The technological dilemma for entrepreneurial leaders: who drives innovation?

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Authors: [a]Lebene Richmond Soga, [b]Kofi Osei-Frimpong, [c]Rita Nasr

[a]*Lecturer at Henley Business School, University of Reading, RG6 6UD, Reading, UK. Email: Lebene.soga@henley.ac.uk*

[b]*Senior Lecturer at University of Professional Studies, Faculty of Management Studies, Accra, Ghana.*

[c]*Doctoral Researcher at Henley Business School, University of Reading, RG6 6UD, Reading, UK*

Abstract:
Theories of technological innovation have often involved how humans adapt to the new technologies as well as what impacts these technologies have on other human activities. However, technological innovation in most cases delivers change that was not anticipated thus evoking arguments of whether entrepreneurial leaders are those driving social change as they seek to remain competitive or whether their technological innovations possess a life of their own. This chapter takes a critical view of this technological dilemma for entrepreneurial innovation and competitiveness. It explores theories of technological determinism, the social shaping of technology, and the social construction of technology as necessary philosophical lenses that we need to re-visit. Consequently, the chapter argues the methodological implications these ontological perspectives pose to entrepreneurship research involving technological innovation and also argues for newer perspectives of approaching the phenomenon.

Keywords: Entrepreneurial leadership; Innovation; Technological determinism; Actor-network theory; social shaping of technology; social construction of technology

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Introduction

Technology is undoubtedly a critical resource for contemporary organisations as it supports and also consumes significant levels of resources within the organisation (Pearlson et al., 2020). In a world that is increasingly described as a digital world (Bennis, 2013), one in which technology is ubiquitous (Vodanovich et al., 2010) or a world of hybrids (Bloomfield, 2001) inter alia, entrepreneurial innovation has thrived by fundamentally changing the way humans organise themselves. Whereas technology has altered how work is organised and therefore having corresponding impacts on labour and operational processes, demonstrated in the ubiquity of technological infrastructure in organisations, arguments have also been raised as to whether such role of technology is worth the time and resource committed to those technological undertakings at all (see for example Marshall, 2006). This dilemma remains for entrepreneurial leaders as they deploy technology or seek to do so in order to drive innovation for competitive advantage. But really who drives innovation in the organisation? Is it the human deploying technology as a means to an end or is it the technology that 'forces' the desired innovative change and what consequences emerge?

In Zuboff's (1988) ethnographic study of the deployment of a technological system at a pulp mill (detailed in her book, *In the Age of the Smart Machine*), she argues the transformative *impact* of technology in organisations. Kallinikos (2011) recognises the importance of Zuboff's work by acknowledging how even after two decades, Zuboff's (1988) study, 'as perhaps every great work, holds out remarkably… [having] …rapidly gained recognition across a wide spectrum of social science disciplines, including management and organization studies, information systems, social psychology, and sociology, and has been debated and quoted extensively' (p.1). We hold similar views and take it as a starting point to advance arguments on some major debates this field of study has generated over the years. Even more importantly, it is argued that despite the era of the publication of Zuboff's work, key insights concerning the impact of technologies on organisations remain useful for the analyses of phenomena such as current technological innovation that were not yet present when she conducted her study (Kallinikos, 2011).

In the Age of the Smart Machine presents us with the argument that technology fundamentally restructures our material world, resists the magnetism of past ways of working, delivers innovative possibilities, and compels new decisions within the organisation (Zuboff, 1988). Being such a revealing study of how individuals felt about the transformation of their work vis-à-vis the technology, as well as the changing dynamics of managerial control, the call for how technology impacts individuals and work could not be any more pressing. However, this is also indicative of how importance is placed on technology creating a path for humans, with little thought on how humans have participated in shaping or constructing this impact of technology on themselves. The study also demonstrates how technology, which is originally intended to automate work, simultaneously generates data that triggers a new set of reflexive processes that inform different managerial behaviours and actions. In other words, technology does not only automate work, it also reflexively 'informates' managers and elicits corresponding managerial action (Zuboff, 1988). From this school of thought, a passiveness of leadership action in its relationship with technology is implied so that even an unintended consequence of technology determines how leadership is practised within the organisation.

A key question remains for us, that is, what practical and methodological implications unfold when this capacity of technology to 'informate' becomes amplified as entrepreneurial leaders introduce various technological innovations into their organisational practices? Zuboff's (1996) later analysis on the need for a new kind of leadership in the information economy may be instructive. In this later analysis, Zuboff (1996) argues that the *impact* of technology on organisations is not benign. For instance, even though its transformative power in the organisation cannot be overlooked, technology has nonetheless compelled managers to pursue ways of improving organisational efficiency that has become detrimental to the **moral** fabric of the organisation. That is, its 'informating' capacity has engendered an evolutionary mechanism in which low-skilled workers are no longer employable. In a practical sense, exploiting this new 'informated' organisation demands

> 'opening up the information base of the organization to members at every level, assuring that each level has the knowledge and skills to productively engage with that information, and endowing all members with the authority to express and ultimately act on what they can know. It implies a new social

> contract that redefines who people are at work, what they can know, and what they can do' (Zuboff, 1996, p.16).

