basic assumptions of efficiency and maximization, as materialized across both historical and more contemporary forms of Taylorism, are at the heart of many current and near-future workplace developments. It will also be shown that the presence of dominant imaginaries of efficiency and maximization within current managerial and technological practices and developments can be extended into what is termed 'AI'.

Efficiency across formalized techniques: its pitfalls in organizational life

According to Heidegger (1977, p.15), the essence of technology is anything but technological in that it is a kind of thinking that reveals only one way of existing, seeking more and more efficiency for its own sake, while 'driving on to the maximum yield at minimum expense'. In similar vein, Ellul's (1980) technological society is a society of techniques requiring that we always choose the most rationally efficient techniques for every endeavour. Technique is a mindset or ideology which values efficiency over all other things (Ellul, 1980, pp.1–20). This 'certain frame of mind . . . of looking at situations', which seeks maximum yield with least effort, involves a rationality consisting of mathematical calculations, systematizations and the creation of standards (Ellul, 1980, p.23). More recent authors, such as Alexander (2008), have similarly argued that efficiency is prominent within contemporary society because of the force of technology mindsets.

Yet efficiency is a slippery concept that 'has taken on not only a variety of technical configurations but also a bewildering array of more common meanings' (Alexander, 2008, p.135). Being closely linked to the characteristics of their particular historical contexts – the most powerful and enduring concepts of efficiency found in modern western commerce and culture have their origins in the study of machines in eighteenth-century Europe (Alexander, 2008). During this period, Jeremy Bentham also envisioned a system of workhouses as a rational and 'mechanical' enterprise, across a design which he called the Panopticon (Clegg, Courpasson and Phillips, 2006). It was essentially a surveillance system with records and rules regarding timetables and the nature of work to be carried out, and was to become a key component in the efficient organization of schools, hospitals and factories. Much later, the work of Frederic Taylor became fundamental to creating the employee as a consciously designed utilitarian project, by stressing the need for national efficiency: the engineering sciences had by now proposed precisely defined parameters across the minimization of the ratio between the total input in any system and its effective total output (Clegg *et al.*, 2006, p.48; Alexander, 2008).

In this sense, efficiency involved abstractions, such as concepts and judgements, which were 'purpose-driven, partial, and useful for understanding, inference, and interventions' (Winther, 2014, p.1). Yet, as James (1950) and Dewey (1929) remind us, 'vicious abstractionism' and 'the philosophic fallacy' can lead to 'pernicious reifications'. On the one hand, 'artificial simplification or abstraction is a necessary precondition of securing the ability to deal with affairs which are complex, in which there are many more variables' (Dewey, 1929, p.173). Such scientific modelling consists of abstractions constructed across various types of abstractive processes – and can be useful for specific interventions in, and representation of, complex processes; but can also be dangerous in promising too much, either because of 'fallacious' context-stripping or 'vicious' interest-driven motives, or both (Dewey, 1929; James, 1950; Winther, 2014). Such dangerous abstractionism can occur in the diagnosing of situational issues via the use of such decontextualized 'evidence-based' methods as those proposed, for example, by Taylor's scientific management approach, involving time and motion studies to determine the one best way of executing tasks (Clegg *et al.*, 2006). Furthermore, such abstractions and categorizations have politics; sorting concepts into groups also alters their meaning and potential uses (Suchman, 1994). This was the case with Taylor's scientific method as categorizations became technologies/systems of control, surveillance and discipline of work activities, thus allowing a shift of power into the hands of management (Clegg *et al.*, 2006). Moreover, the expert knowledge once possessed by craftsmen and artisans was transferred to management to be reconfigured and standardized. Such knowledge, acquired through years of experience involving technical know-how, practical wisdom and 'deep smarts' able to sense discrete patterns, was replaced by explicit rules and procedures to be followed in a repeated and alienating fashion (Leonard and Swap, 2004; Clegg *et al.*, 2006). Such expert knowledge replacement constitutes gross truncations in knowledge, in which certain forms of unarticulated (and non-articulable!) tacit expertise, such as bodily-somatic and collective/social tacit knowledge, are fallaciously replaced and/or reduced by contextually stripped explications and abstractions in the form of routines and rules (Ribeiro and Collins, 2007; Collins, 2010; Winther, 2014). Taylor's naïve rationale was that workers would achieve job satisfaction across increased productivity, yet initial increases in productivity at Bethlehem Steel were soon undermined by workplace alienation, leading to decreased worker output and further dissatisfaction (Clegg *et al.*, 2006).

Conversely, and in a general sense, both James and Dewey proposed that 'the abstract and the concrete suffuse one another, and hence that the distinction – the abstraction – should not in itself be turned into a dualism and reified' (Winther, 2014, p.17). The concrete, which involves the environment, is always dynamic, while the abstract consists of our own subjective interpretations of that very environment. Eventually the holistic pragmatic term of 'transaction' emerged, consisting of the environment subsuming the subjective individual, with the latter deriving meaning, significance and identity from the active role he/she plays within that transaction (Emirbayer, 1997, p.287). In this manner, actors do not simply interact with the environment, but shape it by being affected by it (Crossley, 2011, p.31). Contrary to Taylor's thinking, worker satisfaction cannot be separated or abstracted from his/her work environment.

Efficiency across digital Taylorism: enter renewed organizational consequences

Digital technologies appear to have either brought back Taylorism or simply made it more evident in many contemporary management practices in the workplace (Au, 2011; Irani, 2015; Moore and Robinson, 2015). Brown, Lauder and Ashton (2011, pp.7–9) specifically refer to 'digital Taylorism', a system based on the global organization of both routine and knowledge work, whereby the latter involves creative and intellectual tasks being subject to the same process as chain work. Their argument is that, once codified and digitalized, such tasks can be conducted by automatic programs with computerized decision protocols, thereby replacing human decisions and judgements. Such processes can be easily relocated across computerized global connections, thereby rendering many jobs easy to export, change or replace. Digital Taylorism essentially follows one or more of Taylor's original principles by:

1. breaking down complex tasks into simple standardized ones
2. measuring/surveilling everything that workers do
3. linking pay to performance.

The negative impacts of standardization have, for example, been felt in both the US public school system as well as the Danish home care sector, whereby standardization leads to alienation amongst teachers and home care workers, stifling job satisfaction, creativity, as well as innovative approaches tapping into worker competencies and experience (Au, 2011; Gerdes, 2008). Here, Taylorism is clearly identified across the planning/management vs execution delineation, whereby teachers, for example, are forced to execute standardized curricula 'that require no creative input or decision-making' on their part, while using 'verbal scripts that define and limit what they can say as they teach', with the sole objective of addressing high stakes testing imposed upon them by the US Federal Government (Au, 2011, pp.31–2). While in the Danish home care sector, over-emphasis on standardized protocols for patient care muzzles or truncates the tacit knowledge which experienced home care workers have acquired as well as reducing their levels of engagement within the profession, thereby affecting quality of services rendered (Gerdes, 2008).

