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A SWOT Analysis Relating the Internet of Things to Designing Effective HR Performance Management Systems

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Introduction

In the history of work and human resources (HR), the New Lanark textile mill community managed by the entrepreneur Robert Owen in nineteenth century Scotland is frequently looked back on as a pioneering and progressive community form of organization, given its emphasis on valuing employee education and creating fair working conditions for all (Donkin 2010). In this utopian integration of the industrial and the social, Owen introduced a colored wooden block suspended near each worker's station called a 'Silent Monitor' to indicate their performance. On each of the four sides of the block was a different color (white, yellow, blue and black), and the color turned to the front reflected the assessed level of performance from the previous day, a record of which was also kept in a 'book of character' (Donkin 2010).

Two centuries on from this historical example of New Lanark, organizations are still greatly invested in monitoring, managing and developing the performance of employees as successfully as possible. The purpose of this chapter therefore is to investigate how the emerging technological trend of the 'Internet of Things' (IoT) is likely to affect the HR processes and practices involved in employees' performance management, where the wooden blocks and paper ledgers of the nineteenth century are replaced by the digital, wireless, interconnected sensors and devices of the twenty-first.

Although definitions of the IoT are competing and still evolving, at its simplest it reflects "the possibility of connecting various physical objects ("things") to the Internet…[that] can exchange information and interact with each other…[and] become "smart things" that can behave autonomously [in ways] appropriate to the context and the situation" (Strohmeier et al. 2016, 5). The IoT vision for the next generation of the Internet becomes grander as more physical objects worldwide become digitally connected to the Internet and each other, and are able to intelligently and autonomously control and configure themselves and their environments (Li, Xu, and Zhao 2015).

In the workplaces where technological trends such as IoT will continue to have an impact on employees, behind any broad discussion of talent management or HR strategy, there needs to be some consideration of the performance management systems and processes in place within organizations (Aguinis, Joo, and Gottfredson 2011). Performance management concerns the "continuous process of identifying, measuring, and developing the performance of individuals and teams and aligning performance with the strategic goals of the organization" (Aguinis and Pierce 2008, 139-140).

A focus on performance management in relation to IoT is timely given that the former is often viewed skeptically and narrowly in terms of 'performance appraisal', which is only a small part of performance management focusing on a relatively non-strategic meeting, typically once a year, to describe an employee's strengths and weaknesses (Aguinis et al. 2011; Aguinis and Pierce 2008). Resolving this confusion is important given that annual performance appraisal meetings with employees are now widely considered as outdated, inadequate, and a bureaucratic waste of time (Aguinis et al. 2011; Ewenstein, Hancock, and Komm 2016). Furthermore, the path forward is generally considered in terms of building more sophisticated, scientific, open, fair, continuous and inclusive performance management systems with multiple raters, ratings, sources of data and feedback, with links to rewards at all levels, and adjustments to fit aspects of strategic and international business contexts (Aguinis et al. 2011; Ewenstein et al. 2016).

Some organizations are at a stage where they are developing or using more dynamic, continuous forms of performance coaching supported by technology, in the form of apps and crowdsourcing to collect performance data in real-time, for example (Ewenstein et al. 2016). In terms of IoT, the question becomes how various forms of digitally connected, data-driven objects can contribute usefully and appropriately to these processes, with advantages and drawbacks being anticipated and navigated accordingly.

Thus far, however, there is almost no research explicitly theorizing or studying the IoT in relation to HR practices and strategies, despite the broader work emerging about business industry applications of the IoT and the use of smart technologies in the workplace (e.g. Kim, Nussbaum, and Gabbard 2016; Da Xu, He, and Li 2014). One recent exception is work by Stefan Strohmeier and colleagues (2016), who conducted a Delphi study with 37 academic and practitioner experts in HR or Human Resource Information Systems (HRIS), which confirmed a range of general expectations that the IoT will lead to major changes in HR technologies, functions and positions. Among other things, these included greater collection of employee data through sensors, more technically integrated interactions between novel objects and existing HR software, and the continuing automation of administrative HR work and positions.

Given the limited work to date specifically theorizing the links between IoT and HR practices, specifically or generally, this chapter aims to contribute to a fuller understanding of the potential positive and negative relationships between IoT and performance management, as well as constructive actions that HR functions can take to engage and address such relationships. To some extent, this requires creative theory building (Shepherd and Suddaby 2016), drawing together some relevant strands of existing work concerning the IoT, performance management, electronic-HR (e-HR), digital sociology and urban informatics to extrapolate and imagine how the IoT might affect future work environments and HR practices.

There are many theoretical, practical and technological frameworks around the IoT emerging, some expanding the acronym into Internet of People, Things and Services (IoPTS), as a reminder that as well as the 'things' or objects themselves, there are people interacting through them, and services being provided across them (Eloff et al. 2009). Such frameworks can fragment the field to some extent, but where there are common and complementary factors they are useful for guiding inquiry.

