INTRODUCTION:

UNDERSTANDING IA

- Do you know how Netflix is able to generate $1 billion in additional revenue yearly?
- How has Unilever significantly increased by 25% the diversity of new talent hired? How did ANZ Bank reduce operational costs by more than 40%?
- How can our world potentially save 10+ million lives per year?
- How can we triple our global budget for education, help restore our planet from pollution, or eliminate hunger forever?
- How can we increase the resilience of our health and economic systems to safeguard people's lives and livelihoods even during pandemics or crises?
- How can governments address the needs of our aging populations, improve services to citizens, reduce debt, and increase economic growth?
- And how can we provide a new renaissance for our society, making it more human and reinventing what we call "work"?

We believe the best answer to all these questions is:

INTELLIGENT AUTOMATION
(also known as Hyperautomation)

This book is the first one to focus specifically on the new and game-changing concept of **Intelligent Automation** (IA). IA, or "Intelligent Process Automation", is a new notion, officially coined in 2017 by IEEE[7]. More recently, IA has been given different names, including **Hyperautomation** (by Gartner), Integrated Automation Platform (by Horses For Sources), and Cognitive Automation (by several sources).

Through our experience, research, and discussions with the leaders of global organizations, we believe that IA is one of **the most important drivers of enterprise efficiency and competitive relevance in the future**. We are also convinced that IA can **solve many of the most pressing issues in our world**, like improving education, caring for our planet, and saving lives. IA is becoming so ubiquitous and impactful that it has been listed as the number one technology trend for 2020 by Gartner.[8]

We, the authors, draw our perspectives from a decade of first-hand experience implementing IA for the world's leading companies and public institutions… and we appreciate the complexity of the craft. This is why we have set out to create a pragmatic and action-oriented guide for those looking to capitalize on the potential for IA.

By providing real-life use cases, we seek to raise awareness and explain the benefits and critical success factors of implementing IA for customers, employees, companies, and even society as a whole.

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7   Institute of Electrical and Electronics Engineers (in charge of setting the standards in the computer science industry), 2017. "IEEE Std. 2755-2017, IEEE Guide for Terms and Concepts in Intelligent Process Automation".

8   Gartner, 2019. "Top 10 Strategic Technology Trends for 2020". https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2020/

We also seek to offer, through the lens of IA, a unique analysis and view of the future of business, customer experience, work, and society. We've set out to create a resource that is easy to read and accessible to a broad audience.

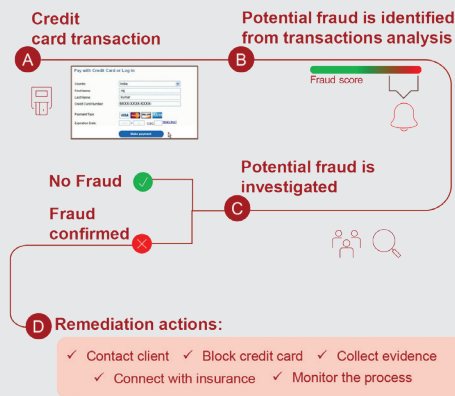# Understanding the power of IA through an example

In the near future, IA undoubtedly has the capacity to deliver the highest technological impact on organizations. As an illustration, let us take two of the most popular and impactful technologies of our current times: artificial intelligence and robotics. We have seen compelling use cases using one of these two capabilities. **The power of IA is such that it can meet most of the needs artificial intelligence or robotics can't satisfy individually**. The explanation is that IA combines not only the capabilities of both but also other complementary ones like sensing the environment or structuring workflows of information. By connecting capabilities, IA increases the breadth and depth of the impact of each technology involved. Case Illustration 0.1 presents a real-life example of this concept.

Case illustration 0.1: Credit card fraud management use case

Credit card transaction fraud is a critical topic. It causes annual losses of some $28 billion[9] and is a source of frustration for customers, retailers, and financial institutions. It is so prevalent that we believe it has happened at least once to most of our readers. As clients, we often blame our bank for not identifying these issues earlier and warning us. Also, even though losses tend to be insured, reimbursements take months. And before that, customers have to go through several administrative and inconvenient tasks, including filling in forms, providing evidence, and calling.