The choice of 'who people are' in the 'informated' organisation as it were, the author argues, now becomes a moral burden for managers who must subscribe to a 'kind of moral leadership that can articulate new values' (Zuboff, 1996, p.17). Opening up of the information base within the organisation may be parallel to today's digital technologies introduced into organisations, but this presents a conundrum when notions of 'morality' are mentioned. Although arguments of morality are out of scope for this chapter, it is still indicative of how power and agency are attributed to technology that it is able to lure humans into such contested zone. What this 'moral leadership' is, is unclear but the call for **proactive** action by managers in an 'informated' organisation seems contradictory. This is because technology is presented earlier as dictating the pace while at the same time calls are made for managers to be proactive in the changing organisation.

Arguably, these arguments constitute many twists of thought-provoking phenomena especially when juxtaposed with recent developments of technological innovation in entrepreneurial organisations. Whether organisations are passive actors in their relationship with technology, or rather (pro)active in their connection with technology, implications for entrepreneurial leaders in the organisation cannot be taken for granted. This is because leadership is attributed to organisational success or failure (Müller & Turner, 2010; Nixon et al., 2012; Pisarski et al., 2011; Turner & Müller, 2005) even though that is itself a contested phenomenon in some cases (Grint, 2005; Yukl, 2010). To deepen our analysis of the arguments around this technological dilemma, we turn to major debates in the literature that overarch the role of technology in organisations. At the core of these debates is the question of who is really in control; is it the human or is it technology that is deployed in the organisation to drive innovation?

As an overview, this chapter examines the philosophical dimensions associated with technology and its relationship with entrepreneurial innovation. We begin by laying out arguments in technological determinism which is at one end of the spectrum. We then discuss the social shaping of technology and finally at the other end of the spectrum, we raise the debates regarding the social construction of technology. We recognise the weaknesses in these schools of thought and provide one way of examining the arguments

raised, using the actor-network perspective. We conclude the chapter by offering what implications these arguments hold for future research and practice.

Technological Determinism

Who is in control? Do entrepreneurial organisations have a choice in how they organise or reorganise themselves in the face of their (new) technological innovations? These are questions that potentially undermine or challenge the role of entrepreneurial leaders depending on one's worldview on the subject of technological determinism. Determinism is the idea that there is an inevitable path for progression in society determined by some factor (Smith & Marx, 1994, 1998). Philosophically, William James identifies in the old classic, *Essays in Pragmatism,* what the notion of determinism acknowledges. For him, determinism

> 'professes that those parts of the universe already laid down absolutely appoint and decree what the other parts shall be. The future has no ambiguous possibilities hidden in its womb: the part we call the present is compatible with only one totality. Any other future complement than the one fixed from eternity is impossible' (James, 1948, p. 40).

The philosophical argument here is that the universe, according to determinists, is one complete whole whose many parts must fit into their respective places in order to conform to a predetermined actuality. Here, the direction taken by events becomes an issue of the will (or its imprisonment) thereof; that is, no other possibilities exist except those necessitated of things preceding them, all other possibilities are rendered imaginary and cannot be reified. In Smith and Marx (1994, 1998), the possibilities that exist in organisational practices are necessitated by the dictates of technology, which the authors argue dates back to the industrial revolution in which scholars believed that technological innovation drove change in society more than any other factor. Smith (1998) for instance provides an analysis of the historical development of the idea of technological innovation driving social progress. In his evaluation, technological innovation assumed a place of dominance in American culture while artists and writers touted technology as a force that could deliver the promise of American life. 'Such technocratic pitches constituted a form of technological determinism that embedded itself deeply in popular culture' (Smith, 1998, p. 14).