This chapter uses three IoT frameworks to guide its SWOT (strengths, weaknesses, opportunities, threats) analysis of the key factors affecting how effectively the IoT and performance management can fit together as part of a 'smart' HR performance management system. Firstly, Eloff and colleagues (2009) propose a three-dimensional model of IoPTS based around configurations of different aspects of *privacy*, *trust* and *security* in any given system. Second, Wilson and colleagues (2015) break down emerging IoT usage into four areas of *security, self-quantification, machine optimization* and *enhanced experiences.* Finally, Miorandi and colleagues (2012) propose four main IoT research areas: *security*; *computing, communication, identification; distributed systems;* and *distributed intelligence.* They also note six critical domains of IoT application: *smart homes/buildings, smart cities, environmental monitoring*, *health-care*, *smart inventory/product management*, and *security and surveillance.*

Following a SWOT analysis guided by these IoPTS and IoT frameworks, the chapter concludes with several implications and issues for future HR research and IoT-supported performance management practice. The aim of the chapter is to argue that the IoT builds on existing strengths and weaknesses of technological and HR systems in organizations, but also extends towards more far-reaching opportunities and threats for HR and performance management along a longer-term horizon of the next few decades.

SWOT Analysis

This chapter has chosen SWOT analysis, over and above other frameworks, to unpack the IoT in relation to HR strategy and competitive advantage, given the tool's exploratory, flexible and balanced nature in representing a current technological trend, as well as its heuristic value for guiding practical risk and value pursuits in organizations. The precise origins of SWOT analysis are not entirely clear, yet it has been around as a structured planning tool for assessing the strategic fit of an organization or other venture with its external environment since around the 1950s, and has remained relatively popular in its usage among managers and consultants ever since (Chermack and Kasshanna 2007). Surveys examining consultants' use of SWOT at large companies have criticized the framework for being too generally descriptive as to verge on being meaningless, for creating excessively long lists of factors, for lacking in prioritization, and for not connecting properly with latter stages of a strategic implementation process (Hill and Westbrook 1997).

However, the use of SWOT in the current chapter is argued to be justified precisely because these criticisms indicate over-simplifications, misconceptions or forms of misuse of the SWOT tool (Chermack and Kasshanna 2007), and even include the seeds of constructive suggestions about how to deploy it more effectively. In that spirit, Weihrich (1982) has argued that SWOT can be applied most fruitfully when factors are clearly prioritized, it is mapped to features of the wider context, used in conjunction with other tools, used repeatedly over time, and the dynamic interrelationships between specific factors in the SWOT quadrants are considered more systematically. Similarly, Chermack and Kasshanna (2007) argue that the effectiveness of SWOT depends on whether it is implemented in an open, unbiased fashion as part of a broader developmental process (not entirely unlike performance management itself).

Clearly these considerations are important, and this chapter will continue to emphasize them in strengthening its own contributions, using SWOT to proceed with its project of identifying major inherent strengths and weaknesses (SW) of IoT and performance management practice internal to organizations, and relating them to opportunities and threats (OT) in broader external environments. In turn, this allows discrete potential actions and points of guidance for HR and managerial decision-makers to be derived.

In sum, SWOT can help to dictate or inform IoT/IoPTS strategy in HR by outlining a holistic set of practices and domains, negative and positive, as well as how practitioners can ensure strengths are ‘matched’ to opportunities, and weaknesses and threats ‘converted’ to strengths and opportunities, respectively (Piercy and Giles 1989). In line with Eloff and colleagues’ (2009) IoPTS framework, the SWOT here seeks to address all three dimensions of security, trust and privacy in relation to HR and performance management. Organizations need to match existing employee data *security* practices to opportunities to improve and convert them away from threats. Organizations should leverage employee trust as a strength where it already exists as a resource, and build it up where it is weaker or lacking. Finally, existing privacy practices may serve as strengths, but could easily become threats if organizations do not anticipate technological change and manage risks and upscale proactively.

For further examples and evidence in support of the value of this approach, SWOT has been applied similarly and insightfully to improving practices such as managing diversity in teams (Jackson, Joshi and Erhardt 2003), change management (Hughes 2010), and the use of virtual reality (VR) technology in rehabilitation and therapy (Rizzo and Kim 2005).

