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Industry X.0

Realizing Digital Value in Industrial Sectors

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Preface

The world has become digitally connected to the point of no return. Each day around five million devices become linked up with either each other, the Internet or both. There are around 6.4bn data-communicating objects in the world and by 2020 this number is forecast to explode to around 20bn.¹ Our digital universe is in healthy expansion mode.

From this perspective, today's device boom – the wristband pulse monitors, smart watches, satnavs and intelligent thermostats – are just the overture to a long and eventful journey towards lives digitally augmented, supported and enabled in ways unlike anything humans have ever experienced before.

The advance is propelled by our craving for technical innovation and our tendency to adapt promptly to new ways of interacting and engaging with machines and devices as soon as they exist. We as consumers will keep asking why this or that gap in the market has not yet been filled by some device or software solution. Businesses – the focus of this book, hence the title “Industry X.0” – and their increasingly digitally native workforce, used to a highly digitized private lifestyle, will put the same kinds of questions to their industrial vendors, displaying a new form of “industrial consumerism.”

At the core of this seismic upheaval sit Living Products, physical products reinvented as software-intelligent devices that act, think,

and are closely and constantly aligned with their users and ecosystems.

Clearly, then, the industrial sphere, the sphere of technologically produced physical objects, will play a major part in the seminal trip towards the planet's digitization. Digital technologies will create a stage on which we as public, businesses and industry experts will pull off spectacular things in the coming years.

Consider the following: the first pharmacy staffed only by robots, is expected to open its doors in 2021;² sensorized medical pills that report back to the makers when patients have swallowed them are currently in development; Siemens is already successfully running prototypes of completely unmanned, self-organizing and hyper-productive industrial plants;³ and raw materials giant Rio Tinto has huge mining operations based on automated trucks and drill systems provided by heavy equipment makers Caterpillar and Komatsu.⁴ Cars, industrial machinery and tooling, pumps, circuit breakers – they can all be rendered Living Products by adding software intelligence.

The ship has clearly sailed for digital sceptics, both as citizens and business leaders. The industrial enterprise world, comprising two thirds of the world's gross domestic product, will be changed beyond recognition by digital technology, disrupting decades-old business habits, conventions and operating models. The ways in which labor works, machine-based processes are organized and information is shared will be turned on their heads. Strategic corporate thinking will be forced to incorporate completely new data-driven business models to secure a future for any enterprise. No wonder the US, Germany, China and Japan – all strongholds of successful industrial enterprises – have, with varying focus, put industrial digital transformation high on the agenda.

There is no turning back. What matters now is to make the most of the digital transformation. We have the opportunity to shape it. There is not one standard way to make it happen, the journey must be tailored to each enterprise individually.

That is why this book, unlike other publications, not only addresses the “why” of the industrial sphere’s wholesale digitization but also, primarily, the “how,” examining in detail the steps industrial businesses need to take to get the greatest positive effect and value from digital.

Packed with easily accessible actionable insights and suggestions, it should be a vital resource for industrial business leaders at all levels, C-suite and below as well as across all functions. It should help them discover, think through, adopt and implement the roadmap necessary for their enterprises to head out for the new territory, and act as an aide-memoire as the journey progresses.

Acknowledgments

In this book I have managed to gather and shape forward-looking advice around a complex subject: the emergence of the Industrial Internet of Things (IIoT) and its transformation of the industrial sectors. I visited and revisited the topic in detail and assessed its ramifications for the enterprises affected. And I developed a good deal of thought leadership in the process.

All this would have been impossible without the input of a large number of knowledgeable people from beyond our core book team. I was fortunate to be able to tap a wide intellectual catchment area: corporate thinkers, co-consultants, and clients, based in the US, UK, Germany, France, Italy, Korea, Europe, Japan, and China, contributing either broad ideas that helped shape the general themes and scope of the book or practical industry experience, focused sector insights, and firm opinion to test our own thinking. Their input has been invaluable in shaping the book's observations, analyses and hypotheses.

To all of them I would like to express a sincere "Thank you." The support of every one of you individually was a *conditio sine qua non* for pulling this off and collectively represents a piece of vanguard consultancy thinking on what is currently one of the most pressing subjects in the business world.

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Introduction

Coinciding with the wholesale digital interlinking of society, the digital disruption and transformation of the industrial sphere is one of the world's current megatrends, affecting companies representing two thirds of global GDP.¹ Makers of cars, planes, trains, domestic appliances, heavy equipment and engineering technology, pharmaceuticals, and utility and raw materials businesses are all undergoing waves of technological upheaval as we speak.