While providing detailed documentary evidence for such claim, what is obvious is Smith's (1998) focus on the wider social *impact* of technology leaving out intra organisational dimensions. However, in using Mumford's 1964 *The Myth of the Machine* and Ellul's 1967 *The Technological Society* to bolster his analysis, Smith (1998) draws out the strength of technology asserted by these authors and their possible impact in organisations. For instance, Jacques Ellul's classic, *The Technological Society*, is a provocative one that reduces the human to a 'slug inserted into a slot machine' (Ellul, 1967, p. 135). Even though the human is seen as a moral entity able to decide either good or evil, it nonetheless possesses no power over 'technique' – technological advancement. Rather, technology exercises its autonomy by dominating the human with its advancing spheres. The human could only stand aside or become technology's servant, according to Ellul. That is, humans could not have power over technology in the organisation because the organisation must survive by its dictates (that is, technology's), eventually behaving like a machine; perhaps becoming mechanistic and non-flexible in its structure like in Burns and Stalker's (1994) characterisation of a 'mechanistic' organisation (although this characterisation may not be a direct implication of technology). Implicitly, what these arguments suggest is that the boundaries between the social and the technological are now blurred or probably non-existent to the extent that technology forces its way into the equation by its imperatives. A logical implication then is that entrepreneurial leaders in organisations are themselves subject to the directives of the technologies they introduce into their organisations.

Even though social constructivists (Bijker, 1995; Pinch & Bijker, 1989) reject the postulates of technological determinism, questions of technological determinists are still pertinent and therefore must not be overlooked. Drawing from Smith (1998), Lawson (2007) admonishes that technological determinism although an under-theorised phenomenon invariably becomes irresistible and researchers will find it difficult to repel its dangerous charm. Perhaps this is because 'the central point is that technology itself is not neutral. Everything is sucked up into the technological process and reduced to the status of a resource that has to be optimised in some way' (Lawson, 2007, p. 35). A methodological implication for this argument is that, the technology being used in the organisation must also form part of the unit of analysis.

However, the non-coherence of theories of technological determinism in the literature, in itself, causes a rethink of its underlying ideologies. For instance, in *Does*

Technology Drive History?, a collection of arguments by Smith and Marx (1994, 1998) on the dilemma of technological determinism, a close examination reveals two divergent views. First, views of such contributors as Heilbroner and Perdue that connote technology as the instrument dictating change; these are characterised as *hard* technological determinists who would view technological innovation as solely *impacting* the entrepreneurial action inside an organisation in a **specific** manner, which the researcher must investigate. Second, those arguments as presented by Hughes, Bulliet, and Marx that introduce an element of the 'social' into the idea of technological determinism. Here, social change or *impact* is as much a product of other factors like economics and social behaviours, as it is the technological innovation. In other words, the direction in which events move is not only a matter of the force of technology but also of socio-economic/cultural influences. It therefore suggests that the attribution of the degree of agency to technology must be weighed against those of other social influences as well (Hughes, 1998). The implication is that, in an organisational context, the social shaping or construction of how the technology *impacts* the organisation and therefore its entrepreneurial leaders must also be explored. Thus, arguments for *hard* technological determinism seem to be diluted with a *soft* approach on how the phenomenon is or should be construed.

Methodologically, the *soft* account suggests the inclusion of social constructivist perspectives (Hughes, 1998). But this idea of *soft* technological determinism that incorporates social influences is difficult to grasp if technological innovation is to be ascribed any power that drives organisational progress. Bimber (1994) for instance argues that the term, *technological* determinism, better not be used at all as it is impossible to consider the social as being a component of 'technological' determinism. But even in established organisations like the Massachusetts Institute of Technology (MIT), technology's 'deterministic' drive of progress seems palpable. Williams (2000) highlights 'the irony, and the poignancy, of MIT's history' (p.645) by revealing that although arguable, her 'MIT colleagues are convinced it [that is, technological determinism] is simply true' (p.649). Williams is a historian of technology and a one-time dean of students and undergraduate education at MIT. Her experiences as well as those of others when she was leader make up the core of her argument, probably a good example of a leader's personal frustration with technology. Williams (2000), who narrates technological change at MIT with its corresponding cultural changes, problematizes the idea of technological determinism using

her own experiences of the tensions created as a result of the introduction of new technologies. These tensions, she admits, were those in which technology usually won when trade-offs needed to be made. Implicit in the narrative is a frustration about the power technological innovation exudes in an organisation that organisational actors would have to literally chase and address resultant challenges that occur.

Methodologically, Williams' (2000) analysis implies a thorough consideration of the lived experiences of those involved with technology in order to pass any judgement about how their lives have (or have not) been impacted by the technology. This approach may sound contradictory since technological determinists are not so much interested in whom (or what) technology impacts as they are in the technology that causes the impact. Wyatt (2008) expresses similar methodological concerns with arguments of technological determinism raised by Heilbroner (1994) and Edgerton (1999) in which it is not the lived experiences of social actors that matter, but the technologies available to them that are of consequence. In other words, the object of analysis of any research involving technology must be the technology itself (either in use or just available to actors) and not the lived experiences of those using the technology. But it is also clear that we cannot ignore the relevance of technological determinism to real life experiences, as dismissing it will be akin to ignoring a thundering herd of elephants (Wyatt, 2008). The arguments thus move us to the idea of the social shaping of technology which to a large extent, embraces social elements in the analysis.

