Business Models in the Digital Age: The Internet of Things

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CHAPTER 4

BUSINESS MODEL INNOVATION IN THE DIGITAL AGE: THE INTERNET OF THINGS

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Introduction

We are living in what is commonly referred to as the "digital age," which is distinguished by an overlapping ecosystem of digital technologies – each one building on those before and catalysing those to come. This process often referred to as 'digital transformation (DT),' is not only changing nearly every aspect of our personal and communal lives, but also the dynamics of companies and organisations of every size, and in every industrial sector. It is requiring them to realign their products, services, processes, and business models to the conditions of an increasingly digital world (Kreutzer et al., 2017, p. 1). It is also rewriting the rules of customer engagement, competition, data utility, innovation, and value. If companies do not find an appropriate response to these changes, they run the risk of going out of business. Consequently, responding to them requires more than a piecemeal approach; it calls for a total integrated effort – a process of holistic DT within companies, other types of organisations, and whole economies more generally. A key element in this DT will be a company's ability to adapt its business models (BM) to take advantage of and meet the challenges these technologies create. History has demonstrated that many prominent firms that have previously been known for their innovative products, suddenly lose their competitive advantage due to a combination of blinkered mindsets, inflexibility to adapt, or an inability to recognise the threats that new technologies or start-ups pose to their existing BM(s). Strong players such as AEG, Blockbuster, Grundig, Nixdorf Computers, Triumph, Brockhaus, Agfa, Kodak, Quelle, Otto, and Schlecker are vanishing from the business landscape one after the other due to their failure to adapt their BMs and strategies to the changing environment before it was too late (Gassmann et al., 2014).

Peter Drucker, often considered the father of modern management, observes that: *"Today's competition between enterprises is not the competition between products, but the competition between business*

models." Building upon this idea Matt Atkinson Chief Marketing Officer at Tesco PLC provides a succinct and insightful overview of the modern economy and organisational landscape in the Foreword of the academic book "The 10 Principles of Open Business: Building Success in Today's Economy" (Cushman & Burke, 2016). Atkinson reflects, "*The world is in a state of transition, where technology, customers and economics are driving change* (no longer products and the producing company)*. At the centre of which is the ongoing demand from customers, for transparency and collaboration. The connected nature of these technologies, and the shift in these technologies are creating new businesses, and new business strategies and models. It is essential that businesses are reactive to these changes and adopts appropriate tactics.*" Subsequently, the "BM" concept has become extremely influential over the past 20 years.

A BM can generally be defined as a unit of analysis to describe how a company works. More specifically, the BM is often depicted as an overarching concept that takes notice of the different components a business is constituted of and puts them together as a whole (Osterwalder & Pigneur, 2010). This concept has been more prevalent in the communication of businesspeople and in the business press than in the management research literature, but the latter literature has witnessed a significant increase in interest over the past decade. Likewise, business model innovation (BMI) has been increasingly promoted as a necessary reaction to strategic discontinuities and disruptions, and is shifting bases of competition, increasing the importance placed on innovation and knowledge as value-creating attributes, and is leading to the emergence of new forms of competition through the development of new BMs based on DT. Added to this mix the digitisation of society and the economy, founded on technologies such as the Internet of Things (IoT); is transforming the value propositions and BMs of companies, organisations, and vendors, by enabling them to adapt existing or introduce new BM constructs that allow them to remain relevant and derive value for all of their stakeholders. For example, "servitization**"** models that involve companies developing digital capabilities to provide services and solutions to their customers, which supplement their traditional product offerings, are becoming increasingly popular. This type of BM creates new revenue streams by allowing the manufacturers and service providers to monetise the data they collect as part of the process and enhance existing offerings with new service level agreements (SLA).

