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Exploring the Digital Transformation Based on Big Data with Ubiquitous Internet of Everything

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Abstract: Digital technologies present both game-changing opportunities for and existential threats to companies. Digital services in consumer-facing organizations offer novelty value propositions, closer consumer relationships and higher automation of consumer-facing processes. Facing big digital data streams generated by ubiquitous Internet of Everything(IoE) and savvy customers with mobile computing and social media, this paper focuses on digital transformation journeys seeking digital capabilities and digital leadership to upgrade organizational performance, one is discovering big data value, the other is dual methods with agile. The finding provides practical implications that can help guide practitioners in digital transformation.

Keywords: Internet of Everything(IoE), big data, analytics capabilities

1. INTRODUCTION

In a new era of low-cost, small electronic devices with sensing, communications and computing capabilities, commonly known as the "Internet of Things" (IoT), integrate connected devices and people into the Internet of Everything(IoE), make it possible to explore big data analytics opportunities for leveraging wearables in organizations. In particular, the Digital Data Streams(DDSs) generated by the widespread adoption of IoT devices will create opportunities to transform the business competitive landscape in many industries.

Facing considerable challenges, organizations with long-established processes and legacy systems should combine information from diverse sources(e.g. IoT and IoE) and develop new digital capabilities to derive value, such as successfully introducing Big Data Analytics(BDA) capabilities to create knowledge, make better predictions and tailor services, namely digital transformation. The key is to shift the focus from technology to business values. As a result, transforming to fully digital services requires an organization to acquire specific capabilities, listed as Table 1 and Table 2 in the perspective of Chief Digital Officers(CDOs).

Table 1. Digitalization capabilities^[1]

Connect capabilities	Intelligence capabilities	Analytic capabilities
IoT(e.g. 5G, RFID, Bluetooth, GPS, WSN, PI)	Cloud computing	BDA
	Embedded system	CPS(Cyber-Physical Systems, e.g. digital twin)
	Smart sensors as an actuator	AI technology
	Edge computing	AR(Augmented Reality)

Table 2. Digital capabilities in the perspective of CDOs

Digital capabilities	CDOs type ^[2]	The role of CDOs ^[3]
Digital innovation	Digital accelerators	Collaboration direction (inwards vs. outwards)
Data analytics	Digital marketers	Data space (traditional data vs. big data)
Customer engagement	Digital harmonizers	Value impact (service vs. strategy)

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Weak digital capabilities may limit the effectiveness of managerial improvisation, as many organizational structures and culture. To move into the digital age, a globally operating company needs to have in place a value-adding operational backbone, but many of them struggle with achieving this and the associated transformation program. Consequently, business digitalization requires substantial organizational transformation and new organizational structures and business processes. To address unexpected events rapidly and creatively, organizations increasingly are required to rely on their ability for managerial improvisation. A literature-based framework of MIS Quarterly Executive within five years, this study makes a theoretical perspective to digital transformation research that explains how organizations transition with ubiquitous IoE and in the big data era. And for enhancing enterprise capabilities for digital leadership, the finding provides further practical implications that will guide practitioners in digital transformation.

2. DIGITAL DATA STREAM(DDS) DRIVEN BY BIG DATA

Digital transformation has been defined as the use of new digital technologies, such as mobile, artificial intelligence(AI), cloud, blockchain, and IoT technologies, to enable major business improvements to augment customer experience, streamline operations, or create new business models. The key long-term technological trends are the increasing capability of the firm with customers to communicate, collect, store and analyze information. IT-driven smart Product-Service Systems (smart PSS) evolution and implementation as Figure 1. With digital sensing ability(digital scouting, digital scenario planning, digital mindset crafting) to realize digital seizing(such as rapid prototyping, balancing digital portfolios, strategic agility), then take advantage of internal enablers(cross-functional teams, fast decision-making, and executive support by example) and overcome internal barriers(rigid strategic planning, change resistances and high level of hierarchy for instances), finally achieve digital transforming(such as navigating innovation ecosystems, redesigning internal structures and improving digital maturity).