Social Shaping of Technology

One divergent view from the idea of technological determinism is the concept of the social shaping of technology (MacKenzie & Wajcman, 1999). As argued earlier, *soft* technological determinism introduces an element of the social by asserting that technology alone cannot be attributed agency when it comes to social change, instead, other factors like culture, politics, economics, and so on, make up a plethora of influences on the social in addition to technology. The social shaping of technology (SST) carries notions similar to those of *soft* technological determinism as recognised by MacKenzie and Wajcman (1999). They argue that technological determinists tend to focus on the *impact* or *effects* of technology and therefore fail to acknowledge how social and organisational processes are themselves constitutive of technology. In other words, technology does not necessarily influence an

organisation from some external source but is itself intricately shaped by the organisation. What this assertion generates methodologically is that we need not only ask how individuals *adapt* to the technology, instead, we must also find out how individuals *shape* these technologies either for political or other organisational reasons.

SST argues that in shaping technology, certain political dynamics are deployed, which may make the technology favourable for one group but unsavoury to others whom Winner (1993) for instance laments become 'irrelevant' social groups. Example, the 1920s to the 1970s saw Robert Moses as the master builder of New York; he was contracted to build roads, bridges, parks, and other public places. Moses built bridges to Long Island so low that only car-owning whites of 'upper' and 'comfortable middle' classes could have access (Winner, 1986). The bridges thus excluded the poor racial minority who mainly used public transport buses. On the surface, the bridges were meant to transport automobiles; nonetheless they were also designed and built to serve Moses' racial prejudice. It is however worth noting that this evidence is disputed in Joerges (1999) who refutes any such attribution of racism to Robert Moses by Winner (1986). This example is an indication of controversies about technology and society that technical things possess qualities built into them that reflect the desires of certain groups of individuals.

Technology is thus a dialectical union of the technologically possible and the socially desirable so that there is a translation of certain human intentionality into technological innovations (Rauner, Rasmussen & Corbett, 1988). Consequently, one implication of the SST approach is that the adoption of technological innovation by entrepreneurial leaders in an organisation must not be seen as merely a technological input. In other words, the technology also embodies specific forms of power and authority within the organisation (Subašić et al., 2011). However, the notion of inbuilt political intentions in technology or artefacts like Moses' bridge makes the argument problematic. It presupposes that technology is a static object whose inbuilt determinate aims would effect a desired change for which others must comply (Akrich, 1992). This brings one back to technological determinism, only this time with a focus on implicit human commands.

Orlikowski (2000) thus raises epistemological concerns on how the researcher can obtain knowledge of technology's inbuilt politics. She argues that rather than view technology as an embodiment of certain 'structures' – 'rules and resources instantiated in social practice' (p.406) – it must be considered as an enactment of **emergent** social

practices. That is, the 'use of the technology involves a repeatedly experienced, personally ordered and edited version of the technological artifact, being experienced differently by different individuals and differently by the same individuals depending on the time or circumstance' (Orlikowski, 2000, p. 408). The implication is that, how individuals deploy the technology within the organisation may be shaped by factors that were not originally anticipated in its adoption.

Moreover, it is only when individuals actually use the technology in the organisation that it can be said to shape their actions thus raising the idea of 'sociomateriality' – the argument that considers the relationship between individuals and technology as an entanglement and not as distinct entities (Orlikowski & Scott, 2008). SST theorists have thus posited technology as not only *impact*ing the organisation but is also constitutive of certain social practices, is politically shaped by some privileged individuals, engenders emergent practices, and is intimately entangled with individuals within the organisation. Methodologically, these arguments suggest that the researcher examines at the 'micro' level, how individuals are interacting with the technology in order to understand fully its social shaping effects (Orlikowski, 2000). This shift from a focus on the technology itself to the social gets even more radical with the idea of the social construction of technology, explored next.

Social Construction of Technology

Social construction of technology (SCOT) is an argument that rejects the ascription of any organisational *impact* or progress to some technological logic (Bijker, 1995). Instead, SCOT argues a *construction* of the technological artefact by people within the organisation based on the meanings that the technology has for them (Pinch & Bijker, 1989). Here, it is not just a *shaping* of what technological innovation is already there but a question of *how* and *why* the innovation came to be used and now taken for granted (Latour, 1987). For SCOT proponents, there are 'relevant social groups' that are involved in negotiating the deployment of technological innovation, but these groups of individuals often differ in their views of how the technology may be appropriated, a notion referred to as 'interpretative flexibility' – that is, to one group the technology may be useful in a particular way but to another group, unreasonable (Pinch & Bijker, 1989). This lack of uniformity on what a technological innovation means for individuals in an organisation receives 'closure' when a

common interpretation becomes agreed upon. The implication is that entrepreneurial leaders who wish to deploy any technological innovation in their organisations would have to be aware of potential conflicts. This is because 'facts' about technology are always a matter of different interpretations of relevant social groups (Bijker, 1995) while other individuals become marginalised or 'irrelevant' (Winner, 1993). This is a limitation of SCOT as it lacks consideration for the wider social, cultural and political milieu within which technological innovation is made possible (Klein & Kleinman, 2002).