Many of the technology companies that have set the tone for today's businesses also appear to be applying Taylorism. Take Amazon's Mechanical Turk, an internet platform which allows companies to break jobs into smaller tasks and offer them to people across the globe, known as 'Turkers', who perform small tasks for menial pay (Irani, 2015). This whole process, known as 'crowd sourcing', can also involve training of AI systems to learn new tasks that were historically too complex for a computer. Here, Turkers are involved in menial and mentally wearing tasks involving the labelling of millions of data sets, often in the form of videos, whereby each individual can be repeating the same simple action hundreds of times. In a more general sense, crowd work can replace some forms of skilled work with unskilled labour as tasks are decomposed into smaller and smaller units (Kittur *et al.*, 2013). For example, speech transcription and copy-editing are increasingly being accomplished with crowd labour, whereby even more complex tasks such as writing, product design, or translation may be amenable to novice crowd workers with appropriate technological supports (Kittur *et al.*, 2013). Such cognitive efficiency at the expense of education and skill development reflects yet another aspect of Taylorism in its original form, which according to Clegg *et al.* (2006) involves the depletion and transfer of workers' knowledge towards total management control.

Moore and Robinson (2015) also highlight Taylorist influences within more entrepreneurial and knowledge intensive environments, as seen in the augmented use of steps 2 and 3 of Taylor's scientific management. As workers' experience intensifies precarity, intense competition and anxiety for jobs, they internalize the imperative to perform using their 'mind to subordinate their body to the ego-ideal and hence to the economic system . . . a process increasingly supplemented by machines that expand processes of workplace discipline' across the use of wearable monitoring devices (Moore and Robinson, 2015, p.2). Creative knowledge workers are now expected to incarnate a dialectic of self-observation and self-exploitation, leading to widespread deception as knowledge workers compare their actual achievements with the myth of what they are supposed to achieve in terms of valorization and real monetary gains (Schmiz, 2013). Furthermore, knowledge performance is based solely on what can be captured and codified as an end result, and thereby fails to recognize tacit actions and knowledge flows, thus undervaluing the total output of workers (Till, 2014).

The above examples of digital Taylorism have proven to be anti-creative (Brown *et al.*, 2011) in all spheres of work, including the creative working classes now increasingly under the control of digitized scientific Taylorism through (self-)monitoring and pay-for-performance, whereby discourses on the importance of creativity in the workplace are at odds with the actual deceptions, de-motivations and overworked conditions experienced by knowledge workers (Schmiz, 2013).

Artificial intelligence (AI) and Turing's conversation test

In the following section, we briefly review the notion of artificial intelligence (AI) and certain discourses associated with it. We will use the terms 'learn', 'teach', 'train' and 'intelligence', yet we adhere to Searle's (1980) position – a computer cannot understand the symbols it manipulates. We anthropomorphize artificial systems when speaking of AI concepts. To teach in the human sense implies learning, which in turn entails internalization across self-awareness and consciousness. This is not the case with machines, yet it is the domain of endless futuristic speculation among the general AI community (Kaplan and Haenlein, 2019). More concretely, we will present why, despite recent 'successes' reported in the mass media, AI continues to fail the Turing test (Elish and Boyd, 2018). We then introduce the concept of human *mètis* knowledge. Here, we shall argue why and how it can outdo machines in ambiguous situations.

Realities vs recent mass media discourses on AI

Various applications and techniques based on learning algorithms fall under the term 'AI' (Jarrahi, 2018). AI is a 'surprisingly fuzzy concept' (Kaplan and Haenlein, 2019, p.15), often loosely defined as intelligent systems with the ability to think and learn (Russell and Norvig, 2010). All current AI involves applications to specific tasks, known as 'narrow' AI (OECD, 2018). For reasons of scope, this paper will not address other speculative forms of AI that do not currently exist, such as 'general' AI and 'super' AI which have the aim of eventually replicating human consciousness and self-awareness (Kaplan and Haenlein, 2019). Current AI encompasses machine learning (ML), consisting of algorithms enabling systems to learn (Jarrahi, 2018), or more precisely improve, their outputs based on previous iterations (Mitchell, 2006). ML improves its output by instructing computers to modify (or teach) their internal algorithms based on previous iterations (i.e., experience) (Buchanan and Miller, 2017).

Deep learning (DL) is a subset of machine learning involving artificial neural networks (a set of algorithms modelled loosely on the human brain) that learn from large amounts of data (LeCun, Bengio and Hinton, 2015). Such neural networks are designed to identify numerical patterns extracted from mathematical vectors into which all real-world/sensory data (images, sounds or text) are translated (Hagan *et al.*, 2014). Deep learning across neural networks finds correlations across approximations. It approximates an unknown function f(x) = y between any input x and any output y, and so is often referred to as 'the universal approximator', assuming that they are related either by correlation or causation (Palit and Popovic, 2005).

The visibility of artificial intelligence has been boosted by IBM's Watson and Google DeepMind's AlphaGo, which beat human champions at Jeopardy and Go (Dejoux and Léon, 2018). Some claim that IBM's Watson's natural language algorithms (as specific forms of machine learning), across the use of approximations and probabilities, have 'the ability to understand nuanced human-composed sentences, and assign multiple meanings to terms and concepts'. This, in turn, allows Watson to 'develop intelligent solutions based on past experience' as well as to give it the ability correctly to discern cancer patterns (Jarrahi, 2018, p.578). Similarly, AlphaGo was able to self-train itself to beat 2016 World Champion Le Sedol four to one at a game requiring considerable levels of human intuition (Silver *et al.*, 2017).

Before deconstructing the above events, we first return to precursors of the term 'AI'. Turing (1950) proposed a method for evaluating whether machines could exhibit intelligent behaviour equivalent or indistinguishable from that of a human, the well-known Turing test. The rationale was that if a computer could imitate the sentience of a human being, would that not imply the computer itself was sentient? The test would consist of a human evaluator judging natural language conversations between a human and a machine, knowing in advance that one of the two was a machine. All participants would be hidden from one another with exchanges limited to a text-only channel. If the evaluator could not reliably distinguish the machine from the human, the machine would pass the test. To date, no machine has passed the Turing test (Russell and Norvig, 2010; Proudfoot, 2011).

IBM'S Watson was first developed and deployed for a very narrowly defined task - searching and matching textual clues to answers in the game of Jeopardy! As Ferrucci (2012) points out, this varies with human interpretative capabilities. Words in isolation, or sentences and entire discourses stripped from context in a particular culture, at a particular time, do not mean the same (Weick, 2009; Collins, 2010). The majority of questions in Jeopardy! ask for factoids, with over 90% of answers linked to Wikipedia titles, so the Watson team exploited a few hooks and identified certain key words (Ferrucci, 2012). Watson, like all other machines, manipulates numbers, as opposed to social constructs (Elish and Boyd, 2018). In similar manner, by combining deep learning configurations with predictive Monte Carlo tree searching algorithms, Google's AlphaGo performed a very narrow problem-solving task with well-defined rules (Silver *et al.*, 2017; Elish and Boyd, 2018). Yet, AlphaGo, like IBM's Watson, is not able to carry out a spontaneous conversation (Elish and Boyd, 2018).