These attractive new opportunities are resulting in true organisational and cultural transformation as much as a technological advancement. This demands what Kranz (2017) refers to as an "architectural approach to IoT deployment," which follows standard deployment patterns and the making of small modifications based on a situation and the specifics of the problem being addressed. The evolution of

business perspectives of the IoT can be seen to be driven by two underlying trends: i) the change of focus from viewing the IoT primarily as a technology platform to viewing it as a business ecosystem/network; and ii) the shift from focusing on the BM of a company to designing ecosystem/network BMs (Leminen et al. 2012). Adopting an ecosystem/network approach enables companies to break down internal and external silos and requires a more a holistic view of the enterprise. In this context, companies are required to look at BMs beyond a firm-centric lens and respond to changing business dynamics as part of an ecosystem/network of partner stakeholders e.g. other companies, Government agencies and customers. In other word's an agile and integrated approach to BMI is essential for companies to survive and excel in the digital age. This is critical in the case of so-called 'Digital' or 'IoT' entrepreneurs whose ventures and transformation of existing businesses through the creation of novel digital technologies and/or novel usage of such technologies; and are considered by many countries as a critical pillar for DT and resulting digital economic development. This idea is explored in more detail in the remainder of this chapter.

Digital Transformation

DT of industries and society is a key element for growth, entrepreneurship, job creation, and welfare. DT enables speeding up the development of innovative responses not only to local economic and societal challenges, but for reaching sustainable development goals (Business Finland, 2018). Despite the apparent promise and significance of DT, there is not a commonly accepted definition for the term. Moreover, the terms digitalisation and digitisation are often used interchangeably leading to some confusion. Schallmo et al. (2018) propose a comprehensive definition of digital research based on previous research on the subject relevant to our focus, which is as follows:

"The DT framework includes the networking of actors such as businesses and customers across all value-added chain segments, and the application of new technologies. As such, DT requires skills that involve the extraction and exchange of data as well as the analysis and conversion of that data into actionable information. This information should be used to calculate and evaluate options, in order to enable decisions and/or initiate activities. In order to increase the performance and reach of a company, DT involves companies, business models, processes, relationships, products, etc."

In short, DT describes the use of digital technologies (such as ubiquitous broadband, cloud storage, mobile technologies, data analytics, machine learning/ artificial intelligence, and emerging production technologies such as additive manufacturing) and the data they produce to connect companies/

organisations, people, physical assets, and processes to generate better business outcomes, including capitalising on customer needs, realising efficiencies and productivity growth, improving the effectiveness of decision making across the company/organisation, and enabling new BMs (Hao et al., 2020). DT is thus distinct from digitisation, which refers to adding digital elements to existing processes, BMs, and strategies. In this sense, DT affects all sectors of society, particularly economies. It opens new networking possibilities and enables cooperation between different actors, who, for example, exchange data and thus initiate processes. In this context, the DT of BMs plays an essential role because BM's individual elements can be digitally transformed.

While DT offers the potential for new, innovative BMs, companies that are exploring DT may find that their previously used technologies still yield better cost benefit ratios than new, yet expensive, technologies that remain untested in the market (Arnold et al., 2020). For these reasons, companies that face relentless changes in the technological environment need to balance their decisions between an orientation towards the present and one towards the future. For this, companies rely upon their absorptive capacity - the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends - before designing their innovation strategy and eventually innovating their BM (Müller et al., 2020). To address these issues, we focus on one of the DT 'base technologies' – those that support and provide connectivity and intelligence for smart systems in an integrated way (Frank et al., 2019) - the IoT. We choose this emphasis due to the DT's reliance on the creation of networks and interconnectivity among existing assets enabled by the IoT (Frank et al., 2019), and the significant influence IoT is forecast to have on the nature of future dynamics of companies and their offerings (Atzori et al., 2010).