Methodologically, what SCOT suggests is that the researcher needs to identify what 'relevant' social groups were involved in the adoption of the technology (Bijker, 1995) but also seek to find what the 'irrelevant' social groups were in the process (Winner, 1993). Understanding what meanings these different groups of individuals make of the technology may be instructive in appreciating how the technology has influenced their organisational or entre/intrapreneurial practices. However, as Klein and Kleinman (2002) argue, it is problematic to conceptualise society as composed of groups when in reality, many different views occur with power asymmetry both between and within groups. To identify these 'relevant social groups' Bijker (1995) suggests a snowball technique, which Klein and Kleinman (2002) find challenging. In a 'snowball' method, 'the researcher interviews a few actors at the start, asking them to identify relevant groups, and in this way eventually builds up the set of all groups' (Klein & Kleinman, 2002, p.32). It still risks exclusion of other social actors or becoming so big a 'snowball' that it becomes almost impossible for any meaningful analysis (ibid).

While critiquing Bijker's (1995) methodological propositions in SCOT, Klein and Kleinman (2002) argue a 'structural' approach to conceptualising and investigating 'closure' of a social group's construction of technology. They argue that structures such as the group's political resources, economic resources, culture, and so on must be considered as influential indicators in examining how a particular technology came to be socially constructed. However, this wider socio-structural approach seems to be only concerned about the *design* of technology as also are other social constructionist ideas (see Bijker, 1995; Pinch, 1998; Pinch & Bijker, 1989), and not the *adoption* of the technological innovation into a new or different setting which is equally relevant for entrepreneurial leaders. This is because entrepreneurial activity in organisations is not only about the creation or design of new ideas (Schumpeter, 1934) but also about the discovery and use of

existing ideas (Kirzner, 1973, 1999). Consequently, implications for SCOT in organisational settings are ignored since most organisations tend to *adopt* and not design from scratch the technologies they find useful for their ventures (McCabe, 2007; Saldanha & Krishnan, 2012).

What is common with SCOT scholars as argued so far is the shift from the technological innovations alone as the units of analyses, to the social dynamics that engendered the final acceptance and use of any particular technology. Winner (1993), who also disagrees with turning to the technologies alone as the objects of analysis (cf. Heilbroner, 1994; Edgerton, 1999), looks for an alternative approach from social constructivists (e.g., Pinch & Bijker, 1989). However, disappointments still remain when we take only a SCOT perspective in that the consequences of technology are seldom a focus of study. This is because 'what the introduction of new artifacts [technology] means for people's sense of self, for the texture of human communities, for qualities of everyday living, and for the broader distribution of power in society – these are not of explicit concern' (Winner, 1993, p.368). Moreover, the interpretive behaviours of individuals on whether the adoption of certain technologies in an organisation is of value or not, cannot be taken for granted (Leonardi, 2009; Orlikowski & Gash, 1994). We cannot also neglect the unintended consequences of the deployment of technology even though SCOT only implicitly alludes to these.

Whereas technology is acclaimed as having the capability to drive change (Grübler, 2003; Zuboff, 1988), shape outcomes in organisational practices (Tushman & Murmann, 2003), offer flexibility in work processes (Lucas Jr & Olson, 1994; Valcour & Hunter, 2005) where flexibility is defined as the ability to adapt to new and changing requirements from external market forces (Lucas Jr & Olson, 1994), unintended consequences are also identified in organisational studies with implications for entrepreneurial leaders. For instance, Church *et al.* (2002) argue that the relevance of technology in organizational development and change initiatives, though evident, engenders an over-reliance on the technology, which in turn increases the potential for unintended consequences.