Thus the following sections below correspond to the four quadrants of the SWOT tool, and in each case three major factors are prioritized in relation to IoT and performance management. The SWOT analysis and discussion in the remainder of this chapter can thus help organizations avoid pitfalls when applying the IoT/IoPTS to their HR systems, in terms of understanding the current risks and limitations of IoT trends, and developing the right capabilities and architecture for running IoT systems efficiently and effectively in the delivery of HR services. In particular, it will indicate how current performance management HR practices can be enhanced via greater information processing to aid better quality decision-making, employee and line manager empowerment, and more seamless interconnectivity across teams and distributed, diverse workforces. The SW aspect of the analysis helps to engage the *current* status of IoT/IoPTS and performance management or strategic HR capabilities, whereas the OT aspect helps to trace possible *evolutionary trajectories* of change if HR strategy and IoT/IoPTS innovations become more entwined. In particular, this concerns the expansion of employee monitoring, the interconnectivity of employee performances on a larger scale, and the increased interaction with digital objects and data to coordinate tasks more efficiently and effectively (Eloff et al. 2009).

HR academics and practitioners should therefore be able to use the SWOT survey to make incremental adjustments to existing practices and systems, while proactively preparing for managing future risks and investing in future IoT-related opportunities.

Strengths

The first major strength factor of both IoT and performance management proposed here is that both concepts are embedded within a rich existing knowledge base in terms of their history or legacy, and related trends, applications and paradigms that continue to affect workplaces and HR in ways that speak to organizational performance and effectiveness. If they are considered as entirely new or reduced to existing in a relatively isolated vacuum, then there is a risk that the strength that could be drawn from these existing connections be overlooked. Performance management, for example, can and should be informed by related, long-standing areas of HR, organizational behavior (OB) and psychology literature on goal-setting (Latham and Locke 2007), feedback seeking (Ashford, Blatt and Vande Walle 2003), and conceptions of talent management (Dries 2013). Indeed, as notions of performance and talent have evolved, a more comprehensive view of the wider system becomes important, in terms of understanding and capitalizing upon the interplay between technologies, stakeholders and organizational practices in shaping forces of supply and demand in labour markets (Bersin by Deloitte 2013).

Similarly, the IoT sits nested within a next-generation cluster of closely related technological developments or trends that are likely to mutually reinforce one another's development through their synergies (Dosi 1982), spurring growth and innovation forward until at least 2025 (Pew Research Center 2014). These trends include big data analytics, social media, cloud computing, machine learning, artificial intelligence (AI), biomedical engineering, wearable technologies and VR. The strengths here can be drawn from the past and present as well as by projecting into the future. In terms of wearable technologies, for example, health, safety and productivity aspects of performance have been usefully tracked via armbands, belts, visors, watches and other sensory devices in healthcare, sports, the military and many other industrial and organizational settings going back fifty years or more (Wilson 2013). Thus building on existing devices and equipment is a strong way to keep developing IoT applications. Historically, these developments date back to some of the earliest trends in trying to rationally and normatively improve workforce efficiency and motivation (Barley and Kunda 1992), particularly in terms of Taylorism, scientific management and 'time-and-motion' studies (Kanigel 2005).

The second major strength factor of IoT and performance management concerns the fact that they can act as mutually enabling strategic drivers for one another. As a key HR practice or system, performance management is a significant part of the HR profession's platform for developing its strategic contributions to the performance of the organization as a whole (DeNisi and Smith 2014). While the precise nature of the strategic synergies between technology and HR strategies are still relatively elusive (Marler and Parry 2016), the IoT and related digital, data-driven trends are likely to play a role in strengthening the capacity of HR in at least two ways. First, by helping HR to gather evidence more systematically to better support its decisions (Rousseau and Barends 2011), and second, by more precisely accounting for how employees add value to an organization's balance sheet in conjunction with more fixed, tangible assets (Fulmer and Ployhart 2014). A fairly recent example of this strength in action comes from the work of Alex 'Sandy' Pentland, his Human Dynamics Lab at MIT, and the company he co-founded, Sociometric Solutions (Pentland 2012). By using sensors built into sociometric badges worn by employees, these researchers have been able to track workers' commutes, financiers' trading patterns, call centre employees' coffee break schedules and the conversational dynamics of team meetings to suggest interventions for improving productivity to the tune of millions of dollars in value added (Pentland 2014).

A third and final strength factor inherent to the prospect of IoT technology supporting performance management concerns its renewed emphasis on the socio-technical – the integration of the human and the physical or material in real-time, with an emphasis on managing performance in ways that dovetail with ergonomics and usability (Clegg and Walsh 2004). A performance environment populated by various IoT devices and sensors would more explicitly invite a broader systemic analysis of the hardware, software and 'liveware' (employees, teams, managers) in the workplace, in terms of controlling risks and enabling customized, self-organizing opportunities for learning to occur in local, embodied and networked ways (Carayon 2006; Davis et al. 2014). For example, Italy's biggest grocery cooperative, Coop Italia, worked with Microsoft and other partners to adopt a 'supermarket of the future' IoPTS concept, using motion sensors to offer customers a more seamless, interactive and responsive shopping experience. This also stands to enhance employee performance, enabling employees to gain more rapid, richer insights into customer preferences, and make more efficient, dynamic use of spare shop space (Ray 2016).