Smartened, tightly connected, data-driven industrial products and processes are going to go mainstream in all advanced and many emerging countries very soon. Embedded in the wider trend towards the Internet of Things (IoT), its sub-segment, the Industrial Internet of Things (IIoT), will digitally orchestrate factory floors, physical products, workers and all enterprise functions and processes, unleashing enormous value potential.

Beyond the Product: Outcomes and Value

In only a few years time we will look back and call the two decades since the turn of the century the period of "the end of the product." Ever more advanced digital technology will help to establish a new world in which customers will ask businesses for complex "outcomes" delivered by digital services around physical products instead of delivery of mere hardware.

The software “tissue” and data analytics that will eventually permeate the industrial sector will create a very distinctive new stage of economy. Enterprises will have departed from a conventional focus on manufacturing “dumb” low-margin products made for anonymous markets to forming very personalized relationships with their customers, driven by the latter’s instantaneous demand for “switched-on,” software-connected, and eventually even Living Products and Living Services with huge value potential. Digital technology will also enable providers of outcomes to monitor the shape of outcomes and usage patterns in the field.

In the churn of this megatrend, the terms B2B and B2C will start to blur. In fact it will be one of the defining fascinations of the industrial sector’s digitization that enterprises used to dealing with business clients will suddenly be forced to think like consumer-facing businesses as part of the trend known as “industrial consumerism.” This means, that, for not only consumer goods companies but B2B industrial companies too, final outcome experience and service quality will now be the top criteria for success or failure – and eventually the only significant source of corporate value in this sector.

This is driven by a shift in customer attitudes and, as such, is a clear rebuke to the common assumption in government that it is businesses that will drive the broad-based trend towards digitization. What we currently see is the opposite: the urge for change clearly stems from the demand not the supply side.

It is the phenomenon of industrial consumerism and the emergence of Living Products that are driving the change. In that regard many governments are too focused on creating the right environment for digitizing the shop floor, not realizing that this is not the right starting point for enterprises to arrive at the necessary new business models.

In only a short while we will be accustomed to markets in which tried-and-tested industrial hardware products will become permanently reconfigurable software containers, eclipsed in profitability by their own new service qualities.

This will have dramatic effects for businesses and how they go about managing their products. This will be when companies immerse themselves in ecosystems and alliances with what today would seem unlikely partners – another seismic shift for most of today's industrial organizations.

It will therefore be paramount for industrial companies to master this radical transition successfully, opening themselves to a journey that will change their operating models, ways of working and organization beyond recognition – the alternative being a catastrophic loss of market clout and profitability.

This is why this book's aim is to familiarize business leaders from the industrial sectors with the key competencies necessary to tackle all this – competencies such as creating unified Product Lifecycle Management (PLM), embedding software and connectivity in products and services, using analytics to drive value and growth, creating closed-loop agility in development and manufacturing, selling "as a service" and orchestrating the digital and industrial ecosystem, to name but a few.

Two Battlegrounds, Trapped Value and Six "No-Regrets"

From the perspective of industrial enterprises, digital disruption will have two major battlegrounds. On the one hand, it will be about leveraging new digital technologies to bolster internal efficiency throughout all functions, as only this will fund expansion into current and future markets around Living Products. Buried value can

be found plentifully, especially in legacy industrial businesses, and digital technology can typically bring it to light for investment into the future.

On the other hand, digitization will challenge businesses to work out how Living Products with a smart software lifeblood can make a market, how an advanced, technology-driven and value-creating digital customer relationship could look, and how it can be embedded into new and unaccustomed outcome models.

Both fields currently probably appear to many business leaders like giant construction sites with no horizon, with works in constant progress because the technologies deployed are incessantly evolving. Which one should one pick, when and along which roadmap? This sort of disorientation might even repel enterprises and their executives to the point of postponing work or even giving up completely on attempting a future-proof digital strategy.

Certainly at the moment, the progress of IIoT adoption is sluggish. Research conducted for the World Economic Forum showed 72 percent of the C-level executives interviewed were convinced that the IIoT would fundamentally change their industry, but just 20 percent had a thought-through strategy for harnessing it.²

The dizzying vortex is not just because of digital technology's swift advances. It is also the ever-complicating mix of numerous underlying technologies such as sensors, cloud computing, processing power, business intelligence algorithms, robots, artificial intelligence, cognitive computing and big data.

The decision to give this book the title "Industry X.0" was born not least from the awareness that technology now is in such dynamic flux that its staging posts can no longer be pinned down for longer than a moment. Industry 4.0 will turn swiftly to 5.0, to 6.0, and counting.

Still, in the middle of this raging tech storm there exists a bedrock foundation of digital models, mantras and measures that will create immediate value in any industrial enterprise. A company that adopts them and makes them work adequately will be steering the right digital course regardless of what the future holds and which trajectories digital technology takes.