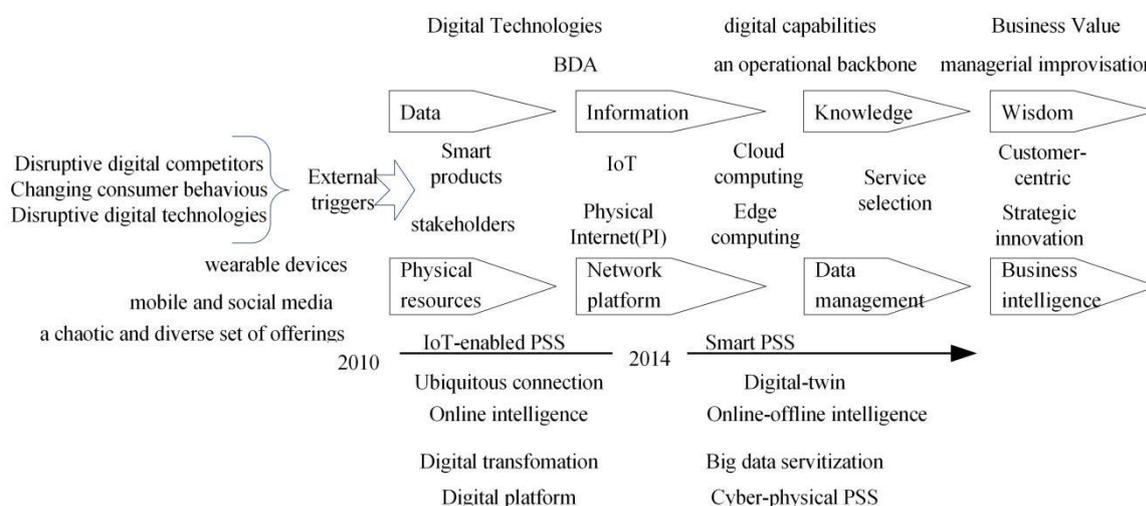


Figure 1. IT-driven smart PSS evolution and implementation

The use of BDA and cognitive computing help to reframe marketing decision making, to understand the main levers to attain marketing goals, such as the enhancement of relationship with customers, continuous learning and development of new products and potential innovation^[4]. Digital transformation is an ongoing process of using modern digital technologies in everyday organizational life, which recognizes agility as the core mechanism for the strategic renewal of an organization's business model, collaborative approach and eventually the culture^[5].

2.1 DDSs from IoT to IoE driven by customers

2.1.1 From IoT to IoE improving organizational performance

The rapid development of information and communication technologies has enabled the prevailing digital transformation (i.e. digitalization), where physical products can be digitized in the virtual space and seamlessly interconnected. Meanwhile, industries are ever increasingly adopting service business models (i.e. servitization), offering not only physical products but also services as a solution bundle to meet individual customer needs. Such convergence of both digitalization and servitization (i.e. digital servitization) has triggered an emerging IT-driven business paradigm, smart PSS. And self-adaptiveness with sustainability, advanced IT infrastructure, human-centric perspectives, and circular lifecycle management are the core future perspectives to explore^[1].

Digital servitization has cyberspace and the counterpart physical space with physical resources, the former including cloud computing like Pass, Saas, Iaas and edge computing; the latter involving co-design, co-implementation, logistics service, value recreation.

When physical objects are connected to the Internet, they can identify themselves with other devices and exchange data automatically and seamlessly. When people adopt emerging wearable devices that are attached to the Internet, opportunities are created for organizations and individuals that can surpass the impact of even the most significant technologies of the Industrial Revolution and its aftermath. This convergence of connecting people and devices is termed as the IoE^[6]. For example, firms can eliminate residual operational risks through different types of data flows and can overcome performance bottlenecks by extending naturally degrading organizational capacities through wearable technology. By equipping workers with such technology, firms can elevate competencies and capabilities which improve organizational performance.

2.1.2 DDSs generated by IoE to realize business value

Digitally savvy customers are demanding more while threats of digital disruptions from recent entrants are rising. For example, DBS(<https://www.dbs.com.sg/index/default.page>), a large Asian bank, responded to digital threats and opportunities by adopting a digital business strategy^[7]. Another example, organizations apply the customer service life cycle framework to harness the IoT to enhance customer experience^[8].

To effectively harness the DDSs flowing from their digitized industrial products to create innovative data-driven services, a capability framework and actions is provided^[9], which guide original equipment manufacturers as they progress through a stepwise evolution of six strategic service stages based on the digitization journeys of Thyssenkrupp(<http://www.thyssenkrupp.com.cn/>) and SIEMENS.

Value realization is improved when the agility of the resource allocation process is appropriate for the levels both of DDS platform maturity and commitment from data-driven top management^[10].

2.2 Mobile computing and social media driven by customers

In the early stage of an agile software development project, customer representatives have explicit and implicit responsibilities that facilitate the creation of software to meet evolving customer needs promptly^[11]. Overcome the challenges, Hummel(<https://hummel.net/>), a European sports fashion company, successfully transitioned to omnichannel retailing^[12].