BMI in the context of The Internet of Things (IoT)

The IoT

The term "IoT'' – also called the Internet of Everything or the Industrial Internet – is a relatively new and potentially disruptive computer paradigm that is likely to change business processes, strategies, and competencies across many industries (Lee & Lee, 2015). From a technological perspective, IoT is used as an umbrella keyword covering various aspects related to the extension of the Internet and the Web into the physical realm, by means of the widespread deployment of spatially distributed devices with embedded identification, sensing and/or actuation capabilities (Miorandi et al., 2012). More specifically, it is: "A technological paradigm in which devices, machines, and humans interconnect with each other in

order to create data-based services to support day-to-day living" i.e. smart homes, human activity monitoring (Lee & Lee 2015). In this context:

- **"The things"** refer to tags, sensors, and smartphones, etc., which are applied to collect measurement data from and share processes information to end-user locations.
- **Wireless sensor networks and radio-frequency identification** are the technical tools used to transmit the data from one point to another.
- **Applications** are the tools through which a user can access and manipulate the gathered data.

Value is subsequently realised by complementing smart, networked assets with contemporary technologies including scalable computing, information analytics, and mobility; and presenting it in a way that is useful to a user (Frank et al., 2019). In this sense, IoT envisions a future in which digital and physical entities can be linked, utilising appropriate information and communication technologies, to enable a whole new class of applications and services (Miorandi et al., 2012). This is achieved through (i) the resulting global network interconnecting smart objects using extended internet technologies, (ii) the set of supporting technologies necessary to realise such a vision (including, e.g., RFIDs, sensor/actuators, machine-to-machine communication devices, etc.) and (iii) the ensemble of applications and services leveraging such technologies to open new business and market opportunities (Atzori et al 2010). Affordable sensors and fast connections have radically increased the amount and type of data available and altered the way companies collect and use it. More importantly, they have changed the way many companies conduct their business, and are challenging some of the oldest brands to rethink their identities (Schimek, 2016).

Consequently, IoT is an important enabling technology, which is being increasingly implemented by companies and organisations of all sizes and represents one of the top strategic technology trends to shape future business opportunities. From a business perspective, companies can use IoT to connect products and devices, which allows them to tap new areas of business and to offer their customers entirely new product and services. Additionally, direct lines of communication with customers provide realistic insights into how they use connected products and services and allow companies to tailor their offerings accordingly based on accurate, descriptive, and real-time data. Companies will enjoy a clear competitive advantage if they realise it is imperative to connect their products and devices through IoT in an integrative way, but those who only focus on the technological aspects of an IoT project have already lost

the race. Additionally, companies who devote their full attention to customer benefits are the most likely to enjoy long-term success. It is therefore essential to identify and innovate promising BMs and supporting tactics before embarking on an IoT project. Such models should establish and maintain long-term relations with business ecosystem/network partners and customers, by offering them new digital experiences and added value. Examples of this include new or improved services, higher efficiency, or better quality (Bosch Software Innovations, 2017). Before examining the impact of IoT on BMs and BMI it is important to establish what is meant by these terms.

The Business Model (BM)

A BM refers to the logic through which companies design the architecture and mechanisms they use to create, deliver and capture value for their stakeholders through their activities (Foss & Saebi, 2016; Jørgensen et al., 2018; Osterwalder & Pigneur, 2010; Reim et al., 2014; Teece, 2010). More specifically, the BM concept takes notice of the different functions a company is constituted of and puts them together as a whole (Osterwalder & Pigneur, 2010). These functions typically include a value proposition, target market(s), value chain, revenue mechanisms, value network or ecosystem, and competitive strategy (Chesbrough, 2007). Accordingly, each company is implicitly based on a BM, even though it is not always explicitly presented. A BM can add to the competitiveness of a company by offering a logical and consistent approach to the (innovative) design and execution of the business. In other words, a BM describes how the magic of a company works based on its individual bits and pieces.