Language and conversation are inherently complex, uncertain and ambiguous (Marneffe, Manning and Potts, 2012). For example, McComb and Semple (2005) show the interrelationship between social and language complexities, while Maddieson (1984) presents the phonological and morphological complexities of language, respectively. In turn, uncertainty phenomena in language/discourse and its own inherent complexities have been examined from different aspects, including syntactics, semantics and pragmatics (Marneffe *et al.*, 2012). Weick (2015) makes a clear distinction between uncertainty and ambiguity, the former defined as a lack of information, and the latter as consisting of too many interpretations of a situation. Hence, in a clear-cut world, 'while uncertainty is located at the boundary between knowing and what is yet unknown within a certain frame, ambiguity is located at the boundaries between different frames of knowledge or different kinds of knowing' (Dewulf *et al.*, 2005, p.117). Yet, Walker *et al.* (2003) also refers to a more nuanced overlap between uncertainty and ambiguity in which context and conceptual uncertainty are shown to be strongly related to ambiguity across subjectivity and intersubjectivity.

This overlap can also be extended to complexity. Complexity involves 'situations . . . characterized by an abundance of elements or variables' (Jarrahi, 2018, p.5). In the case of complexity where we all know and explicitly agree on the rules – that is, at tasks that are clearly defined, and in which the analytics within these systems tap onto dependable or 'good' data (Marwala, 2015; Elish and Boyd, 2018) – AI's superior computational capabilities allow it easily to surpass humans. Yet, performing such tasks with known and agreed rules can only limit us to the syntactic (or representational) complexities of language (Lorino, Tricard and Clot, 2011).

The complexities of semantics and pragmatics involve endless rules associated with both context and practice. These are uncertain beforehand and can only be determined after the fact; that is, across immersion within the community of practice in question and where each context is unique unto itself (Dreyfus and Dreyfus, 2005; Collins, 2010). Another component of semantic complexity is the diversity of interpretive perspectives, hence ambiguity, in which 'even if a common syntax is present, interpretations are often different' and 'the problem then shifts from processing information to learning about the sources that create these semantic differences' (Carlile, 2002, p.444). Meaning between interpreting subjects transcends mere syntactic units. When learning language, we each learn unique, tentative and sometimes ambiguous 'things that are never said' (Collins, 2010, p.280). Utterances are personal and reconstructed all the time (Tsoukas, 2009). Furthermore, utterance or speech is the product of interaction between interlocutors. As Tsoukas (2009, p.944), inspired by Bakhtin, says, 'an utterance has a potential to mean, but . . . its potential is realized through another's response'. Conversation cannot be reduced to mere data' processing – it is a 'dialogical meaning-making process' transcending mere representational syntactics inherently involving both uncertainty and ambiguity (Lorino *et al.*, 2011, p.793). Turing's conversation test, then, is a test of complexity, uncertainty and ambiguity all rolled into one, allowing us to understand why current AI cannot successfully pass it (Elish and Boyd, 2018).

Language and conversation as ambiguous knowledge

Explicit knowledge is typically viewed within the representational perspective consisting of a stable and universal entity (Szulanski, 2000). Within this perspective, explicit knowledge is viewed as formalized verbal or written words, numbers, and texts that can be shared as data, scientific formulae, product specifications, and so forth, hence assuming a predominantly syntactic aspect of language (Liu, Chai and Nebus, 2013). Yet, explicit knowledge also contains non-representational interpretative aspects (Tsoukas, 1996); for example, interpretative ethnographic texts or text as discourse and fiction (Van Mannen, 1988) as well as the semantic aspects of language whether in spoken or written form (Benvéniste, 1980). Furthermore, explicit knowledge involves subjective acts of construction. No matter how formalized a rule, knowledge of these rules will always involve some degree of interpretation and uncertainty calling for inferences and judgements (Tsoukas, 1996). Explicit knowledge involves meanings which require the mobilization of social non-representational constructs, which cannot be fully reduced to mere objective representational knowledge objects (Tsoukas, 1996). In a similar manner, Polanyi (1962, p.87) argues that a person's tacit skills are always cooperating with his explicit knowledge. While explicit knowledge involves articulated language interpretations, a person's tacit skill is knowledge that cannot be fully articulated. Yet the very meaning of articulated language interpretations in the form of symbols relies partly on the tacit (Polanyi, 1962, pp.139–41; Swap *et al.*, 2001).

Here, we open a brief yet important parenthesis on tacit knowledge. While certain notable authors have conceptualized the notion of knowledge conversion between the tacit and the explicit, with the latter is viewed as the identical articulation of the former (Nonaka and Takeuchi, 2004; Nonaka and von Krogh, 2009), others – including ourselves – are critical of this approach (Tsoukas, 2003; Ray and Clegg, 2007; Ribeiro and Collins, 2007; Collins, 2010; Virtanen, 2013). For example, Collins (2010) identifies three interconnected sub-categories of tacit knowledge as weak relational/implicit, medium somatic/bodily and strong collective/social tacit knowledge. He argues that both somatic/bodily and collective/social tacit knowledge can be only partially explicated. Here, 'explication' is a constructivist term referring to expressing out loud what we believe or interpret to be the explicit form of tacit knowledge, as opposed to a full representational or objective conversion from tacit knowledge into its explicit form such that both have identical contents (Glasersfeld, 1995; Ribeiro and Collins, 2007; Ray and Clegg, 2007; Collins, 2010). For reasons of scope and limitations, we invite readers to a more detailed argumentation as presented in both Holford and Hadaya (2017) as well as Sanzogni, Guzman and Busch. (2017). The important point here is that, building upon Collins's (2010) somatic/bodily and collective/social aspects of tacit knowledge, language involves both tacit bodily (or phenomenological) aspects as well as tacit social practices which go beyond what can merely be codified or articulated (Collins, 2007, 2010;

Kupers, 2008). Language involves knowledge in the form of entanglement between the representative and the non-representative, as well as entanglement between the explicit and the tacit.

Language is also tied to social practices that socially integrate individuals across dialogue (Wittgenstein, 1972) or, as Shotter (2011, p.7) states:

> as living, embodied beings, we are all living out our lives within an unceasing flow of language intra-twined activities. . . . As a consequence . . . we act jointly or dialogically . . . Uniquely new understandings, appropriate to the circumstances of their occurrence, are continually created within it . . . they emerge, and the entangled nature of the process of their production cannot easily be untangled.

We can speak of entanglement between individual and collective knowledge, but also entanglement between emergent knowledge as ongoing practice, otherwise known as knowing, and knowledge in the form of resultant articulations, also known as knowledge as possession (Cook and Brown, 1999; Orlikowski, 2002).

The above entanglements between the representative and the non-representative, the tacit and the explicit, the individual and the collective, as well as knowing and knowledge as possession, lead us to the ambiguous or fused knowledge referred to as *mètis* (Détienne and Vernant, 1978; Baumard, 1999). This is precisely the type of knowledge required to deal with the ambiguity of maintaining a conversation; and in a more general manner, the ambiguity to address an ambiguous environment (Weick, 2015).