With the phenomenal growth of mobile and social media, many organizations are realizing they need an online presence to reach out to digitally savvy customers. However, delivering seamless customer experience across various online and offline channels is increasingly challenging. With the trend that online reviews of services and products are increasingly posted via mobile devices rather than a website^[13], a social media strategy to make capital out of the chaos is shaped^[14], including a mix of four tactics(namely, listening and branding, mining and deciding, conversing and sharing, and co-creating and innovating). A platform-independent framework for considering the effects of social media on enterprises is provided^[15], which also identifies the implications for managers as they consider the design decisions for an enterprise social media platform. The framework comprises the fundamental capabilities (establishing social networks and accessing digital content) of social media and the impacts (on organizations-employee performance and user behavior) these capabilities have.

3. DIGITAL TRANSFORMATION JOURNEYS TO MAINTAIN DIGITAL LEADERSHIP

Digital leadership defines as doing the right things for the strategic success of digitalization for the enterprise and its business ecosystem^[16]. Digital leadership means thinking differently about business strategy, business models, the IT function, enterprise platforms, mindsets and skill sets, and the workplace. For example, leveraging digitalization is one of the LEGO Group's (<https://www.lego.com/zh-cn>) four strategic priorities and is fundamental for it to become a world leader in its industry.

3.1 Traditional companies seeking to discover big data value

Traditional manufacturing organizations can successfully introduce BDA and master related organizational transformations. Recommendations built on the three-stage evolution of BDA capabilities at AUDI are provided^[17]. Four key lessons are drawn with a Swiss electricity utility conducted a seed project-a bottom-up initiative to develop an analytics ecosystem of business, organizational and technological capabilities.^[18] Lufthansa(<https://www.lufthansa.com/cn/zh/homepage>) exploit big data as the basis for renovating its traditional business model to one that embraces customers as value co-creators^[19]. To deliver a superior customer experience, USAA(<https://www.usaa.com/?akredirect=true>) re-architect its business by redesigning structures, roles, incentives, processes, and IT systems, integrating its previously separate insurance, banking, and investment products around customer life events (e.g., buying a car or a house, getting married)^[20].

Four BDA actualization mechanisms are identified^[21], namely enhancing, constructing, coordinating and integrating, which is implemented an automotive manufacturing company, i.e., establishing customer-centric marketing, provisioning vehicle-data-driven services, data-driven vehicle developing, and optimizing production processes.

3.2 Prime transformation journeys success in the digital era

The industrialized transformation approach of UPM(<https://www.upm.com/>), a Finnish forest industry company, is underpinned by five principles-template-based, business-driven, matrix-organized, tight supplier steering and cascaded planning^[22]. Taking account of the greater use of agile development methods, guidelines for improving IT project estimation are provided^[23], rather than traditional waterfall. And a digital services capability model is present that allows an organization to assess its current capabilities and identify gaps.^[24]

Table 3 summarize dual methods for digital transformation journeys. Depending on the type of unexpected event, two digital capabilities are identified^[25]: a flexible IT infrastructure and a well-developed information management capability-that organizations can use to foster managerial improvisation and can leverage. And two digital strategies and two technologies are identified^[26], the former are customer engagements and digitized solutions; the latter are operational backbones and a digital services platform, which enabled assets are essential for executing those strategies. How work is done to create digital workplaces and improve employee experience, transforming is focused^[27], which entails addressing two dimensions-responsive leadership and employee connectedness-with three design levels for each dimension. Here introduced the bimodal IT archetypes^[28], which decompose the IT function into two modes: (1)traditional focused on stability; (2)and agile focused on the speed and experimentation necessary to support innovative uses of IT in a digital business context.

Table 3. Dual methods for digital transformation journeys

Paper	Dual mode	Detail
[25]	Digital capabilities	Flexible infrastructure and a well-developed information management capability
[26]	Digital strategies	Customer engagement and digitized solutions
	Technologies	An operational backbone and a digital services platform
[27]	Dimensions	Responsive leadership and employee connectedness
[28]	Bimodal	Traditional and agile

4. CONCLUSIONS

Here identifies the capabilities needed and provides lessons for organizations looking forward to a successful digital business strategy. In the digital economy, deploy an architecture for participation that makes the best of digital technologies by harnessing the power of users. Such user-driven innovation has accelerated a dramatic advancement of the internet that, in turn, has accelerated the co-emergence of subtle innovation resources in the marketplace. However, big data as an industry, not a technology, many ethical issues arise, such as reselling consumers' data to the secondary market, it's important to foster a sustainable big data industry.

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