In a study of PepsiCo's Web-based career management platform in which the organisation wishes to encourage a new culture of collaboration and open communication, Church et al (2002) identify that threats to adequate representation, decreased participation rates of employees, issues about employee confidentiality, lack of faith, and technical hiccups tend to potentially threaten the integrity of the whole developmental

process. The authors find that the ability of technology to drive organisational development has at the same time revealed potential threats. This paradox is also observed in Lucas Jr and Olson (1994) who argue that technology in an organisation enhances organisational flexibility by removing constraints on *where* and *when* work is accomplished, accelerating the processing of information thus affecting the pace of work, and allowing the organisation to respond quickly to market demands. They however concede that technology itself is inflexible, that is, significantly increasing costs, time and effort to change technological systems, being hard to maintain, and in many cases making it difficult to modify workflows and organisational structure for which the organisation can become stuck in such inflexibility over time.

Thus, technology comes along with unanticipated consequences as the organisation becomes dependent on its imperatives. In fact, even the almost mundane technologies like electronic mailing (i.e., email), Intranets, and other social technologies that are deployed for communication among individuals in organisations arguably come with their own unintended consequences. Email for instance, some have argued can become a symbol of stress for individuals (Barley et al., 2011; Duxbury et al., 2007; Murray & Rostis, 2007). As a technological means for communication and collaboration (Tyran et al., 2003), emailing is largely asynchronous; asynchrony is the idea that the technology allows individuals to send messages anytime without expecting feedback immediately as would have been the case in for instance, telephone conversations in which communication is a two-way activity – in this case, 'synchronous' (Barley et al., 2011). Nonetheless, email undeniably impacts human interaction but is thus shown to induce stress.

It is however worth noting that the extent of technology's full effects on the human remains disputed as SCOT perspectives only seek to understand how humans have come to interact with their technologies and not what the technology has 'caused'. Example, the assertion that email can become a source or symbol of stress is refuted elsewhere (Chesley et al., 2003; Phillips & Reddie, 2007; Renaud et al., 2006). Overall, a 'holistic' approach to this technological dilemma demands that methodological approaches that seek to explore the phenomenon would be better served if we considered arguments from these three schools of thought discussed so far. Here, the utility of the actor-network theory, we argue, becomes pertinent to the research undertaking in that it acknowledges technology's ability to act on humans for which unintended consequences are sometimes inevitable.

An Actor-Network Perspective

In the 1970s, French anthropologist and social scientist Bruno Latour and British sociologist Steve Woolgar deployed ethnographic approaches to investigate what Scientists did in the laboratory. By examining the production of scientific 'facts' in the laboratory, they observed how non-human companions such as chemicals, petri dishes, mice, graphs, etc were deployed as allies to overcome challenges against the outcomes of their work (Garrety, 2014). The idea that non-human elements in human sociality could be relied upon to play a part in establishing what humans would accept as facts provoked a different way of thinking in sociology. Later in the 1980s, French sociologist Michel Callon, British sociologist John Law, together with Bruno Latour became the main proponents who first used the term 'actor-network theory (ANT)' to represent the array of concepts that emerged from those 'laboratory studies'. These interrelated concepts would later challenge the distinct boundaries between subject and object, nature and culture, essentially what was human and what was non-human (Singleton & Michael, 1993). Key among the ideas raised by ANT is that of non-human agency. That is, the exercise of agency was no longer about human intentionality alone, but simply 'the ability to act and elicit a response either with inherent intentionality in the case of a human agent, or (un)programmed intentionality in the case of a designed artefact' (Soga et al., 2020, p. 8).

The ANT outsteps traditionally held dichotomies of Nature/Societies thus positing the social as materially heterogeneous (Latour, 2005; Law, 1992). Here, both humans and non-humans – things, technology, texts, machines, etc. – all constitute the social and therefore are actors (or actants) in the heterogeneous network of relations. The implication is that the various technologies that are deployed in organisations by entrepreneurial leaders in an attempt to remain competitive are as relevant as their human counterparts. This position challenges the nature of what counts as 'social' although it is not without criticism (see Elder-Vass, 2015; Shapin, 1998). However, ANT's approach to sociology, which is also its 'radical and controversial contribution' (van House, 2004, p. 15) is that it helps us re-examine how we understand and research organisations.

For ANT theorists, the organisation must be understood as a set of entities brought together, of which the character is undetermined (Callon, 1993; Law, 2004). Its undetermined nature means that an organisation is intermeshed with unidentifiable processes that call for constant negotiations from actors within it. The implication is that, in

order for entrepreneurial actors to maintain their competitive positions, they will have to reorder themselves in response to any shifts in the market. This ANT perspective thus conveys the idea that for the entrepreneurial leader, the deployment of technology for competitive advantage can be a strategic move but also a relational one. In the former, technology becomes an ally to help achieve a strategic objective whereas in the case of the latter, technology is as much an actor as the humans in the organisation, working together relationally to respond to external market demands.