Business Model Innovation (BMI)

In the past 50 years, the average BMs lifespan has fallen from about 15 years to less than five. As a result, BMI is now an essential capability for companies seeking to drive breakout growth, reinvigorate a lagging core, or defend against industry disruption or decline. The BM is therefore gaining in importance as a starting point for BMI and transformation. BMI describes a holistic approach to new BM design or existing BM reconfiguration, which sees a deliberate change of one or more key element of a BM and its respective interrelations. This normally leads to a qualitatively new BM, which differs distinctively from the previous one. The resulting BM can range from an incremental improvement to a radical new way of doing business (Bucherer & Uckelmann, 2011).

In this sense, BMI is the art of enhancing advantage and value creation by making simultaneous—and mutually supportive—changes both to a company value proposition to its customers and its underlying

operating model. BMI is important to companies as it usually has a stronger impact on profit margins than product and service innovations and it can disrupt established industries. BMI can, therefore, be viewed as an attempt to develop or identify new BM strategies by "searching for new logics of the company and new ways to create and capture value for its stakeholders. It focuses primarily on finding new ways to generate revenues and define value propositions for customers, suppliers, and partners (Foss & Saebi, 2015, pp. 169)."

BMI in the Digital Age: An IoT perspective

As has been described, BMI acts as a means of enhancing advantage and value creation by enabling better informed, simultaneous, and mutually supportive changes, both to company's' value proposition to customers and its underlying operating model. At the value proposition level, these changes can address a company's choice on target market segment(s), its product and/or service offering(s), and revenue model(s) (Deimler & Kachaner, 2020). As companies become increasingly reliant on digital technologies in all their activities, BMI should also serve as means to align technology development and economic value creation and ensure they remain competitive in times of rapid change fuelled by technological innovations, including IoT. Porter and Heppelmann (2014, 2015) underline the importance of this approach by maintaining that connectivity offered by up-to-date technologies, including IoT, are driving the development of new products and processes, and new BMs, with strong implications on the organisation of the company. Companies must leverage the possibility of "servitizing" their businesses through difficult-to-imitate services, differentiating themselves not only from competitors, but also downstream players that are empowered by the digitalisation process (Vendrell-Herrero et al. 2017). Despite this, IoT has often been portrayed primarily as a technical-implementation challenge, with the drive for adoption spearheaded by specialists in the Chief Information Officer (CIO) function. Yet real business gains from IoT require changes to business processes. Connecting production equipment to the internet, for example, will allow a company to manage its usage more effectively and predict when maintenance is needed. However, if the supporting BMs are not appropriately innovated and optimised, then the value will not be maximised and at worst not realised at all. It is, therefore, important for companies to understand the impact IoT is having and will have on their BM and subsequent BMI (Kraijak & Tuwanut, 2015).

The overarching principle of an IoT BM is to focus on customer needs and capture and deliver value through the exploitation of its pervasive nature, and the rapid improvement of IoT-enabled technologies

that allow different innovative activities and differentiated customer offerings (Atzori et al., 2010; Lu et al., 2018). As previously mentioned, the real upheaval IoT will create is through its ability to enable companies to evolve from product producers to service providers, a process commonly referred to as servitization. These services are typically supplied to customers through customised Product-Service System (PSS), which are described as a marketable set of products and services capable of jointly fulfilling a user's needs (Mont, 2002). Most PSS offerings are categorised into three BM types: product-oriented (PO), use-oriented (UO), and result-oriented (RO) BMs, as these continue to be the most prevalent types of product/service BMs (Reim et al., 2015; Rosa et al., 2019; Tukker, 2004). Whilst these models have been around for several decades, IoT can enhance them through its ability to pool resources into systems in real-time, that include multiple linked systems, meaning that there are endless ways to use the information and to innovate IoT BMs, which can create, deliver and capture value in different ways (Leminen et al., 2012). For example, for a tool manufacturing company that intends to make a PO offering (e.g., tool optimisation software), activities that surround creating, delivering, and capturing value will continue to be linked primarily to products but with an added service function. In contrast, using a RO model (e.g., total care solution) the PSS provider takes full responsibility for providing the promised results by intimately combining products and services. The transition of traditional pure products BMs to IoT PSS-based forms allows for the creation of value through services in different parts of the system (Osako et al., 2019). However, the selection of the BM depends to a large extent on the company's resources, capabilities, and user needs (Leminen et al., 2012), which can ultimately create strategic and competitive benefits for companies adopting these forms of BMI (Frank et al., 2019; Tukker, 2015, 2004).