Banks proactively monitor transactions to flag potential fraud; a typical high-level process is shown in Figure 0.1.

Figure 0.1: Typical fraud investigation process
Source: © Bornet, Barkin & Wirtz

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9   The Nilson Report, 2019. "Payment Card Fraud Losses Reach $27.85 Billion: Annual Fraud Statistics Released by The Nilson Report". https://www.prnewswire.com/news-releases/payment-card-fraud-losses-reach-27-85-billion-300963232.html

Context: In 2019, to improve customer experience and limit its losses due to card fraud, a leading bank decided to leverage the latest technologies. It **created a state-of-the-art machine learning-based program** to identify fraudulent transactions automatically. The impact of this application was beneficial for the bank, which increased the volume of fraud resolved by 30% in less than four months. Nevertheless, while it improved the speed and completeness of the fraud identification process, **the employees' and clients' experience worsened** (see stage 1 in Table 0.1).

Solution: To address this issue, the bank decided to **take a more holistic approach**. It requested support from a team in charge of IA at one of its subsidiaries. The first action from this team was to review and redesign not only the activity of fraud identification but also, more broadly, **the end-to-end process** with an emphasis on the customer and employee experience (see stage 2 in Table 0.1). While 20% of the process was automated with machine learning, the IA team succeeded in automating more than 80%.

Outcome: As a result, the **customer and employee experience drastically improved**. Most of the tedious tasks were now performed by technology (see stage 3 in Table 0.1). Overall, the bank increased the number of fraudulent transactions solved by 70% and generated more than $100 million in additional savings per year.

The advantage of using IA has been to provide the capabilities to solve the problem holistically. It illustrates how the concept of IA has the power to create end-to-end touchless processes, cutting across an organization and delivering a broad range of benefits. We have summarized the key aspects of this transformation in Table 0.1 below.

Table 0.1: A journey towards IA for a bank fraud system

Leveraging Intelligent Automation to enhance a bank fraud management system			
Stages in the transformation journey	**1 Before transformation (manual)**	**2 New system leveraging machine learning (only)**	**3 New system leveraging Intelligent Automation (incl. machine learning)**
Timeline	*Before Jun 2019*	*Jun to Dec 2019*	*Jan 2020 onwards*
Description of the key process activities	❶ Transactions were **checked manually** on a sample basis. ❷ **Investigations**, collection of evidence, and credit card blocking were **performed manually** by the team. ❸ **Communication** (with clients and insurance companies) was **performed manually** by the team.	❶ **All transactions were checked** (no more sampling). The system could identify potentially fraudulent transactions in just a few seconds by analyzing client transactions, as well as their behavioral and demographic data. ❷ **Investigations**, collection of evidence, and credit card blocking were still **performed manually** by the team. ❸ **Communication** (with clients and insurance companies) was still **performed manually** by the team.	❶ The same machine learning-based system was used. ❷ **Investigations and collection of evidence were performed using an intelligent workflow**. Credit card **blocking actions were automated** using robotic process automation. ❸ All event-triggered **communications were automated**. The system proactively provided clients with **early warnings** of potential fraud, enabling them to take prompt and easy actions. Clients and insurers had access to **a 24/7 intelligent chatbot** to answer their questions and update them on the status of the fraud resolution process.
Morale of the bank's fraud investigation team	**Medium** ● The process was **very manual**, and repetitive.	**Low** ● The team faced **difficulties in coping with the workload**, which increased drastically as the system was identifying more potentially fraudulent transactions. ● In addition, the bank employees complained about their work becoming more tedious, repetitive, and **less fulfilling**. While the fraud team used to leverage its intuition, strategy, and analysis to identify and investigate fraud, this role was now taken by the system. The team's new role was primarily to focus on collecting, indexing, and archiving the fraud evidence.	**High** ● The **team's workload decreased**, and the work became more fulfilling as most of the repetitive and tedious activities were performed by technology. ● As an outcome, **the team could focus on more value-adding activities**, like building relationships with clients, managing the exceptions (e.g., investigating the most complex cases) and monitoring the overall process to anticipate any issues. ● The team was also able to **focus on constantly improving the new system**, increasing its accuracy levels, and extending its scope to manage additional payment means like cheques and bank transfers.
Client satisfaction (rated on a scale from 1 to 5, 5 being very satisfied)	3/5	2/5 **Rationale**: the high workload **decreased the team's responsiveness** in answering clients' questions and the time it could dedicate to client relationships.	4/5 **Rationale**: **early communication** on potential fraud identification, 24/7 support, **reduction by half of the end-to-end process time** (from the identification of the fraud to the reimbursement by the insurance).