Consequently, ANT offers processes (what it calls 'moments') of translation that create and sustain its heterogeneous network of relations (Callon, 1986). Translation is a concept of interrelated approaches that include *problematization*, *interessement*, *enrolment*, and *mobilization* (placed in this orderly sequence by Vurdubakis (2007) not necessarily for a straightforward stepwise prescription but for simplicity). In *problematization*, an actor seeks to build or sustain their network of relations by identifying and exploring a problem in terms of a solution that they want to promote. Example, an entrepreneurial leader who seeks to introduce a new technology to drive innovation would first identify what problem the incoming technology would solve, be it process or product innovation. In ANT terms, because the actor wishes to build a network of relations that would support specific objectives, they make themselves or their proposed solutions obligatory passage points (OPP), that is, indispensable courses of action or necessary centres of activity that are needed to fulfil the objectives (Callon, 1986). Example, the entrepreneurial leader might point to what competitors are already doing as basis for action.

The next moment of translation is *interessement* where the actor generates interest by persuading others about how the proposed solution generates collective benefits for the network of relations. Example, the entrepreneurial leader might argue how the new technology would help increase profits or the organisation's reputation or market capitalisation or overall competitiveness and so on. The next moment of translation is *enrolment* in which various actors are assigned specific roles in the emerging network of relations in order to carry out laid out objectives. Example, the entrepreneurial leader might identify some individuals in the organisation who would be responsible for the processes of technology adoption and implementation. In the final moment of translation, which is *mobilization,* the actor mobilises members of the network of relations while sustaining

commitment (and also making withdrawal difficult). Example, the entrepreneurial leader might generate buy-ins through training programmes or upskilling of organisational members to enable adequate use of the newly installed technology. In this example, ANT shows how the deployment of a new technology to drive innovation triggers a set of processes in which a network of relations comes to be formed and sustained. This network is one in which technology and humans come to relate together within an organisation in order to achieve a set objective.

The implication of this ANT perspective is that the researcher now considers the technologies deployed by entrepreneurial leaders in any analysis without necessarily being technologically deterministic. This offers a significant shift in the study of how entrepreneurs deploy technology within their ventures for some competitive advantage or simply for enhanced procedural efficiencies. The unit of analysis moves away from the entrepreneurs or entrepreneurial teams alone to what is now *an assemblage of the human individuals and the technologies* they have deployed in their organisation. Law (1992) for instance, asserts Napoleons are no different in kind to commoners. In other words, the technologies must be given equal consideration in as much the same way as the human actors. Although this ANT argument attracts criticisms for anthropomorphism (which ANT is not!), the value of this methodological approach 'lies in a more sophisticated appreciation of the fluid and multiple nature of reality, the view of the active role of objects in shaping social relationships, and a theoretically informed approach to guiding sampling and data collection' (Cresswell et al., 2010, p. 10).

Similarly, ANT theorist Callon (1986) establishes the notion of generalized symmetry, which implies that, the same descriptive or explanatory framework that is employed for humans must also be applicable for objects, in this case the technologies. He argues that it requires the researcher to be impartial to the voice of all actors. Methodologically, this implies a qualitative undertaking in which the researcher *follows* all actors in the organisation. By following the actors – that is, both entrepreneurial leaders and their technologies – the researcher is thus able to trace their trajectories in order to establish how innovation has taken place within the organisation or how this technological dilemma this chapter argues has unfolded. As highlighted earlier, the underpinning argument of the ANT approach is that both humans and the technologies they deploy form a network of heterogeneous relations and they all act on one another within the network (Latour, 2005).

The methodological implications of ANT are not without weakness, which is a result of its ontological assertions, thus making the 'ANT method' sometimes difficult to operationalise. Example, ANT does not make clear from where we begin tracing actors in a network of relations since the network is unbounded (Latour, 2005). It is easy to assume this as only 'following' the human actors to trace how entrepreneurial leaders deploy new technologies for innovation in their organisations. But this assumption may as well apply to the technology. This is a pragmatic decision for the researcher. How specifically a technology could be 'followed' is not made clear in ANT. We suggest ethnomethodological techniques in this sense. This could involve long term observations of the interaction between entrepreneurial leaders or organisational members and the technologies they use. ANT is also criticized as being only descriptive with no explanatory power so that in tracing actors, we are left with describing the context of the actor-to-actor interactions without explaining why it is so.