To give another example, John Lanchester, the British novelist and journalist, in his account of using the 'Amazon Echo' device in his home, reports being pleasantly surprised by the life-enhancing, user-friendly benefits of the voice-activated technology, also noting how enabling these features could be for those whose sight or mobility are restricted (Lanchester 2017). Often when technology is discussed in HR terms in the workplace, it is reduced to automation, decreased headcount and other cost-savings benefits (Marler 2009). With regards to the IoT, however, responsive devices that can connect more dynamically to the Internet and other objects open up the possibility of more enablers or 'affordances' that interact with human capabilities more directly to enrich them (Want, Schilit and Jenson 2015). This could help challenge views of talent and performance as a competitive 'war' (Beechler and Woodward 2009), and promote more creative, collaborative and inclusive performance management systems that enable diverse users through IoT technologies. Furthermore, IoT devices that communicate with their own anthropomorphic voices can encourage greater engagement through their perceived social presence (Kim 2016), and it is not too hard to imagine how these strengths might dovetail with a performance management system in the form of an IoT-supported 360-degree feedback program, for instance.

Weaknesses

While there are the existing foundational strengths connecting IoT and performance management described above, there are also at the same time, suggestions of weakness in some of these prospects.

First, the IoT and wearable technology has so far really only shown growth in some domains and markets – such as healthcare devices, industrial sensors, and household appliances – and relatively slow or uneven growth and adoption at that (Bradshaw 2017; The Economist 2016). One can argue that the IoT still seems to require something of a technological leap of faith beyond the success of smartphones and tablets, where the dream of living and working in a brave new world of densely inter-connected infrastructure, standardization and measurement may defy fuller expansion and aggregation for some time to come (Bell 2015). However, time will tell whether this stays a weakness of the IoT as an emerging industry yet to develop dominant standards and established competitors (Gustafsson et al. 2016), and for how long – but there are still many unanswered questions, and by most accounts, progress in both households and workplaces has been fairly piecemeal so far (Bell 2015; Pierce 2015). In a similar, albeit less novel way, performance management is also struggling to reach a tipping point in progressing beyond outdated annual appraisals (Heathfield 2007), on the one hand, and brutally disruptive 'forced ranking' performance management that promotes, develops or fires groups of employees based on categorized performance rankings (Pfeffer and Sutton 2006). Amazon, for example, still reportedly uses the latter approach, sometimes termed 'rank and yank', despite reports of its destructive effects on individual employees and organizational performance (Spicer 2015). In sum, the IoT and performance management are unlikely to work strongly in combination until ineffectual elements in their respective marketplaces are eliminated, and more interactive, user-friendly products and practices adopted more widely.

A second weakness concerns the general lack of digital skills and digital literacy among current generations of employees and managers necessary to competently implement and refine IoT-supported performance management systems. For example, a recent survey of 268 HR professionals from across a range of UK organizations found only 15% or less of them reported team expertise in various digital skills, where social media and mobile skill levels were reported slightly higher than others like data, analytics, user experience, and digital learning (Patmore et al. 2017). HR practices like performance management seem to be moving rather slowly along the digital adoption curve, largely due to reasons of inadequate retraining, and slow updating and integrating of legacy systems into improved decision-making and demonstrations of ROI (Patmore et al. 2017). The best computer or data scientists and start-ups are still often described as 'unicorns' to signify their rareness (McNeill 2016; van der Aalst 2016), and in the majority of organizations it's unclear as of yet how such rareness can shape or develop into connected workforces that collaborate more extensively on IoT-related innovations (Puthiyamadam 2017). Beyond HR and tech functions, across diverse managers and employees embedded in an IoT-supported performance management system more broadly, uneven or weak digital skills and access could reinforce inequality-related issues arising from 'digital divides' along various socio-economic and socio-demographic lines (van Dijk and Hacker 2003).

A third and final weakness can be proposed in relation to any shortcomings inherent to the automation of IoT components of a digital ecosystem, particularly as they interact with any human and cultural shortcomings inherent to a performance management system, the two sets of shortcomings being likely to exacerbate one another to some extent. Since the first days of electronic computer terminals in organizations, for instance, there has been a sense that devices and automation present users with something of a confined and self-contained situation that can constrain their cognitive processes (Weick 1985). So-called 'ironies of automation' can present themselves, where human operators are assisted by technology in terms of general improvements in efficient and reliable performance, but face expanded challenges where the technology fails under more abnormal conditions, and the operator is left with the full responsibility of diagnosing and recovering from the problem (Bainbridge 1983). A related concept is that of 'automation surprises', where technology designers' intentions lead to unintended consequences for users, prompting new kinds of error, confusion and questions along the lines of 'what is this technology doing?' and 'why is this happening?' (Sarter, Woods and Billings 1997). Regarding IoT technologies, the media have reported 'everyday grips' with Amazon and Google voice assistants, such as automatically ordering unwanted products, and responding to a child's misheard request by directing him to porn, much to the panic of his parents (Clark, 2016; Waters 2017).