Intentional ambiguity (*mètis*) as a response to environmental ambiguity

Unexpected emergencies present themselves across 'dynamic ambiguity' (Baumard, 1999, p.35). Such ambiguity can foster puzzlement and indecisiveness despite peoples' access to impressive levels of codified knowledge (Baumard, 1999, p.2). According to Weick (2015), unintended ambiguity in the form of unexpected crises can be addressed only across intentional ambiguity. Curiously, *mètis* is a form of obscure knowledge called upon precisely in transient, shifting, disconcerting and ambiguous situations – 'situations which do not lend themselves to precise measurement, exact calculation, or rigorous logic' (Détienne and Vernant, 1978, pp.3–4). Baumard (1999) identifies *mètis* as a 'knowledge of ambiguity', drawing inspiration from Détienne and Vernant's (1978, p.14) own words:

> Although *mètis* operates within so vast a domain, although it holds such an important position within the Greek system of values, it is never made manifest for what it is, it is never clearly revealed in a theoretical work that aims to define it. It always appears more or less below the surface, immersed as it were in practical operations which, even when they use it, show no concern to make its nature explicit or to justify its procedures . . . *mètis* is a type of intelligence and of thought, a way of knowing; it implies a complex but very coherent body of mental attitudes and intellectual behavior which combine flair, wisdom, forethought, subtlety of mind, deception, resourcefulness, vigilance, opportunism, various skills, and experience acquired over the years.

Aristotle singled out navigation and medicine as two activities in which the practical wisdom of *mètis* acquired through long experience was indispensable to expert performance.

> These were seen as *mètis*-laden activities in which responsiveness, improvisation, and skillful, successive approximations were required . . . The problem, as Aristotle recognized, is that certain practical choices cannot, even in principle, be adequately and completely captured in a system of universal rules. (Scott, 1998, p. 322)

It is a combination of 'street smarts' and 'deep smarts', the former being the ability quickly to detect and react to anomalies, and the latter a deep theoretical and practical understanding of associated patterns, phenomena and anomalies of a given domain (Leonard and Swap, 2005; Dreyfus and Dreyfus, 2005; Hatt, 2016). This combination of quick and deep can be seen in this quotation from Detienne and Vernant's (1978, p.8):

> *Mètis* is impulsive, swift, but in no way does it act lightly. With all the weight of acquired experience that it carries, it involves thought that is dense, rich and compressed. Instead of floating hither and thither, at the whim of circumstances, it anchors the wind securely in the project which it has devised in advance thanks to its ability to look beyond the immediate present and foresee a more or less wide slice of the future.

Baumard (1999) presents a more systematic characterization of *mètis's* ambiguity in two dyadic pairs working in complementary fashion; namely, explicit vs tacit with individual vs collective knowledge, resulting in four knowledge modes. First, the characterization makes use of individual explicit technical knowledge (i.e., *techne*) in the form of books and formal procedures – similar to Dreyfus and Dreyfus' (2005, p.782) stage 1 novice involving the decomposition of

> the task environment into context-free features that the beginner can recognize without the desired skill. The beginner is then given rules for determining actions on the basis of these features, like a computer following a program . . . to begin to develop an understanding of some particular domain.

Secondly, *mètis* involves collective explicit knowledge in the form of familiarity with the rules, laws and regulations of a given environment that one must face or outwit (Baumard, 1999). This is what Dreyfus and Dreyfus (2005, p.783) refer to as a stage 2 advanced beginner learning formalized situational knowledge in the form of:

> instructional maxims [that] . . . refer to these new situational aspects, recognized on the basis of experience, as well as to the objectively defined non-situational features recognizable by the novice.

Thirdly, *mètis* taps into tacit collective knowledge, knowledge of the invisible and hard to explicate structures acquired through social practice (Baumard, 1999; Collins, 2010). Such tacit knowledge is found within communities of practice where specialized language and practice are learned through social immersion, collaboration and deliberation (Dreyfus, 1996; Collins, 2010). Fourthly, *mètis* involves individual tacit expertise embodied in the practice of formalized technical knowledge (*techne*) within real-life situations (Baumard, 1999). Such embodied intelligence, which Collins (2010) refers to as somatic tacit knowledge, rejoins de Certeau's (1984) practice of everyday life, whose skilful action or 'personal knowing, involves participation through indwelling' (Polanyi and Prosch, 1975, p.44). Indwelling, acquired through repetition, involves the lapse into unconsciousness of certain things and acts ('subsidiary awareness'), accompanied by the expansion of consciousness of other things and acts ('focal awareness') (Polanyi, 1962).

Mètis's **long acquisition and quick deployment**

These four modes of knowledge overlap one another within *mètis* and produce 'polymorphous knowledge' (Baumard, 1999). In presenting them, we have hinted at how *mètis* is acquired through:

i) the internalization of formalized abstract knowledge (*techne*/*episteme*)
ii) the internalization of formalized situational knowledge (as formalizations of past collective experience)
iii) social practice and dialogue/deliberation, and
iv) repetitive individual practice of technical knowledge within real situational contexts involving indwelling.

For (i) and (ii), we refer to Guiette and Vandenbempt's (2016, p.89) 'detached coping'. Here, deliberate intentional actions are solicited across mental representations and conceptualizations of an external reality. Theoretical and analytical reflections occur 'on action' rather than 'in action', and typically within 'high chronological-physical' separation of action and reflection, such as laboratory, classroom or highly controlled simulated settings. For (iii) and (iv), a vigilance, a 'mindful experience' across 'mindful observation', is called upon in order eventually to achieve the required cunning, responsive anticipation and skill (Baumard, 1999). Mindfulness involves an expansive 'attentional breadth' or directing attention towards both external events and internal states (Dane, 2013). According to Langer (2000), mindfulness as an act of learning is a divergent thinking approach that is always connected to context, thus allowing one to examine an idea by considering alternatives, thereby creating more possibilities rather than focusing on a single outcome. As one's experience grows, multiple solutions from multiple perspectives can eventually be drawn upon to fit multiple contexts. Mindful learning is also what Guiette and Vandenbempt (2016, p.90) refer to as 'mindful coping', characterized by involvement in practical activity and thematic deliberation on how such activity is carried out (Dreyfus and Dreyfus, 2005). Deliberate attention is paid to the unfolding experience of the present moment while withholding judgement. Mindful coping allows for the perception of dynamic complexity within the practice at hand without falling into premature conceptualizations or preinterpretations which risk being irrelevant (Guiette and Vandenbempt, 2016).