Callon (1991) for instance, argues that 'to describe a skill is thus, at the same time, to describe its context' (Callon, 1991, p. 138) and therefore we might need some other theory to support the analysis. We suggest theories such as cultural historical activity theory, urban ecology theory, sociomateriality, and other theories of practice could fill some of the gaps argued. Theories at the level of structure like structuration theory or institutional theory could offer insights at macro levels of analysis while ANT addresses the more micro level analysis. The idea of generalized symmetry also presents us with not only an ontological challenge as we grapple with technology's non-human membership of an organisation (Collins & Yearley, 1992; Elam, 1999), but also an epistemological challenge as the researcher must give voice to the technology. Cresswell et al. (2010) acknowledge these weaknesses and suggest pragmatic approaches to navigating an ANT study since 'methodology cannot resolve the higher epistemological [and ontological] debate[s]' (p. 9). Following, we explore what implications the ANT approach has for the arguments raised so far with respect to future research and theory.

Implications and Future Research

We return to our core question: who is really in control as entrepreneurial leaders deploy technology in order to drive innovation or in order to remain competitive? From the arguments raised in this chapter, technology's role in human activity does not seem to offer

a straightforward answer. Yet the question remains significant for entrepreneurial leaders who wish to engage technology towards their entrepreneurial activities, particularly new technologies in order to drive innovation. This is because technology's failure could result in catastrophic outcomes (Keil & Robey, 1999). Example, the once successful healthcare company, FoxMeyer, with twenty-three distribution centres across the United States wanted to take advantage of the increasing aging demographic in order to expand market share. This entrepreneurial drive led the organisation to deploy an Enterprise Resource Planning (ERP) software with an expectation to manage inventory efficiently, reduce operating expenses, and expand services. Ultimately, FoxMeyer hoped they could undercut the competition through lower prices as the new technology was estimated to save the company $40 million in annual operating costs (Olson, 2004). With such expectations of cost savings, which ERP systems can achieve (Davenport & Brooks, 2004), FoxMeyer then '…signed large new contracts, underbidding competitors based upon new expected lower costs' (Olson, 2004, p. 6). These new contracts forced changes in system requirements, coupled with other coordination problems in a web of many other unexpected situations to eventually result in colossal losses of over $15 million (Olson, 2004). Finally, FoxMeyer filed bankruptcy and a technological input that was expected to be revolutionary for the business became a nightmare.

Several studies show various levels of failure as a result of the implementation of new technological systems (Keil & Robey, 1999; Majed & Abdullah, 2003; Reel, 1999; Robertson & Williams, 2006). In fact, even with successful technological implementations in organisations, 'previously simple procedures may become complicated and local flexibility constrained' (Marshall, 2006, p.1). As a result, the implications that new technological implementations convey for entrepreneurial leaders are those that potentially carry existential ramifications for their business ventures. The question of 'who is in control?' is thus paramount to our understanding when it comes to practice, methodology and theory. From a technological deterministic perspective, the entrepreneurial leader is hopeless in his/her attempt to lead their business venture in the competitive market. From the perspectives of social shaping of technology and those of SCOT, the entrepreneurial leader must work collaboratively with various social factors or observe how these factors come to create the organisation he/she desires to build.

A passive approach could result in undesired outcomes as the social factors would have been left to construct or shape unintended outcomes. ANT's ontological argument means that the entrepreneurial leader who is now an actor (among other actants) in the heterogeneous network of relations must actively deploy strategies to be in control. What those specific strategies are remain elusive and offers opportunities for future research. For instance, FoxMeyer blamed its bankruptcy on its new ERP systems implementation, and it went on to be acquired by McKesson, also a major drug company which ironically reported success with the same ERP technology (Olson, 2004). The strategies deployed by McKesson so that it reported success instead of failure as a result of the technology could offer insights for entrepreneurial leaders. Policy could also address some of the challenges entrepreneurial leaders face in their network of heterogeneous relations. To foster entrepreneurial activity, policy could support access to technology, knowledge spill-over, entrepreneurial networking and entrepreneurial finance. This would remove some of the obstacles entrepreneurial leaders are faced with as they navigate their heterogenous networks.

Conclusion

This chapter acknowledges technology as an important actor in the decisions made by entrepreneurial leaders for their business ventures. However, we find that the deployment of technology within the organisation raises a dilemma for all actors involved and could sometimes threaten the business venture itself. The singular lenses of a technological deterministic view or arguments of social shaping of technology or social constructivist positions alone do not adequately address the challenges posed when new technologies are introduced. This deployment of technology to gain competitive advantage through innovation also raises the question of who is really in charge of the process? The significance of this question is in the intended outcome for implementing the technology in the first place. If the intended outcome is to be head of the competition, answering this question becomes key to remaining ahead. Accordingly, we have argued for the utility of a 'new' theoretical lens – the actor-network theory – one that is neither solely technologically deterministic nor socially constructivist. That is, a theory that accepts technology as a non-human actor and acknowledges it as being in a heterogeneous network of relations with the

humans deploying it. That is, it must avoid placing an overemphasis on the agency of only the human actors or on only the technological actants for any meaningful analysis.

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