The same weaknesses of automated and data-driven technologies and devices can present in the workplace too, and at a more systemic level when they interact with human and cultural weaknesses of performance management systems. Common mistakes using talent analytics in performance management, for example, include systems biased and exploited to overemphasizing certain metrics, ignoring non-quantitative aspects of performance, and only holding lower-level employees accountable to the technology, not senior management (Davenport, Harris and Shapiro 2010). Examples of this might include Amazon's 'Anytime Feedback Tool', an internal platform which office workers can use to anonymously share praise and critique/blame regarding their peers. The tool has been criticized for being used as a hotbed of political scheming and sabotage that can ultimately lead to employees being unfairly eliminated for reasons unknown to them, and which they are powerless to challenge (Stone 2015). IoT technology can also be used as an appropriate means to inappropriate performance ends in relation to leaders and executives embracing a cult of extreme physical ‘super’ endurance, supported by wearable biometric devices and mind-boosting drugs (The Economist 2015).

Opportunities

The main opportunities for generating value through the IoT and performance management can be understood in part by considering the visions surrounding the IoT, and how they might enhance the way performance management systems are designed and implemented.

First, one key vision is the ‘Industrial Internet’ or Industry 4.0, often associated with General Electric (GE) and their large investments into infusing their logistics, operations, manufacturing and product development processes with digital sensors and analytics that connect tasks and equipment that were previously analog in nature (Iansiti and Lakhani 2014). Although discussions of this vision are often limited to describing it as the next generation of manufacturing, the potential for greater connectivity across tasks and equipment is still fundamentally about devices for measuring performance more accurately, reliably and holistically. In fact, the Industrial Internet vision involves blurring boundaries and integrating manufacturing, IT and service skills more tightly together in how we think about employee and business model performance, rather than employees working in functional silos or outsourcing capabilities separately to other companies and groups (Kleiner and Sviokla 2017). Although the change is discussed from the perspective of the equipment being manufactured, the other side of this development involves considering the employees performing tasks using the digitally connected equipment – and the implications this has for providing them with rapid, personalized feedback on their productivity, error rates, safety, and so on. For example, ABB, the multinational technology corporation outlines an IoPTS case study on its website of ‘Remote Support’ and ‘Remote Condition Monitoring’ services, as applied to an SSAB steel factory in Finland (ABB 2017). By using data from drives inside pumps, motors and industrial components ('things'), ABB and SSAB operations and maintenance planning teams ('people'), were able to improve proactive problem resolution and prevention in disturbances and downtime of key processes ('service' and performance management).

Overall, an Industrial Internet means redefining employee production performance by linking it more closely to the coding and use of digital devices, data streams and platforms to cooperate and innovate in relation to diverse others (Kagermann 2015). One image of this future employee – albeit a fanciful and provocative one – is as a sort of James Bond-type actor, whose performance is managed through the improvisational use of gadgets across a series of challenging projects or missions (Rose 2014).

A second and related opportunity concerning the IoT and employee performance extends and deepens the vision of the Industrial Internet through the possibilities inherent to improved machine learning and Artificial Intelligence (AI) capabilities of IoT devices. If the networked objects of the IoT are able to use algorithms and computational processing of large amounts of information from their environment to learn, adapt and make decisions more autonomously, this 'machine intelligence' can usefully "augment employee performance, automate increasingly complex workloads, and develop "cognitive agents" that simulate both human thinking and engagement" (Briggs and Hodgetts 2017: 35). This mirroring of performing employees by thinking, learning, performing devices could revolutionize performance management by putting humans and machines on a more equal and reciprocal footing in terms of how they mutual enhance and complement one another's performances. Although to many organizations such developments may seem far off, given that technology is improving in its abilities to process language and neural-type connections, it is not too hard to envision AI that coaches and supervises employees, and vice versa (O'Reilly Media 2017). Algorithms and devices are already being deemed effective performers in terms of hiring employees and detecting criminals (Datafloq 2017; Kuncel, Ones and Klieger 2014), where humans may be freed up to work more effectively and complementarily on more socially and emotionally involving tasks (Beck and Libert 2017). In sum, the opportunity is to develop performance management practices that are 'transhumanist' – ones that jointly appraise and develop humans and machines in how they doubly add value, be it through automation, delegation, divisions of labor, or more interdependent forms of assistance, learning, care and improvement (Benedikter and Siepmann 2016; Lorenz et al. 2015).