Mindful learning/coping leading towards the polymorphous knowledge expertise of *mètis* requires time and engagement (Dreyfus and Dreyfus, 2005; Guiette and Vandenbempt, 2016). Yet, once acquired, *mètis's* deployment within future ambiguous situations can be swift, carrying all the weight of dense, rich and compressed knowledge (Détienne and Vernant, 1978, p.8). As we progress towards *mètis* through the mindful suspension of judgement, we eventually construct new frames (Guiette and Vandenbempt, 2016). These are more subtle and refined discriminations which

> distinguish those situations requiring one reaction from those demanding another . . . That is . . . the brain of the expert gradually decomposes this class of situations into subclasses, each of which requires a specific response. This allows the immediate intuitive situational response that is characteristic of expertise. (Dreyfus and Dreyfus, 2005, p.787)

Contemporary examples of *mètis* can include surgeons, aircraft pilots and engineers, all in technical domains involving both uncertainty and ambiguity (Schrader, Riggs and Smith, 1993). For example, the emergency water landing of US Airways flight 1549 in 2009 involved *mètis* on the part of both captain and first officer. They had to improvise in the face of ambiguous information involving complex technological systems. The improvisation was successful in that the operators were able to dynamically match themselves to the system's new and sudden non-routine operations (Meshkati and Khashe, 2015, p.92). Here, improvisation is defined as a reluctance to simplify, the ability to interpret signals in different ways and be sensitive to a different variety of inputs in order find new solutions to address the ambiguous situation at hand (Meshkati and Kashe, 2015). In an interview, Captain Sullenberger stated:

> What happened to us was a very rare event . . . it was a sudden shock . . . [yet] I was able to quickly synthesize a lifetime of training and experience and intuitively understand . . . the approach I needed to take . . . to handle the whole thing from start to finish requires a lot of innovation . . . it required us to take all the things that we have learned, adapt it, apply it in a new way to solve the problem we never anticipated and never trained for and get it right the first time. In 208 seconds. (Wachter, 2015a)

With such levels of expertise, unanticipated ambiguous breakdowns are more likely to be addressed through mindful coping rather than through detached coping (Weick, 2015, p.146; Guiette and Vandenbempt, 2016, p.93). Mindful coping induces a meta-awareness of now-ness, an agency of the present in which the pasts and the futures are both experienced and shaped, bringing forth a past solution adapted for the future (Hernes, 2014, p.4). We can link this to Sullenberger's own words:

> I served in Vietnam [in jet fighters] . . . and many years of manual commercial jet experience . . . I had to summon up from me somewhere this professional calm . . . and intuitively understand . . . the approach I needed to take. It was partly a result of my military flight training, from being a fighter pilot . . . even though we had never trained for this, because I had such a well-defined paradigm in my mind about how to solve any aviation emergency, I was able to impose that paradigm on this situation and turn it into a problem that I could solve. (Wachter, 2015a)

Finally, *mètis* is swift, requiring boldness to address ambiguous emergencies (Détienne and Vernant, 1978, p.8; Meshkati and Kashe, 2015, p.95) as Sullenberger explained:

> There are rare occasions . . . you need to pull harder than the flight control system might otherwise allow . . . confidence . . . to manually control the airplane as well as the automation can . . . to . . . effectively intervene . . . when the automation isn't doing what they expect (Wachter, 2015a)

Mètis, 'with all the weight of acquired experience that it carries . . . and . . . thought that is dense, rich and compressed', rises above the level of mere competence – the level of analytical capacity and decision processes found in most existing artificial intelligence-based automated systems – to a higher level that is able to recognize patterns quickly and act out intuitive insights (Détienne and Vernant, 1978, p. 8; Dreyfus, 1996; Dreyfus and Dreyfus, 2005).

Organizational logics, ideologies and configurations thwarting *mètis*

We present examples of organizational configurations and associated knowledge frameworks which tend to discourage or diminish human *mètis* knowledge within the increasingly digitized workplace (Baumard, 1999; Dreyfus and Dreyfus, 2005). We start with Sullenberger:

> As we use technology more and more – and we're encouraged to do so by our airlines because it's so efficient – then we get the sense that it's almost infallible. And, because we haven't done much manual handling of the airplane, we lose confidence in our ability to manually control the airplane as well as the automation can. That sometimes makes pilots reluctant to quickly and effectively intervene when they see things going wrong or when the automation isn't doing what they expect. (Wachter, 2015a)

This brings us to a more general point raised by Faraj *et al.* (2018, p.66):

> for skilled professions whose expertise and training are dependent upon tasks suitable for learning algorithms, the reliance on such technologies by incumbents for routine tasks may threaten the development of the profession's future experts [in that] . . . as incumbent experts retire, the replenishment of the occupational expertise that understands the tasks taken over by the algorithm is in question.

For example, learning algorithms are guiding radiologists toward certain diagnoses that compare favourably with certified doctors, thereby initiating calls within the IT community to cease training radiologists (Mukherjee, 2017). Yet deep expert understanding of these tasks is of utmost importance, in that expert radiologists are still in better positions to make correct interpretations when looking at complex situations involving weak, contradictory and/or disparate signals (Faraj *et al.*, 2018).

Here, we momentarily reflect on Baumard's (1999) argument of *mètis* as a polymorphous knowledge that is discretionary, simultaneous, multiple and tends heavily towards tacit and intuitive dimensions. This stands in stark contrast to *episteme's* and *techne's* more abstract generalizations, analysis and formalized/established representations. Dreyfus and Dreyfus (2005) cogently argue how this latter platonic epistemology of representations continues to manifest itself across modern-day knowledge acquisition research. Yet experts do not follow or apply fixed representative rules and explications such as those found in algorithms and general knowledge/information systems. Their expertise involves embodiment and intuition which cannot be simplified into deductive principles transmitted through book learning alone; and for which the contextual environments in which it is exercised are too complex, non-repeatable and non-predictable for formal procedures to capture (Dreyfus and Dreyfus, 2005; Scott, 1998). Behind modern approaches to knowledge acquisition lies a cognitive gap between knowledge that we think we have used to reach our decisions or outcomes, and knowledge that we have really used (Scott, 1998; Baumard, 1999).

> The systematic and impersonal rules of *techne* facilitate the production of knowledge that can be readily assembled, comprehensively documented, and formally taught, but they cannot by themselves add to that knowledge or explain how it came into being. (Scott, 1998, p.320)

For example, discovering a mathematical theorem requires genius and *mètis*, while the proof and explanation of the theorem follow the tenets of *techne* (Scott, 1998).