Who should read this book, and why?

The book offers several levels of reading. Therefore, it can fit a broad range of expectations across a large audience. The target readers are company leaders, regulators, academics, thought leaders, project managers, experts, consultants, employees, students, or anyone interested in the future of work. The book will fulfill different expectations, depending on the level of experience and exposure of each reader.

For **readers who know IA well,** this book provides, in one place, all the key content you would need in one resource: guidelines, toolkits, references, and success stories and failures. It also includes a comprehensive list of critical success factors and a use case library by function and by industry. These tools will help you to champion IA in your own organization. This work is also a medium for change management and education. You should consider sharing it with your management, colleagues, and clients in order to prepare them for the transformation. Finally, through this book, we aspire to bring a heightened level of purpose to our profession. Beyond augmenting people by refocusing them on more exciting, value-added activities, IA also brings the potential for a renaissance of our society, making it more human. In this book, we set out to demonstrate how.

For **readers who are starting their IA journey**, this is an opportunity to understand the pre-requisites of IA, anticipate and mitigate the pitfalls, and support building a roadmap for the coming years. You

will fully benefit from every part of this book. It is your toolkit for transformational success.

And, for **readers who are just discovering IA** and who are interested in the future of work and its impact on our society: we hope we can provide an eye-opener on cutting-edge concepts that will change our world forever and at a rapid pace.

Finally, **no matter your level of exposure** to IA, we set out to de-dramatize the narrative around job loss due to AI, robotics, and automation. Instead, we provide our perspective on the vast opportunities for our institutions, our communities, and our societies to reinvent themselves by focusing on fundamental human values.

What will you learn from this book?

The Industrial Revolutions started over 200 years ago, automating "blue-collar" work in the agricultural and manufacturing industries. They provided massive and structural benefits to our society, such as the reduction of famine and an increase in standards of living, and they relieved people from laborious manual work.

IA, also called Hyperautomation, is one of the most recent trends in the broad field of artificial intelligence. It is a cutting-edge combination of methods and technologies, involving people, organizations, machine learning, low-code platforms, robotic process automation (RPA), and more.

IA ushers in a new revolution: that of office work, automating "white-collar" work. Today, office work accounts for more than 80% of the job roles in our global economy, such as lawyers, financial controllers, or call center operators. Like the previous automation revolutions, we believe IA will have a significant impact not only on employment but more broadly on our society.

PART ONE of this book covers the promise of IA for a better world. Even though IA has only been coined recently, its applications have spread incredibly quickly, validating its promise. It has already been adopted by more than 50% of the world's largest companies, including ADP, JP Morgan, Lloyds Banking Group, Netflix, and Unilever. The expected impact on business efficiency is in the range of 20 to 60%. It involves the significant improvement of the customer and employee

experience and the vast enhancement of process compliance. These benefits are available to all organizations, across industries, and regardless of function. This book provides a comprehensive **library of more than 500 IA use cases** to illustrate our point (provided at the end of the book). In addition to being a key improvement lever, we also demonstrate that adopting IA has now become a condition for business survival.

We also demonstrate how IA has the potential to save over 10 million lives every year and realize $10 trillion of cost savings. Such a vast amount of money would allow us to triple our global budget for education, help restore our planet from pollution, or even eliminate hunger! On top of that, IA has the potential to bring the next renaissance to our society by changing the way we work, making our world more human.