A third and final vision of opportunity for both IoT and performance management lies in terms of the larger-scale (inter)connectivity that can be achieved, particularly in spatial and geographical terms, to boost performance in aggregate, coordinating and integrating outputs at and across higher levels of analysis. To the extent that the infrastructure and networked physical nature of the IoT is able to grow on a larger scale, there is an opportunity for larger, smarter environments to develop in aggregate, exercising greater capabilities than single devices or subsets of devices. One obvious level in question here is the city, or 'smart city' vision, where the technological solutions of IoT are used to securely manage a city's assets and the quality of life of its citizens and workers (Zanella et al. 2014). In terms of performance management, surveys of talented knowledge workers reveal that a desirable smart city location and community is key for attracting and developing employees that can contribute to a creative economy, second only to salary in job-seekers' priorities (Thite 2011).

Economic geographers and urban planners have long recognized this potential, but urban informatics and the IoT are bringing a digitalized version of the vision more sharply into view. This view acknowledges complexity and the fact that organizations are embedded in wider systems. In acknowledging this, performance management systems can likewise be improved by broadening their notions of performance beyond the internal environment of a single organization. Thus a wider IoT-supported architecture could help provide a useful emphasis on relatively neglected aspects of performance. These might include contributions to solving messy, high-level ‘wicked problems’ such as poverty and terrorism (Waddell 2016), as well as inter-organizational collaboration and boundary-spanning performance behaviors (Calvard 2014; Le Pennec and Raufflet 2016). Employees have always been highly motivated by understanding how their performance has an impact on the bigger picture (Grant 2007), and the IoT can only provide more data and transparency to helping employers and employees appreciate such impact. As well as cities, regional hubs, confederations, clusters and other centers of systemic, networked human and economic activity may well be able to take advantage of similar opportunities too. Organizations and employees have a vested interest in understanding and acting upon IoT-type data generated on issues like parking, traffic, pollution, education, healthcare, crime, weather and utilities, all of which can affect their performance.

Threats

If opportunities can seem distant and idealistic, then the very real threats facing the IoT and performance management capabilities of organizations can equally serve to temper those opportunities with some insightful realism and informed pessimism about potential issues and obstacles to progress.

One threat that could severely delay or prevent the establishment of IoT-supported performance management concerns the sheer complexity of IoT objects (variety, dynamism) and the need to ensure their standardization and compatibility in informing performance standards and policies to some crucial extent. Managing heterogeneous applications, environments and devices has been cited as a major IoT challenge, particularly in establishing interoperability standards and protocols at global or international levels, where consensusbuilding and regulatory planning (e.g. for radio spectrum allocation) can be very slow, involving many stakeholders (Bandyopadhyay and Sen 2011). The reality is that the IoT remains fragmented, with standards still proving elusive across manufacturers, operating systems, and levels of connectivity and programmability. Furthermore, bigger firms remain relatively disinterested, with little immediate incentive to cooperate and surrender competitive advantages unique to their own products and services - in short, the IoT may fail to 'speak a common language' (Newman 2016).

In terms of HR information systems (HRIS) and performance management, interoperability issues of the IoT will add to the typical implementation issues facing managers and employees, of replacing existing legacy systems with new software, customization across components of the organization, and training and support in reinforcing new technological standards (Dery et al. 2013). Thus the adoption and effectiveness of the technologies can be highly uneven across employees in the organization, and at worst they may feel that the system is unfair or counterproductive (Stone, Stone-Romero and Lukaszewski 2003). There is a very real threat that the Internet of Things could expand and amplify the worse aspects of bureaucracy at work – the dehumanizing, absurd, frustrating and coercive webs of inflexible rules – as they are translated across great assemblages of objects and data (Graeber 2015; Stanley 2015).

This feeds into a second threat, which is that employees will resist both the technological changes represented by the IoT, as well as more general changes made to performance management processes. It is arguably no secret that Internet technologies can lead to unhealthy patterns of human addiction and dependence that negatively impact workplace performance (Griffiths 2010). However, heightened awareness and concern over these issues does have the potential to invite more political responses, and even more aggressive 'neo-Luddite' acts of resistance, such as attacks on drones, people wearing Google

Glass products, and taxi drivers rioting against Uber cars and drivers in France (Dillet 2015; Hill 2014). Regardless of how extreme the response in any given situation, employees are likely to be ambivalent in general about the heightened surveillance, monitoring and invasions of privacy represented by IoT performance management at work.

Electronic performance monitoring is a notoriously sensitive issue, and arguably can run counter to popular management rhetoric on employee empowerment, trust, flexibility, and ‘results only’ work environments. Survey evidence, for example, shows employees feel negatively towards being closely monitored or recorded through devices, and even more so if the monitoring is focused on individuals and unpredictable in nature (Jeske and Santuzzi 2015). Clearly a respect for ethical and legal boundaries, as well as social support, are needed to frame monitoring more positively, although other digital developments such as social media continue to create controversial grey areas around performance monitoring in employment relationships (Jeske and Shultz 2015). The fact that a name has been coined for users who exhibit misconduct in relation to Google Glass wearables – ‘Glassholes’ – is very telling. It serves as a reminder of the tensions and strains IoT could put on workplace relationships, as well as the risk that wearables and other objects be used to actually encourage darker forms of counterproductive work behavior that show contempt for privacy and rights (Healey 2015). A broader, critical, Foucauldian perspective on this threat lies in acknowledging that power runs through both human employees and material objects in complex, interactive ways – leading to a ‘government of things’ arranged according to their possible (inter)actions (Lemke 2015).