Along these lines, certain observations have been made regarding evidence-based medicine (EBM) (Greenhalgh, Howick and Maskrey, 2014). Timmermans and Berg (2003) have highlighted the overemphasis of experimental evidence in the form of generic or average results and its effects on both basic science and tacit knowledge from clinical experience. First, the pertinence of average results has been called into question relative to real patients who do not fit textbook descriptions and differ from those in research trials. Furthermore, such evidence has been used to generate clinical guidelines, the sheer volume of which makes them almost unmanageable (Harkins, 2005). Finally, the evidence is being increasingly transformed into algorithmic rules in computerized decision-support systems, structured templates and point of care prompts which can crowd out situational expertise and individualized aspects of clinical consultations (Timmermans and Berg, 2003). Glasziou *et al.* (2013) argue that in such circumstances inexperienced clinicians may (partly through fear of litigation) engage mechanically and defensively with decision support technologies, stifling the development of a more nuanced clinical expertise embracing accumulated practical experience, tolerance of uncertainty and the ability to apply practical judgements in unique situations. Furthermore, physician-technology configurations (such as templates and point of care prompts) have contributed to an increased emphasis within clinical practices on following the rules (Timmermans and Berg, 2003). When conducting clinical diagnosis, novice clinicians work methodically through a long standardized history, exhaustive physical examinations and numerous diagnostic tests (Llewelyn *et al.*, 2014). In contrast, expert clinicians make rapid initial differential diagnosis through intuition, and then use selective history, examinations and tests to rule in or rule out particular possibilities (Greenhalgh *et al.*, 2014). This is in line with stage 5 of Dreyfus and Dreyfus (2005) in which expert judgement is adapted to the situation in lieu of blindly following hard rules more in line with stage 2 or 3 novice work. Llewelyn *et al.* (2014) argue that quality of clinical care should have less to do with following rules and protocols strictly, and more to do with situated/contextual evidence in combination with expert judgement, this last involving a combination of both methodical and intuitive reasoning. One of the commonalities shared between both the remarks of Sullenberger and what seems to be a growing concern within evidence-based medicine is an organizational drive for efficiency in the use of algorithmic automation and standardization.

AI's efficient enactment of truncated knowledge

Both traditional and more recent learning algorithms involve the processing of data that has been restructured and formatted (Faraj *et al.*, 2018) within an objectivist (or representational) approach to knowledge that can be defined, measured, formalized/codified as words, signs and numbers, as well as stored and shared as data (Szulanski, 2000). This IT (information technology) view of the firm (Alavi and Tiwana, 2003; Selamat and Choudrie, 2004; Falconer, 2006), as argued by Holford and Hadaya (2017) as well as Sanzogni *et al.* (2017), has often neglected an adequate understanding of what indeed constitutes the tacit dimension. More specifically, current approaches are flawed in two connected ways:

- The erroneous assumption that embodied tacit knowledge can be retained via its conversion to explicit knowledge and subsequently stored in traditional manner.
- The lack of understanding of what we are trying to retain, transfer and apply when we refer to tacit knowledge.

The embodied nature of tacit knowledge involves two important features: integration within the body and action. The notion of embodied knowledge is, in fact, derived from the phenomenology of Merleau-Ponty (1962, p.30):

> To know how to touch type is not, then, to know the place of each letter among the keys, nor even to have acquired a conditioned reflex for each one, which is set in motion by the letter as it comes before our eye. If habit is neither a form of knowledge nor an involuntary action, what then is it? It is knowledge in the hands, which is forthcoming only when bodily effort is made, and cannot be formulated in detachment from that effort.

We can relate this to the practice-based approach, which considers knowledge as embedded in practice (Gherardi, 2012). This is the case with Collins's collective tacit knowledge:

> dancing in a social setting, speaking a natural language, and riding a bicycle while negotiating traffic on a busy street are examples of collective tacit knowledge. This is a unique human characteristic constituting the 'ability to absorb ways of going on from the surrounding society without being able to articulate rules in detail'. (Sanzogni *et al*., 2017, pp.42–3, citing Collins, 2010, p.125)

Here, we can tap into the constructionist arguments put forward by Glasersfeld (1995) in that human mental operations lead to a mental/subjective construction of reality. These operations involve both the construction of action and symbolic schemes (the latter as interpretive semantics), leading towards sensorimotor and conceptual knowledge respectively (Glasersfeld, 1995, p.76). Each of these schemes is based on unique personal experiences, which may be similar, but never identical to, another person's constructions (2002, p.158). As Carter *et al.* (2008, p.62) state, 'short of a brain transplant, the capacity to know [tacit knowledge] is not a transferable commodity'.

The objectivist approach to IT and AI, on the other hand, dissects and stores all experiences across the practice of reducing complex, infinitely interpretable and partially ineffable aspects of equivocal symbolic and experienced phenomena to mere univocal signs (Faraj *et al*., 2017; Ananny, 2016), resulting in knowledge truncations and subsequent loss of human expertise (*mètis*). Such knowledge truncation also involves the context stripping that occurs in relation to the data used and processed. In turn, this leads to additional skewing and bias, whether in an intentional or unintentional manner, generating disturbances and other unknown and unexpected outcomes which become difficult to explain by humans in any straightforward manner (Faraj *et al.*, 2017).

AI's efficient knowledge truncation highlights on the one hand an epistemological paradox – that is, AI's continued drive for univocal objectivity produces further knowledge impoverishment across the loss of human expertise. On the other hand, this efficiency paradox, as we shall see across organizational examples in the next sub-section, goes beyond mere questions of knowledge.

Algorithmic efficiency's paradoxical effect: more than a question of epistemology

The superior computational and analytical capabilities of learning algorithms has surpassed humans in complex tasks in which the rules are known and agreed to, and the available data are dependable and pertinent to the situation at hand (Marwala, 2015; Elish and Boyd, 2018). In the case of aviation, AI or fly-by-wire technology have been incorporated to reduce the number of hydro-mechanical manual controls and therefore aircraft weight, which translates into reduced fuel costs (Pope, 2014). The trade-off is that incredibly complicated systems running computer software are used to give the same result as conventional manual mechanical links. The pilot no longer controls all direct manoeuvres, while the computer assimilates countless pieces of information and conducts manoeuvres in such a way as to avoid engine stalling or straying into any area of the flight envelope that it deems undesirable (Pope, 2014). The problem has been that computers deter human pilots from requiring a specific performance of the plane in an emergency. An example of this is the Airbus A320 that crashed and exploded at the Paris airshow in 1988. This is also something that Sullenburger noted in his account of his forced landing in the Hudson River:

> I was not quite at the maximum angle the wing could be allowed to try to create lift. And yet even though I was pulling back, commanding full nose up on the side stick, the flight control computers prevented me from getting any more performance. That was something the investigators debated . . . But it turned out that because of this little known aspect of the flight control system, we hit a little bit harder than we would have had we been able to get that little bit of lift out of the wing right before we landed. (Wachter, 2015a)

Furthermore, the continued hands-off approach of pilots leads to erosion of expertise so that pilots no longer have the required hands-on experience to deal with emergencies. This was the case in the crash of Air France flight 447 into the Atlantic Ocean off Brazil. The pitot tubes of the A330 iced over in a thunderstorm, and the flight computers transitioned from protected mode to direct law, making the fly-by-wire aircraft behave very much like a conventional plane. The problem was that the crew had little experience of manual flying and were unable to cope with the emergency (Pope, 2014; Harford, 2016). Similarly, within the health care system, doctors faced with information overload from evidence-based guidelines are, depending on the organizational and institutional politics in place, strongly encouraged to use computerized decision-support systems to help them navigate within the various evidence-based complexities. Paradoxically, bureaucracy can discourage physicians from developing tacit expertise and deep smarts by always forcing them to follow the rules (Harkins, 2005; Harrison and Checkland, 2009; Glasziou *et al.*, 2013).