PART TWO explains the technologies leveraged by IA. IA automates knowledge work by mimicking four main capabilities of workers: execution, language, vision, and thinking & learning (see Figure 0.2). IA combines various technologies, including machine learning, sentiment analysis, data management platforms, speech analytics, data visualization, image and video analysis, biometrics, intelligent chatbots, smart workflows, low-code platforms, robotic process automation (RPA), and several more. In this book, we explain these components of IA and provide examples of how they are used. When these capabilities are combined in solving complex end-to-end business issues, synergies are created, allowing greater benefits to be delivered. We also explain how these technologies integrate within the current IT landscape of an organization and how to build an IA implementation roadmap.

The roadmap to a successful Intelligent Automation transformation

Thinking and learning:
- Big data management
- Machine learning
- Data visualization

Vision:
- Optical character recognition (OCR)
- Intelligent character recognition (ICR)
- Image and video analysis
- Biometrics

Language:
- Intelligent chatbots
- Unstructured information management (UIM)
- Sentiment analysis
- Speech analytics

Execution:
- Low-code & smart workflow platforms
- Robotic process automation (RPA)

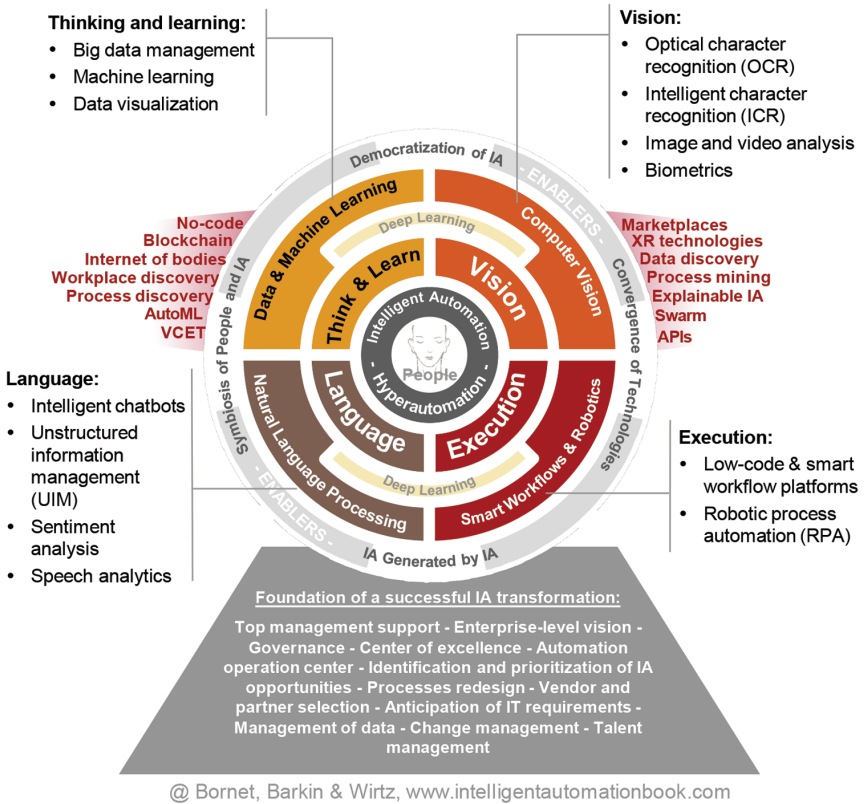@ Bornet, Barkin & Wirtz, www.intelligentautomationbook.com

Figure 0.2: A roadmap of the key notions covered in the book, including the capabilities (Part Two), the foundation of a successful transformation (Part Three), and the enablers (Part Three)
Source: © Bornet, Barkin & Wirtz[10]

PART THREE explains how to succeed in implementing IA. While impactful, implementing IA is certainly not a silver bullet. While it is easy to succeed in implementing a pilot on a limited scope, many organizations have been struggling to scale their transformations. Based on our experience of hundreds of IA initiatives, we have listed in detail the most important factors to enable organizational leaders to succeed in their transformations. In addition to these leading practices, the book describes four new trends that have started to help businesses scale IA. They are also levers that any organization can use to increase the speed and scope of its IA projects. Examples include the democratization of IA, the convergence of technologies, the symbiosis of people and IA, and the use of IA to implement IA (see Figure 0.2). In the longer term, expected innovations will leverage new concepts, such as the internet of bodies, blockchain, augmented and virtual reality, and swarm robotics. The book explains what these cutting-edge technologies and concepts will bring to the automation of knowledge work.