A third and final threat concerns whether or not the overall cybersecurity and safety of an IoT performance management system can be effectively and sustainably upheld. Security researchers have already demonstrated how easily they can hack into a range of objects, including a 2014 Jeep Cherokee automobile, prompting Fiat Chrysler to recall 1.4 million vehicles. The company had to post out USB drives with patches to block any further attacks on the infotainment systems of the cars and the Sprint network connecting cars and trucks (Greenberg and Zetter 2015). In terms of workplace performance, hacking vulnerabilities through particular IoT-enabled objects could threaten employee and employer trust over sensitive objects and information, enable counterproductive performance behaviors like theft or sabotage, and pose serious risks to safety and control while employees carry out their work.

As Roman, Zhou and Lopez (2013: 2270) note, “the threats that can affect the IoT entities are numerous, such as attacks that target diverse communication channels, physical threats, denial of service, identity fabrication, and others.” Cybersecurity mechanisms therefore need to be correspondingly numerous and strong in their defences against these attacks. Because of the dynamic and distributed nature of the IoT vision, traditional security methods are too static and generic, and more flexible and improvisational countermeasures are needed, ones that take into account changing territories of trust and risk (Sicari et al. 2015). The main areas to attend to are access, authentication and identity management. Quick fixes are unlikely to be possible or sufficient, however – organizations will need to map out their performance management systems by layers, how devices provide access to assets and which devices are vulnerable because of being left unattended or having low computing power. In sum, this means taking a systems approach, considering in a holistic way the types of vulnerabilities, threats, intruders and attacks that might be likely to occur in a given organizational context (Abomhara and Kien 2015). Failure to do so effectively is likely to invite an array of possible IoT abuses and threats, including blackouts, break-ins, lock-outs, thefts and other kinds of confusing and dangerous crisis (Dhanjani 2015).

Regarding performance management, Dhanjani (2015) notes the threat posed from nosy or disgruntled employees, citing the example of the likely involvement of disgruntled

Sony Pictures employees in leaking data (executive emails) in 2014 that was damaging to the company brand and reputation. The complexity is such that employees may be in a position to put colleagues and customers at risk, particularly if they have inside knowledge of IoT and performance systems, but also, depending on their role, they may themselves be vulnerable to 'social engineering attacks' – where threat actors rely on human deception rather than attacking the technology directly (Dhanjani 2015). Performance management architects then may need to look carefully at the design of jobs and roles that involve IoT cybersecurity risks, and perhaps even assess and reward competent cybersecurity policy development and compliance, as well as IoT attack detection and prevention, where appropriate.

Discussion

Having presented the SWOT analysis and each set of factors in turn, this chapter now concludes by offering further implications and recommendations, three for future research on the IoT and performance management, three concerning future practice by HR, managers and employees involved in such systems. Ideally, these recommendations should go some way toward 'joining up' the four areas of the SWOT, providing ways forward in terms of exploiting positive opportunities and converting negative concerns into more neutral and positive forces (Piercy and Giles 1989). Specifically, the specific positive and negative areas surrounding the IoT/IoPTS aid in the crafting of corresponding policy recommendations around how to improve the security, trust, privacy and digitally distributed intelligence of HR's performance management practices and strategies, using research as evidence to inform practice.

Starting with future research on HR practices and IoT applications, one recommendation is to give greater consideration to 'sociomateriality' in theoretically explaining and trying to account for sets of relationships and effects. In short, sociomateriality reflects a commitment to integrate, rather than separate, the technological and the social or organizational (Orlikowski and Scott 2008). This simple but profound scholarly move is given even greater urgency by the development of the IoT, where technological classes of material objects are fused even more richly and intimately with daily lives, relationships and practices. Research on components of the IoT and performance management practices (e.g. coaching, appraisals, leadership development) should therefore not overemphasize either technological determinism or unconstrained social construction at the expense of the other. Such research is likely to be more interdisciplinary in nature, and to yield greater insights into how technological and social relationships are entangled, and dynamically affect one another – understandings which will be important for organizations if they are to understand performance issues around control, accountability and capacity (Boos et al. 2013).