IoT BMI implications for entrepreneurship

A change can be observed within the entrepreneurial landscape where entrepreneurs are increasingly transitioning from an internet context to an IoT context, with the use of many IoT systems and technologies (Atzori et al., 2010). From an IoT perspective, the term 'entrepreneur' can be applied in a broad sense. First, it includes private entrepreneurs who establish new ventures related to the IoT. Second, the term includes business leaders of existing private and public organisations who engage in innovation and experimentation with different elements of IoT to improve existing business processes or offer new value propositions to customers (Krotov, 2017). Currently, many countries consider the advancement of IoT and digital entrepreneurship as an essential pillar for future economic development. The IoT is therefore moving from a technology of the future to a present must have tool, which creates

significant commercial opportunities accessible to any type of company no matter its size, age, or access to finance. The transition towards IoT entrepreneurship is therefore of critical importance.

The rapid proliferation of digital technologies enabled by the IoT is profoundly changing operating environments, reshaping traditional business models and processes (Bharadwaj *et al.*, 2012). These technologies are also giving rise to new ways of collaboration, leveraging resources, and reshaping the mentality of entrepreneurs, and hence affect their decision-making processes (Shen et al., 2018). This is resulting in BMI driven by factors, such as new and potential streams of revenue generation, competitive edge, satisfying customer demand, and customer stickiness. To achieve these objectives, entrepreneurs - besides companies of all sizes and maturity levels - are developing BMs that hinge on new relationships with customers and a host of other stakeholders. These BMs expand from the transactional (product sale and, in many cases, after-market parts and service) to those that offer IoT generated data, and the services, insights, and solutions that can be derived from that data (PWC, 2017). In this context, the overarching principle of an IoT BM is to focus on the customer, the capture and delivery of value through the exploitation of the IoT's pervasive nature and the rapid improvement of IoT-enabled technologies to facilitate different innovative activities and differentiated customer offerings and applications (Atzori et al., 2010; Lu et al., 2018). IoT offerings and applications are also increasingly built upon an integrated cloud/internet-based platform (Gubbi *et al.*, 2013), which can provide seamless integration of physical devices, data storage and data analytics to various IoT applications. These integrated systems can allow for such capabilities as virtualisation (also called platform as a service or PaaS) of computing resources and delivering end-user IoT applications in software as a service (SaaS) manner (Krotov, 2017). These IoT offerings and applications typically fall within two BM strategy categories:

(1) Bottom-up or sustaining BM strategies - whereby entrepreneurship strategies use IoT to enhance existing products or services. This requires analysing the properties of existing BM's and devising new ways for improving existing processes or transactions; or
(2) Visionary or disruptive BM strategies – whereby entrepreneurs create a new BM based on the vision of a world in which every object is part of a global, ubiquitous network. Requiring them to question themselves, 'if this vision becomes a reality, what kind of new transactions or business models will be possible?'

In both scenario's, IoT is predominantly viewed as a collection of human and nonhuman objects embedded within a physical environment, connected via a ubiquitous, wireless network (Krotov, 2017). This has resulted in the emergence of three prevalent IoT/digital BMI types: (1) Product-orientated; (2) Use-orientated; and (3) Results-orientated (Table 1) (Reim et al., 2015).