PART FOUR is about reinventing society and work with IA. Entering into the fourth industrial revolution with IA is not without risks. In our view, to prepare our world to effectively translate the key benefits of IA, our societies' roadmap should include some imperatives. New skills are required for workers to stay relevant while working with IA. How are we going to make sure people's skills stay relevant and evolve together with IA capabilities? In addition, according to economists, the use of digital technologies over the last decades has resulted in increasing wealth inequalities. Which mechanisms could we leverage to remediate this issue? On top of this, IA might have a strong impact on the level of employment of workers. A few possible scenarios are outlined. One involves more job roles created, while another foresees the displacement of a massive amount of the

workforce. What are the actions we should implement today to get our world prepared for both scenarios?

What if we see a scenario where a large amount of human workload reduction happens? Considering this scenario in addition to the fact that, currently, 85 percent of employees worldwide don't feel engaged with their work[11], the book explains how IA could help redefine work. IA could offer our society the opportunity for a real renaissance by freeing us from many of today's tedious, repetitive, and unfulfilling work activities. The book describes how we could use our time for more meaningful activities for society, for our families, and ourselves. To get to this attractive future renaissance, we need strong support from institutions, governments, and companies.

Besides calling upon our own experience, we have further informed our definition and perspective on IA by conducting an **extensive industry survey** (the largest to date). Throughout the book, we will refer to this research, providing the insights from over **200 IA experts** around the globe. They have been generous in sharing their experience with us. We list their names in the last part of the book: "List of IA experts who joined the survey." This effort is dedicated, in part, to them and their passion for evolving and transforming IA.

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11   Refer to Part Four of the book for detailed references.

What is IA?

IA, also called Hyperautomation, is a concept leveraging a new generation of software-based automation. It combines methods and technologies to execute business processes automatically on behalf of knowledge workers. **This automation is achieved by mimicking the capabilities that knowledge workers use in performing their work activities (e.g., language, vision, execution, and thinking & learning). The goal of using IA is to achieve a business outcome, through a redesigned automated process, with no or minimal human intervention. As a result, IA increases process speed, reduces costs, enhances compliance and quality, increases process resilience, and optimizes decision outcomes. Ultimately, it improves customer and employee satisfaction and boosts revenues.**[12]

IA focuses on automating the work done by knowledge workers, whose principal capital is knowledge. Examples include programmers, physicians, pharmacists, architects, engineers, scientists, designers, public accountants, lawyers, and any other workers whose line of work requires them to "think for a living."[13] As opposed to manual labor, which is material-based (common in manufacturing industries), **knowledge work** is information-based and commonly found in service industries. Simply put, IA is the "white-collar" version of the "blue-collar" industrial automation, which started in the 19th century.

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12   This definition has been written by the authors, inspired by IEEE Std. 2755-2017. "IEEE Guide for Terms and Concepts in Intelligent Process Automation"

13   Davenport, Thomas H., 2005. "Thinking For A Living: How to Get Better Performance and Results From Knowledge Workers".

For example, IA is used to support and augment the tasks performed by lawyers, financial controllers, or call center agents.

An easy way to explain how IA works is to draw parallels with human capabilities. Through IA, we aim at creating "digital workers" (automation programs), which mimic the actions performed by human knowledge workers. To deliver a work outcome, we, as humans, carry out business processes (a succession of tasks), using our human capabilities. We make use of our capabilities to see, hear, speak, read, understand, act, react, and learn. IA is composed of a combination of technologies that reproduce these human capabilities to deliver business processes on behalf of human workers.