Second, existing research informed by theories of motivation and performance should be tested in emerging research in conjunction with IoT technologies, to see if traditional findings can be replicated with IoT devices and environments, or need to be modified in important ways. Goal-setting theory, for example, is starting to be tested and refined in relation to ‘gamification’ technologies, where performance-related objects and features like leaderboards and simulations are found to have positive motivational effects on task performance (Landers et al. 2015). Building on such research agendas will help ensure that performance management as a set of HR practices remains evidence-based in nature (Rousseau et al. 2011), and that decisions about incorporating IoT systems into the workplace are based on relevant research that both asks and answers the most valuable and well-specified questions.

Third and finally, in ways similar to research driven by sociomateriality, future research on performance management and the IoT may benefit from focusing on transhumanism, in terms of the technological possibilities for boosting human performance by extending, transferring, and improving various resources that go beyond the limits of the current physical and mental capabilities of individual employees. In short, asking how might IoT environments help employees to become ever smarter, fitter and healthier in various contexts? (Bostrom 2005). This may involve seeing off bioethical concerns around inequality and inclusion threatening IoT performance initiatives, on the one hand, where transhumanism is in reality tending towards post-humanism or anti-humanism in how it relates to and values human resources. On the other hand, however, future research might be able to further explore cases where the data and devices of the IoT present opportunities to transform performance in more positive ways (e.g. in sports and medicine). Another case in point concerns the music industry and how the careers and performances of pop stars are now manufactured to some success in highly digital, data-driven terms, going above and beyond the human pop artist themselves to ensure high levels of success (Colburn 2017).

Turning from research to practice, perhaps the first and foremost priority for managers and HR to address is the digital (and statistical/analytical) skills gaps in their workforces. Future work skills, as predicted by panels, tend to prioritize a mixture of cognitive, social and technological capabilities (Davies, Fidler and Gorbis 2011), and so managers and HR may need to think about how these three areas are integrated into their existing training needs analyses and programs to best adapt to trends like the IoT. Coding and programming devices has serious prospects for creating a new generation of blue collar jobs (Thompson 2017), so managers need to consider this in renewing their thinking on skills and roles performed in their organizations, as do HR in terms of recruitment and job design. Extending digital skills training to teams is also a good opportunity to integrate IT and technological functions with operations, HR and other areas of the organization, in order to have more cohesive, value-adding discussions (Twentyman 2016). Furthermore, the physical and material nature of IoT developments may lend itself well to more innovative training across space and objects that invokes design thinking, discovery and experiential learning methodologies, as opposed to more formal, traditional methods in training basic IT operations.

A second area for practice to engage IoT and performance management is to develop shared understandings around classifications of different objects or 'things' in the IoT. For example, some objects may be wearable, other not; some objects may be fixed in a local position, other may be more 'ambient' in their presence and sensory capacities; some may be more adaptive and programmable in their levels of machine learning, others more scripted and limited in functionality, and so on. Dodge and Kitchin (2009), for example, have categorized digital objects along these lines, varying in their permeability, reactivity, and recording capacities. Their most sophisticated class of objects are termed 'logjects', and described as highly interoperable, able to have an 'awareness' of themselves in terms of recording information from their environment for storage and future reuse (Dodge and Kitchin 2009). If managers, HR and employees engage in this classification exercise as a practical change process, it will enable them to develop a common language around IoT-related performance management most relevant to their organizational context, drawing attention to strengths and opportunities, developing clearer strategies about the status and use of such objects in existing task performance situations. The 'endpoints' or direct sensors in the proximal work environment can thus be traced back to functional hubs, and finally to more integrated and enhanced forms of performance management systems and services (e.g. dashboards, talent pipelines) in the cloud (Burkitt 2014).

A third and final area of practice to be focused upon concerns cyber-security and IoT performance management systems that are strong and resilient in terms of avoiding the threat posed by various unwanted, invasive attacks. One way of thinking about this is in terms of trust and fairness in having a system set up in ways that are acceptable to all users. In performance management and appraisals, trust and confidence in the top management and the consistency of the system are intimately related (Mayer and Davis 1999). On the IoT side, the technological reliability, dependability and trustworthiness of various technological layers are no less crucial in shaping employee perceptions of trustworthiness and risk. Thus managers are well-advised to engage in 'trust management' (TM), taking a systematic and transparent approach to showing workforces exactly how data is securely and robustly transmitted and fused across an IoT system according to clear, agreed-upon principles and goals (Yan, Zhang and Vasilakos 2014).

Conclusion

This chapter has presented a SWOT analysis outlining key factors with the potential to positively and negatively influence the success of an IoT-supported performance management system, also drawing implications for future research and practice at the junction of the two topics of the IoT and performance management. Almost no theory or research to date has explicitly linked the IoT as a technological trend with specific HR practices and strategies. Hopefully, as IoT products and services proliferate in households and industries, similar discussions on how to integrate them with various HR practices and workforce settings affecting employees will continue to be debated, explored and refined.

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