	Product-orientated	Use-orientated	Result-orientated
Value creation	Provider takes responsibility for the contracted services	Provider is responsible for the usability of the product or service.	Provider is responsible for delivering results.
Value delivery	Provider sells and services the product sale and service (e.g. maintenance or recycling).	Provider assures the usability of the physical product along with service.	Provider is responsible for delivering results.
Value capturing	Customer pays for physical product and for the performed services.	Customer can make continuous payments over time (e.g., leasing).	Customer payments are based on outcome units; that is, they pay for the result.

Table 1. Comparison of IoT orientated BM categories in terms of value creation, value delivery and value capturing (Reim et al., 2015).

The real upheaval that the IoT will create is through its ability to enable entrepreneurial businesses to evolve from 'product' producers to 'service' providers - 'servitization,' which create a new set of rules that entrepreneurs, particularly internet-entrepreneurs should be aware of (Yu *et al.*, 2017). By collecting and analysing large amounts of unique data from all their customers using IoT-enabled technologies, entrepreneurs can offer additional service-oriented BMs that foster continuous innovation, improved design and quality and customised goods, rather than the production of large volumes of standardised products. This is done using adaptable open and online platform systems, which allow system members to access resources and capabilities from a network of partners and/or platform systems. Enabling them to develop a diverse range of customer focused IoT service solutions (Westerlund et al., 2014), which has previously been mainly within the domain of large companies equipped with abundant resources and capabilities to overcome previous technology development issues independently.

Table 2 provides an overview of some of the types of IoT BMs, which companies are designing or have developed, to best align IoT in a way that best supports their overall business strategy and customer base. It also provides examples of potential monetisation streams of these models. For entrepreneurs, this move towards more customer-focused and service-orientated BMIs is imperative for their business, as it

can generate positive word-of-mouth about their company amongst existing and potential customers. Subsequently, creating more opportunities to expand more quickly, and in some cases, generate more innovation for the entrepreneur(s). This innovation stems from acquiring new knowledge from varying IoT channels, such as those arising from interaction via social media, which can be a unique source of competitive advantage. This can enable them to effectively implement and develop their IoT BMI as part of an ongoing process.

Business Model Type	Description	Potential Monetisation
Product performance monitoring	Customer accesses data from connected asset independently for real-time, periodic "check-ups" on an asset's performance and efficiency of use and signals for predictive maintenance.	Charge a separate premium for apps or web-based tools, cybersecurity, data storage, software updates, or charge an upfront premium for the IoT-enabled asset at the point of sale.
Data analysis/diagnostics from manufacturer	Manufacturer (or third-party vendor) provides predictive maintenance alerts and prescriptive insights, including push alerts on service/ maintenance, security alerts, and software upgrades. Manufacturer owns and remotely manages the data.	Charge, on a subscription basis, for some, or a complete suite of these products and services. Alternatively, can charge on an outcome basis (e.g., improvements in asset uptime or unplanned downtime) and can include bonus incentive or a penalty, based on the outcome. Or, a hybrid of the two.
IoT-driven field services	Manufacturer extends service by offering enterprise-wide solutions, leveraging an asset's product performance data and analysis via alerts to the customer of needed actions/insights (e.g., identifying the part required to prevent a malfunction, identifying the most qualified field technician, or determining a software update to address an issue, manufacturer owns and remotely manages data.	Charge, a subscription basis, or a complete suite of, IoT products and services. Alternatively, can charge on an outcome basis (e.g., improvements in asset uptime or unplanned downtime) and can include bonus incentive or a penalty, based on the outcome. Or, a hybrid of the two.
"The Pay-Per" model	Just as some manufacturers are already charging on an asset usage basis, or on the service that an asset is providing (e.g., Asset Pay-Per), IoT enabled products also lend themselves to similar "pay-per" offerings, including pay-per hour of output, pay-per-alert, pay-per-insight, pay-per-warning, and pay-per-	Manufacturer charges only when a customer uses products, and only when it receives insight or warnings on performance, maintenance, or insights on gaining efficiencies such as power consumption.

	solution, which can be described as IoT Software Pay-Per. Manufacturer owns and remotely manages data.	