IA effectively creates a software-based digital workforce that enables synergies by working hand-in-hand with the human workforce. On the simpler end of the task spectrum, IA helps perform the repetitive, low value-add and tedious work activities such as reconciling data or digitizing and processing paper invoices. On the other end, IA augments workers by providing them with superhuman capabilities. For example, it provides the ability to analyze millions of data points (e.g., collected from the web) in a few minutes and generate insights from them (e.g., identifying customer behaviors with a direct impact on revenue).

By using IA, companies, and workers aim at building touchless business processes (i.e., those requiring minimal human interaction or intervention). Touchless processes, also called "straight-through", represent the highest level of process efficiency (e.g., productivity, rapidity, and cost control) and effectiveness (e.g., quality and compliance).

Unique characteristics of IA

IA has the following characteristics that explain its rapid expansion and its expected drastic impact on our world:

- It is **recent**. The term IA was coined only in 2017 by IEEE. It combines relatively new technologies; most of them have been developed in the past ten years.

- It is **universal**. Most functionalities can be applied across industries (e.g., banking, retail) and business functions (e.g., sales, operations, finance).

- It is **scalable**. After the first program is developed, scaling can be done instantaneously and indefinitely with virtually zero incremental cost. Increasing the capacity of a digital workforce is as simple as copying and pasting resources.

- It is **available 24/7**. IA capabilities deliver services on demand at any time and any day, ensuring the continuity and sustainability of automated processes.

- It is **reliable**. IA systems will always produce the same outcome, based on the same input. Assuming no change in the environment, their level of performance remains unchanged and accurate. When implemented using leading practices, IA systems are highly resilient.

- It is **economically attractive**. Most IA-related technologies are available at a reasonable cost and typically generate payback in less than a year.

- It is **accessible**. IA technologies tend to have intuitive and accessible user interfaces. The skills required to use most of these applications are limited or easy to acquire.

Differentiating IA from AI

Differentiating between artificial intelligence (AI), robotics, and other business process management (BPM) systems, including cloud and workflow platforms, can be complicated. Indeed, boundaries between these concepts are blurred, as they are emerging, continually evolving, and often converging (refer to Part Three, "The convergence of technologies"). However, to bring clarity to our discussion, we draw a few essential anchor points. We have based our analysis on our survey of over 200 IA experts and our own experience. From this, a summary of the current understanding of the key concepts that come together is shown in Figure 0.3.

The main points explaining this framework are:

- **AI**: The applications of AI that are related to IA are the ones associated with the automation of knowledge work. Hence, IA includes all uses of AI across industries, except, for example, gaming, arts, or fundamental research, which are excluded.

- **Robotics**: IA includes software-based robotics. Physical robots used in manufacturing are not considered part of IA.

- **Cloud, workflow, and business process management (BPM):** Platforms that demonstrate some form of intelligence are included in the scope of IA. Excluded are systems with limited ability to support end-to-end processes, and which provide little insights on the work activities performed.
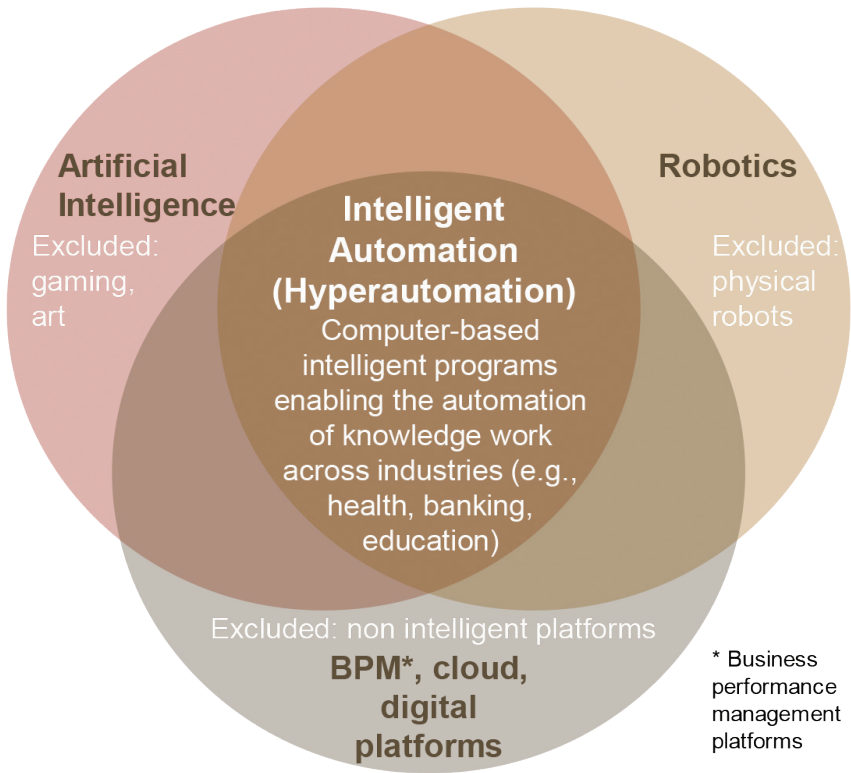
Artificial Intelligence