This is the upside of the current technology frenzy, the opportunity for “unconventional” growth, the chance for industrial businesses that execute their digital strategy right to reap unheard-of speeds of profitable expansion. I think there is every reason to believe the landslide successes of digitally driven businesses such as Amazon or Facebook can be replicated in the industrial sphere.

Those software-only platforms can be a role model for many industrial products. Not all products can be transformed into platforms, but certainly sooner or later every industrial product will be integrated into another product that operates as a platform.

To be as helpful as possible to industrial practitioners, this book is therefore built around a set of fundamental digital “no-regret” capabilities every company should implement and use as a launch pad for digitization. They form the basis for a detailed, strategic tour d’horizon showing what the industrial sector will face over the coming years and how to harness it.

Fluidity and Data Pervasiveness Across the Enterprise

Often referred to as the “fourth industrial revolution,” and better framed as “Industry X.0,” the digital transformation of industrial companies has profound ramifications for businesses’ cost structure, their work process design, the involvement of human labor and, crucially, the shaping of products and services.

Digitization is not – by far – only just about the progressive automation of existing manufacturing facilities and shop floors. Casting the net much wider, it entails completely new digital set-ups across all business functions and the creation of holistic new operating models around software-enabled connected products.

Thus, internally, enterprise digitization covers any process or operation that does not involve direct consumer interaction – areas such as idea generation, testing and prototyping, or R&D, with the management of customer, supplier and partner relationships also crucially defined by the new digital ways of steering industrial production.

Externally, business digitization means hunting for propositions that customers find attractive because they offer excellent software-induced efficiency or convenience, fulfill an outcome or create good value for their own business.

Creating agility and acceleration of processes is hence among the top three commandments for a solid digital strategy. Industrial businesses' product and service development units must be enabled to react in real-time to changes in the market. And in a demand-driven economy, they must be able to hyperpersonalize a product or service in a short timeframe, down to a lot of just one.

This radical shift is only achievable when, among other measures, siloed units within the enterprise are broken up and unhindered information loops are established to connect designers with engineers with marketers with customers with suppliers with boardrooms. An absolute maximum of data pervasiveness but also much more decentralized decision-making processes based on local data analysis will define the well digitized organizations of the future.

Innovation in the New and in the Core – Finding the Right Pivot

Importantly, a dual innovation approach will usually be needed. Most industrial companies still run very profitable legacy product or service lines that need to be maintained while applying gradual innovation steps. In a completely separate strand, a second innovation engine for thinking “outside the box” must be kick-started to come up with new and visionary data-based customer propositions unrelated to the old world. This is going to require some extra human and financial resources.

What this implies – applying ingenuity at different speeds and looking at different technological horizons within one business – is certainly not easy to achieve, but it is a necessity for success in a hyper-connected corporate future. Eventually and over time both innovation streams will need to be led to new and future-proofed business models.

What customers want and expect, are no longer just bigger, better, faster or smaller products and services. Rather it is ideally up to industrial businesses to anticipate through their intimate digital customer relationships what their customers and the customers of their customers require. The “why behind the buy” has to be understood and this requires a new, demand-driven approach to innovation, one open to external input from extended ecosystems and banking heavily on digital feedback loops with the end-user market.

The trends described will also have a massive impact on the way the whole product value chain and product engineers, factory staff and field agents work. From their perspective, incorporating and blending with intelligent machinery and software tools will be the birth of the connected industrial workforce.

Digital technology will augment employees in all functions across a business. Shop-floor employees will eventually cooperate with semi-autonomous machines at very close distance in a state of mutual understanding. They will wear data-collecting devices such as smart glasses or helmets, augmenting their skills to achieve much better productivity. Product engineers will be supported by artificial intelligence (AI) driven software and generative designs. AI will even take a seat in the boardroom, supporting strategic management decisions.

This new work style and work environment will require new training and re-skilling. This holds true for blue- and white-collar workers, managers and executives. Overall, enterprises will have to prepare by adopting a more active role in training, developing and preparing existing staff for the digital age or else suffer a significant skills shortage.

Tying Together Products, Ecosystems and Platform Products

Finally, the IIoT requires that input from customers, subcontractors, partners and suppliers be channelled to continually influence strategy throughout a product's lifecycle. Leveraging allied ecosystem parties is therefore becoming critical to arrive at satisfactory time-to-capability, agility-to-assemble and speed-to-market. And on top of that it will also blur traditional industry boundaries.

Building an ecosystem is a skilful task, requiring business leaders to think laterally, factoring in wide horizons of possible allies and unusual business cases and opportunities. This is a drastic departure from old-style product-focused manufacturing, but is still rewarding and will create enormous value.