Table 2. Overview of common IoT Business Models (adapted from: PWC, 2017)

Several 'second-order' BM value propositions can also be developed, which support the current IoT infrastructure. These are defined second order as they are not immediately related to what appears to be the essence of IoT- the interaction between human and non-human objects and their environments. Instead, these BMs support elements of IoT. A prime example of this is the promising area of creating new business propositions from the 'big data' generated by the devices and sensors that make up IoT (Krotov, 2017).

Whilst, this movement towards IoT BMI, particularly 'servitization' orientated BMs is opening a wealth of new opportunities for entrepreneurs, there are also several concerns they should be aware of. For example, it is increasingly critical for entrepreneurs operating in an IoT environment to monitor more systematically, both the interaction with customers and the sharing of information amongst customers (Yu *et al.*, 2017). Privacy and security, and overreliance on IoT technologies in making business decisions; are also critical issues. The entrepreneur's active participation therefore remains an essential element in final the decision making on IoT BMI changes. Critically, entrepreneurs who have either just launched, or are preparing to launch, their own business must realise the potential IoT has for their solution(s), how that solution(s) is packaged and fits within existing IoT ecosystems, and is subsequently taken to market. Entrepreneurs, therefore, need a strong business case from the outset – for an IoT solution based on actually required business outcomes (for example, compliance), not just an application – with a proof of concept that is unfaltering in its ability to demonstrate value, consider cost, and prove Return-on-Investment.

Despite the early promise of IoT BM implementations and an increasing number of entrepreneurs using IoT-enabled technologies to pursue new business opportunities, there continue to be substantial discrepancies in how advanced different economic sectors are in integrating it into their BMs. For example, significant traction has been made in the logistics, transportation, and smart cities but remains in the early stages of integration in healthcare and agriculture. Research also suggests, fewer than one in ten companies has achieved "extensive" IoT implementation, for both external and internal operations

(Westerlund et al., 2014). According to a 2017 PWC survey on the monetisation of the Industrial Internet of Things, it was found that about half of the manufacturers (47%) currently offering IoT products and services are selling customer-managed IoT platforms (i.e., selling a bundling of product and IoT service, related data gathering and analysis technology and software). Yet 30% of manufacturers have gone beyond that, selling IoT product-as-a-service offerings (e.g., the manufacturer remotely captures customer IoT data and sells data analytics and services, including alerts on performance and maintenance needs). Just 4% of manufacturers are selling fully integrated multi-sourced IoT platforms. Wide-scale adoption of IoT can also be particularly challenging for incumbent companies, who are often concerned with the threat of tech-start-up firms who have no legacy systems/cultures.

The choice of IoT BM can be a complex process for entrepreneurs, particularly as many of them are at an early stage of their DT and IoT journey. As in other technology markets, such as personal computers and the Internet itself, there can be three evolutionary phases:

1. "Arms suppliers" succeed by providing the building blocks of the infrastructure.
2. Companies build broadly scaled applications, such as online searches on the Internet.
3. Companies build adjacent businesses, such as e-commerce on the Web (Manyika *et al.*, 2015).

At the current stage in the evolution of the IoT industry, the complexity of IoT systems, the limited capabilities of many customers to implement them, and the need for interoperability and customisation provide opportunities for hardware, software, and service providers of "end-to-end" IoT solutions to meet specific needs. For IoT technology suppliers, the base of the competition will likely include distinctive technology, distinctive data, software platforms, and the ability to provide complete solutions (ibid).