There have been repeated epistemological calls to combine the best of what humans and technology have to offer in decision making. On the one hand, AI can analyse different layers of complex information and masses of data from various sources (Marwala, 2015). However, AI algorithms, even in situations of purely defined complexity, are also biased in that they ‘are formalized opinions that have been put into code’ such that critical thinking is paramount (Dejoux and Léon, 2018, p.205; Faraj *et al.*, 2018). It has been argued that human actors should critically review and control AI decisions (Dejoux and Léon, 2018). In cases of pure uncertainty, tacit knowledge about a situation allows individual experts to recognize a pattern stored in their memories when making intuitive decisions (Kahneman and Klein, 2009). However, in many uncertain situations, there are components of certainty which AI can retrieve and use to make forecasts, using probabilities (Pomerol, 1997). Once again, the support of machines within contexts of uncertainty can be complementary to human understandings of the situation by providing real-time information to support the decision maker with statistics and pattern-recognizing algorithms (Jarrahi, 2018; Dejoux and Léon, 2018). And, of course, humans have an advantage over AI in ambiguous situations because of their perceptions and ability to contextualize information (Kahneman and Klein, 2009; Jarrahi, 2018).

Yet such epistemological arguments seem to have become secondary in the face of the current logic of economic efficiency in which cost reduction and profit maximization take priority (Clair, 2016). Algorithms and AI are called upon to help organizations do more with less (Autor, 2015), leading to various forms of digital Taylorism even among knowledge workers (Moore and Robinson, 2015). Airline pilots, such as Sullenberger, complain of salary cuts and less manual training. Pilots are now seen as technicians, de-skilled professionals (Couric, 2009; Vartabedian and

Masunaga, 2019). The impact of such managerialism and profit maximization on airline safety is a primary concerns for pilots such as Sullenberger, who are calling for more training for new pilots, not just to maintain manual expertise, but also to understand the limitations and advantages of algorithms (Wachter, 2015a).

Questions of body, mind and power

Along with profit maximization, barriers preventing adequate emphasis on *mètis* within the workplace involve power issues related to the managing of knowledge. Some authors have traced the repression of contemporary forms of *mètis* within the workplace back to Plato, where it is argued Western epistemology's totality was born (Détienne and Vernant, 1978; Dreyfus; 1996; Scott, 1998; Baumard, 1999). *Mètis*'s ambiguous non-categorizable knowledge, which embraces both body and mind, was disdained by Plato's positivist epistemology, which sought to represent all manner of knowledge. Any knowledge that could not be explicated was not considered to be knowledge (de Certeau, 1984; Baumard, 1999; Dolmage, 2009). Categorizations have politics (Suchman, 1994) in that the sorting of concepts into groups alters their meanings and potential uses. When this process is left unchecked and non-contextualized, categorizations become purely teleological weapons of the mind, in that the conceiver is always partially interest-driven (James, 1950). Categorizations are technologies/systems of control and discipline; when facing the radical indeterminacy of *mètis*, they must project 'expected or canonically organized sequences' that are clear, unambiguous and preferred (Suchman, 1994, p.180). Consequently, such intent towards clarity not only fails to capture the situational complexities and ambiguities of an expert in action, but also the ambiguities of a sudden crisis (Dreyfus and Dreyfus, 2005, p.788; Weick, 2015a). Yet, the Western positivistic reflex of imposing categorizations is not merely a matter of epistemological fallacy, it is also a matter of power and reified ontology, as reflected in Foucault:

> for Heidegger, it was through an increasing obsession with techne as the only way at arriving at an understanding of objects that the West lost touch with Being . . . Let's turn the question around and ask which techniques and practices form the Western concept of the subject" (Carrette, 1999, p.161 citing Foucault).

Alongside the digital Taylorization of airline pilots as mere executants and extensions of algorithmic configurations (Moore and Robinson, 2015), coercive power and distortions driven by vested interests have also been reported within the evidence-based environment of the drug and medical devices industries (Greenhalgh *et al.*, 2014). These set research agendas ranging from defining what counts as disease to choosing (often surrogate) outcome measures for establishing efficacy (Leyden *et al.*, 1999; Cohen, 2013). Trials are reported so that small differences are rendered statistically significant, and positive studies are preferred for publication (Every-Palmer and Howick, 2014). For example, one review of industry-sponsored trials of antidepressants showed that 37 of 38 with positive findings were published, but only 14 of 36 with negative findings (Turner *et al.*, 2008).

Such distortion brings to mind Marcuse's technical rationality of efficiency in which technology, culture, politics and the economy merge into one while repulsing all critical inquiry (McMillan and Buhle, 2003). This is most evident within what Lowrie (2017) refers to as the algorithmic rationality. Here, data science is based on the criterion of efficiency; that is, the quest to find the input/output equation which does better and/or expends less energy than another (Lowrie, 2017). Data scientists conduct data categorization through a series of interpretative choices about how to structure information in ways that make it amenable to analysis (Lowrie, 2017). In many cases, this involves the commensuration or homogenization of various forms of data to smooth the frictions (Nafus, 2014). Not surprisingly, data science applications succeed when they lead to an increased business return. Thus, scientific considerations of optimization are also business concerns, in which doing good science equates to doing good business (Lowrie, 2017).

Mindfulness towards alternative discourses on efficiency and democratic processes

Dewey (1927) argues that the democratization of knowledge is primordial in maintaining democracy, believing in the capacity of human beings for intelligent judgement and action. In this spirit, McLoughlin (2002, p.7) emphasizes the human aspect of creative technological change in which humans shape technology within alternative imaginaries or metaphors. This involves an alternative type of efficiency the aim of which is overall human and ecological well-being (Dewey, 1927; Feenberg, 1999). It is an efficiency that does not seek to truncate human tacit experience and meaning (i.e., *mètis*), in marked contrast to the emphasis of both classical scientific management and digital Taylorism on standardized executions and instructions. Above all, it is an efficiency that recognizes technology as a space to be contested, a space in which social groups have the opportunity to influence technological design, uses and meaning.

Digital Taylorism's all-pervasive Ellulian emphasis on ever-increasing efficiency and maximization has shifted decisional power towards technological entities, such as AI and learning algorithms. Becoming conscious of this deleterious enactment requires mindfulness (Weick, 2009). Mindfulness is the first step towards making sense of things (Weick, 2009). In turn, making sense is a highly politicized process whereby 'in reconstructing reality through discourse, actors in the field take part in the redistribution of power itself' (Zilber, 2007, p.1037). In this spirit, matter and meaning are mutually articulated (Barad, 2007, p.152). That is, materiality is constitutively entangled with discursive practices whereby the focus is on enactment and on how specific materialization of discourse makes a difference in practice and with what performative consequences (Orlikowski and Scott, 2015).