Against this ecosystem backdrop, many industrial products will be shaped to become platforms. The trailblazers here are the likes of Apple and Google. Both businesses created an ecosystem-style developer community around their smartphone operating systems as platforms. External app creators are the ones imbuing otherwise “dumb” smartphones with value – to the mutual benefit of all: the developer, the platform owner and the customer. Again, there is no reason to assume that industrial companies cannot replicate a similarly stellar success around mining trucks, jet engines or home technology such as lighting, security or heating systems – though surely not all industrial products can turn into platform products.

How to Use This Book

As is probably already clear, the huge changes digitization is set to bring about in manufacturing can be as bewildering as they are fascinating. This book has been written to be your guide to this new territory. The landscape is wildly complex, but, if you know how to read them, its multitude of features provide compelling pointers for the future.

Think of this, then, as something to be used – a usage manual, if you like, for the Industrial Internet of Things (IIoT). While it may serve as a general-interest primer, it is aimed mainly at those who will be actively implementing the change. It provides a clear delineation of the challenges and opportunities, and invaluable guidelines on drawing up the right digitization roadmap for your organization. Not all routes will be the same.

And just as there is no fixed path towards the digitized industrial future, there is no one route through this book. Read it in order, or zero in on particular areas as you require. In this, you can be guided by this section.

Be aware that each chapter can be read independently and that what is discussed in them is illustrated by company cases and with the key takeaways.

Part I, comprising Chapters 1-3, is your introductory overview of the IIoT transformation, designed to help you orient yourself in the new world. Chapter 1 gives the current big picture. I look at the flurry of massively disruptive new technologies converging to create the IIoT and explain how the result will be an entirely unprecedented paradigm of manufacturing in which businesses will operate in highly unfamiliar ways. Chapter 2 shows where we're headed, explaining how the IIoT will inevitably lead to a new kind of economy, the Outcome Economy. Chapter 3 discusses the enormous value to be gained from digitization of industry.

Part II, comprising Chapters 4-9, is a series of detailed looks at the key areas a digitization strategy will need to encompass. Chapter 4 gets you started on your path towards digitization. It introduces six "no-regret" capabilities – digitally-based changes you can make now that are certain to deliver results. Chapter 5 looks at big (and ever-increasing) data, probably the single most powerful value driver in the Industry X.0 – as long as you get your data analytics right. Chapter 6 takes you through digital product development, discussing the importance of strengthening software capabilities, synchronizing software and hardware clocks, and of having a robust Digital Product Lifecycle Management (DPLM). Chapter 7 highlights the challenges of managing the human workforce in the era of robotization and artificial intelligence. Chapter 8 is your guide to innovation in the radical new world of the IIoT, describing the four main innovator types and explaining why only one can really thrive in the Outcome Economy. Chapter 9 explains how in the IIoT's porous, interconnected world, you will need to become part of an ecosystem and may well benefit from building a platform.

Part III, Chapter 10 is a look further into the future, to 2030 and beyond, at a magical, ultra-fluid world in which products can change shape and the Outcome Economy gives way to the Pull Economy.

At the end of the book you will find all the chapter takeaways – that provide a quick and easy access to the actions needed to be taken to digitize your business –, a glossary of terms and an index.

Too Much Will be Lost by Sitting on the Fence

Arguing the case for digitization in the face of scepticism from staff, investors and business partners may take ingenuity, courage, stamina and lots of skills in change management on the part of executives and business leaders. It is all worth it and there is no alternative.

The ground is shifting, but the industrial world's rapid digital transformation should not to be seen as a threat. It is a major opportunity for value creation, not to mention for an incredibly dynamic and stimulating work environment. Industrial companies should seize it rather than wait and see – or risk becoming a digital laggard, resulting in low margins, weak innovation power, slow profits and even disappearance from the market.

There is, contrastingly, little to fear from making a start at digitization if you take the right approach. You can and in fact should start small, scaling swiftly only if your initiative proves successful. That is the beauty of the digital era.

PART I

The Industrial Internet of Things – Transforming Manufacturing Beyond Recognition

Chapter 1

Industry's Ongoing and Accelerating Digital Transformation

Smartened-up and tightly connected industrial manufacturing processes are going to go mainstream in just a few years in all advanced markets and many emerging ones. A sub-segment of the Internet of Things, the Industrial Internet of Things (IIoT), will digitally orchestrate factory floors, physical products, workers and more, unleashing enormous value. However, critical to the success of this new world will be deployment of the right technology, orchestration of it in the right way, the embedding of enterprises in the right ecosystems of business partners, and last but not least, finding adequately skilled people.