Looking forward it will be increasingly important for entrepreneurs to integrate the capabilities IoT offers into their user/consumer offerings and supporting online channels and communities. At the same time, they will need to define their digital vision and translate it into a set of clear targets and performance indicators that create accountability and serve as guideposts for progress (Sousa & Rocha, 2019). Key issues that result from this include, (1) the need to ensure the exchange of win-win data between IoT-enabled technologies and ecosystem/network members. (2) Effective integration and management of a diverse range of relatively immature objects/innovations across internal and external boundaries, and (3) becoming more comfortable working within and as part of unstructured ecosystems/networks. This

requires a movement away from the dominant company-centric view of conceiving BM(s), wherein the BM is the undivided "property of the firm." To more generic level descriptions of BMs that are supportive in capturing the specific value from IoT for ecosystems/networks.

Conclusion

Digital transformation and the IoT is an Unavoidable Fact of Life and is rapidly emerging as a significant business transformation driver that can disrupt competitors, both known and unknown. Entrepreneurs play a critical role in the development of the IoT (or any other technology). Driven by their desire for self-gain, self-actualization, or contribution to their communities, these entrepreneurs use their technical knowledge, business experience, and intuition to create new BMs in the realm of the IoT. Bringing these business ideas to fruition often requires addressing existing technical, managerial, and legal issues by developing new technologies, new business processes, and connecting the dots to IoT in numerous other ways. Entrepreneurs collectively set various vectors for further development of the IoT (Krotov, 2017). DT and IoT require entrepreneurs from across all industrial sectors to rethink their businesses from the ground up. Although this will not happen overnight, companies need to start contemplating and envisioning the possibilities now. IoT is a learning experience, and not all ideas will work. Not every new BM or go-to-market strategy will prove to be a winner or disruptive force, but some will. Additionally, these changes will not be a one-time occurrence and will require constant alterations as business, operations, and customers demand evolve in rapidly developing business environments. IoT is already and will further change competition dynamics, drive BMI and lead to new BM types for user and supplier companies.

A good starting point on this journey would be to review how similar change issues were handled in the past and apply and adapt the lessons learned. An awareness and thoughtfulness to how many new variables an entrepreneur, established company, or organisation is planning to introduce in an IoT BM and stage its integration carefully. A business justification for integrating IoT solutions into a BM also needs to be developed. If this cannot be identified immediately, an entrepreneur should continue to learn, experiment, and benchmark their results against those of their peers'. At some point, they should identify a compelling ROI for their first IoT project and start their journey. Other key takeaways are:

- Entrepreneurs – as well as all types of organisation - should start their IoT journey by “thinking big but starting small.” This means that you need to be realistic about implementing IoT BM solutions and

taking a stepped approach i.e. IoT should not be implemented in one go. Start by targeting low-risk projects that have clear business benefits, then become increasingly more ambitious as expertise and support grow. This approach is likely to have a better success rate and bring more stakeholders on-board.

- Interactivity and engagement between entrepreneurs, companies, and/or types of organisation and the customer is the key to successful IoT-driven BMI.
- Cooperation and working in partnership with other companies, organisations, and the end-customer – the so-called "co-economy"; who have complementary products, services, processes, etc., is essential to succeeding with the IoT and in the digital economy. Doing it alone, no matter a company's size or resources is unlikely to lead to success with IoT. Companies and organisations must start assembling ecosystems/networks of partners from inside and outside the company and make sure they can work together well.
- The challenge of legacy integration must not be underestimated.
- Companies must resist the temptation to develop custom solutions, but instead insist upon open platforms that can be adopted by the industry and networks they operate in, and flexible enough to allow entry into new markets at a rapid pace.
- Communication along all channels of a business ecosystem/network is critical for IoT and BMI success. As well as taking advantage of the power of established relationships to instigate the adoption of IoT throughout these ecosystems/networks.

This can all appear a daunting and overwhelming challenge. However, there are numerous reasons for entrepreneurs embracing DT and IoT including, (i) strategic advantages gained through reinventing their business through BMI, (ii) attracting and retaining the best and brightest employees, and (iii) innovative go-to-market strategies to attract and retain customers. Finally, new, or reengineered BMs, leveraging digital technologies can create new business and revenue opportunities, unachievable in the past and open new doors to business growth.

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