These performative dynamics draw upon Foucault's (1982) notion of discursive practices as those which constrain or enable what can be said. Power has to do with patterns and contexts of discursive exchanges (Barad, 2007, p.63). An example of performative dynamics is the development of social media websites which collect user reviews and ratings to produce algorithmically ranked products and services in which material discursive practices (of hotel evaluations in particular) have consequential outcomes on users, website technologies (and hotels) alike (Orlikowski and Scott, 2015, p.700). The implication of this for management is that we frame organizations as ongoing material-discursive reconfigurations; that is, we focus on material enactments and examine how specific materializations of discourse make a difference in practice, and with what consequences. In turning our attention to the rise of algorithmic practices, critical questions have been raised about decision-making, protocols and policies, human intervention, surveillance and accountability (Orlikowski and Scott, 2015). By examining the discursive materializations of algorithms, we can gain insights into what and how algorithms are being manifested, where and at what particular times, into the nature of their design and constructions and into their intended scope and purpose. Mindfulness also allows us to examine what organizational realities emerge across such practices in terms of policies, political patterns and exchanges, knowledge, engagement, learning, training, tasks, etc. – and their respective entanglements (Orlikowski and Scott, 2015). The nature of organizing pushes us towards philosophical fallacies in that 'organizing implies generalizing . . . the subsumption of heterogeneous particulars under generic categories' (Tsoukas, 2005, p.124). A material-discursive lens reminds us to be attentive – or mindful – to both sociality and materiality converging as sociomateriality (Barad, 2007). Materialization of discourse stimulates action and change to take place. In seeing how the world behaves, this same enactive lens not only reminds us to be more mindful about how certain outcomes and ongoings come to be, but also to become more engaged in our own negotiated outcomes which enact reconfigurations of organizations (Barad, 2007; Orlikowski and Scott, 2015).

The emphasis or repression of human *mètis* within the digitized workplace has material consequences for the organization and society at large. We have seen that barriers to human *mètis* involve an entanglement of epistemological fallacies and power distortions. Mindfulness to both sociality and materiality is ever more important so as not to underestimate the active role of technology nor to forget human agency (Orlikowski and Scott, 2015). Mindfulness informs practitioners of what type of engagements with technology one should pursue for outcomes which enable the practice of *mètis* (e.g., protocols, policies, training, and design of technology). Our paper gives examples of discursive practices within the media portraying AI successes and strengths in well-defined complex tasks (Jeopardy, chess, Go, etc.) which downplay the complexities, uncertainties and ambiguities of human language and the environment at large. This, in combination with organizational discursive practices over-emphasizing efficiency, standardization and profit maximization, has elevated the importance of learning algorithms and standardized protocols. This, in turn, has enacted human-technology configurations that are eroding or threatening to reduce human *mètis* within organizations. Counter-discursive practices on the uniquely human capabilities of *mètis* over AI are now required to enact (or materialize) more democratic organizational processes in the form of social embodiment of knowledge (Dewey, 1927). In other words, talking about the importance of *mètis* enacts its actual manifestation (Barad, 2007).

Such discursive practices must acknowledge the tangled ambiguities of *mètis* (Baumard, 1999; Barad, 2007). On the one hand, *mètis* as a form of knowledge includes both a distinct declarative/abstractive as well as an irreducible embodied/active aspect (Baumard, 1999). In the airline industry, following the suggestions of Sullenberger, new practices might include a willingness to engage with new cockpit automation and technologies along with increased pilot training on how such technologies operate, in order to understand and recognize their strengths and limitations (Wachter, 2015a). At the same time, pilot training for the manual override of aircraft manoeuvres must be maintained so that when technological limitations are exposed, pilots are still able to intervene (Wachter, 2015a). On the other hand, *mètis* also relates to actions (and therefore power) in the pursuit of collective versus vested interests (which, in turn, are entangled with how we view and categorize knowledge in the first place) (James, 1950; Suchman, 1994). In the case of the airline industry, discursive practices within organizations must allow for pilots to practise manual overrides in the handling of aircraft. Such practice helps maintain the required mindfulness as well as the authority to do so (Wachter, 2015a). Sullenberger summarizes the interrelated knowledge and power of pilot-technology practices of which organizations should be aware:

> The paradox of cockpit automation is that it can . . . relegate the pilots to the role of monitor, something that humans are not good at . . . Humans are much better ‘doers’ than monitors . . . The other problem with technology is, at least for now, it can only manage what has been foreseen and for which it’s been programmed. So one of the weaknesses of technology is that it has a hard time handling ‘black swan’ events . . . I tend to favor having the pilot directly and completely in control of the airplane. The downside of that is that every pilot has to be trained well, be highly experienced, and have a deep understanding of airplanes and how they work . . . We have to design our systems to require our engagement. We cannot design a system that’s so hands off that we are simply required to sit there and watch it for 14 hours. That’s simply not going to work. (Wachter, 2015a)

Although much of the engineering detail about the discursive practices that must occur among managers, pilots and suppliers of complex equipment is beyond the scope of this paper, Sullenberger notes what organizations need to remember:

> our [socio-technical] systems should offer more options than ‘all or nothing’. I’ve been proposing an *a la carte* menu, with increasing or decreasing levels of technology they can use. The only question we [as an organization] have to ask ourselves is what level of technology is most appropriate for a given phase of flight. The answer is the one that keeps us [the pilots] engaged and aware and able to quickly and effectively intervene, and also keeps our workload neither too high nor too low. (Wachter, 2015a)

Similar entanglements of power and knowledge are also to be found in medicine in universal protocols derived from abstract or context-stripped evidence versus the intuition from hands-on experience (Wachter, 2015b). Here too, discursive practices can remind us of the balance required between the strengths and limitations of technology versus the capabilities of humans (*mètis*) (Baumard, 1999; Collins, 2010; Wachter, 2015b). Finally, as we have argued throughout this paper, such complex entanglements of knowledge and power have consequences, for example, for safety and health.

Conclusions

AI's recent successes relate to narrow and well-defined complex tasks. We have argued that AI is unable to address complexity related to uncertainty and ambiguity, as in the case of natural languages. Only humans are able to carry out the highly ambiguous practice of conversation. Such capability is related to what is known as *mètis* knowledge, which is a fusion of many contradictory knowledge categories (Baumard, 1999). This knowledge fusion is more than simply a combination of explicated knowledge categories in that it also integrates embodied tacit and intuitive knowledge that cannot be articulated (Scott, 1998; Polanyi, 1962). *Mètis* knowledge provides the necessary ambiguity often in dealing with sudden crises (Weick, 2015). *Mètis* involves mindfulness, in both its acquisition and its deployment (Baumard, 1999; Guiette and Vandenbempt, 2016). Expert professional work involves *mètis* knowledge.

Organizational over-emphasis on efficiency and standardization has placed both intelligent algorithms and standard protocols at the forefront of organizational operations, while focusing less on maintaining or acquiring human professional expertise in the form of *mètis*. The consequences of losing or repressing such *mètis* within the organization can have serious material consequences. Adopting a material-discursive lens helps us comprehend the entangled problematics of knowledge and power within digitized workplaces, as well to enact alternative discourses and outcomes which mitigate organizational barriers to *mètis.*

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