Excluded: gaming, art

Robotics

Excluded: physical robots

Intelligent Automation (Hyperautomation)
Computer-based intelligent programs enabling the automation of knowledge work across industries (e.g., health, banking, education)

Excluded: non intelligent platforms

BPM*, cloud, digital platforms

* Business performance management platforms

Figure 0.3: Positioning IA with other recent technology concepts

Source: © Bornet, Barkin & Wirtz

The promise of IA

IA has already reached a significant rate of adoption

86% of global business leaders recently surveyed believe that to stay ahead in their given domains, their organizations must deploy IA in the next five years.[14] Another survey by Gartner found that 42% of CEOs have already begun the process of digital transformation, and 56% reported gains after implementing IA.[15]

Because of its unique characteristics, we estimate that IA will be able to reach a level of adoption and sophistication in the next five years which took industrial automation over 200 years. According to a Deloitte survey, **IA already has an adoption rate of over 50%**.[16] This rate is **expected to increase to more than 70% in the next two years**. If this continues, IA will have achieved near-universal adoption within the next five years.

Even though IA is still a new field, **its capabilities are progressing exceptionally quickly**. Some of these technologies are very recent, like deep learning or robotic process automation (RPA). In fact, UiPath, a 40-person RPA start-up just five years ago, has ridden the explosive growth curve of this automation technology to become the

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14 Avanade, 2017. "Global Research on Intelligent Automation". https://www.avanade.com/en-us/media-center/press-releases/intelligent-automation

15 Amy Ann Forni and Rob van der Meulen, 2017. "Gartner Survey Shows 42 Percent of CEOs Have Begun Digital Business Transformation". Gartner. https://www.gartner.com/newsroom/id/3689017

16 Harvard Business Review, 2019. " How Companies Are Using Intelligent Automation to Be More Innovative ". https://hbr.org/sponsored/2019/12/how-companies-are-using-intelligent-automation-to-be-more-innovative

highest valued AI company in the world by 2019 with a valuation of USD 7 billion.[17]

Other technologies have been with us longer, but have recently witnessed significant advances. For example, machine learning, which dates back to the early 1950s, is now playing a pivotal role in enabling efficient object detection and neural machine translation thanks to deep learning.

Estimating the **size and growth of the IA market** is not an easy exercise because of the multitude of studies and the differences in their methods and scopes. Here is our selection of the most recent and established ones:

- AI, which is closely connected to IA, has been gathering momentum for nearly two decades now. Forbes data shows that the number of AI start-ups has increased 14 times since 2000, and investments in AI start-ups have increased six times over the same period.[18]

- According to Gartner, the number of companies implementing AI technologies has grown by 270% in the past four years.[19]

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17 Mike Wheatley, 2019. "UiPath becomes world's most valuable AI startup". https://siliconangle.
    com/2019/04/30/uipath-becomes-worlds-valuable-ai-startup-cool-7-billion/

18 Louis Columbus, 2018. "10 Charts That Will Change Your Perspective On Artificial Intelligence's
    Growth". https://www.forbes.com/sites/louiscolumbus/2018/01/12/10-charts-that-will-change-
    your-perspective-on-artificial-intelligences-growth/#7eabdaeb4758

19 ZDNet, 2019, "Enterprise adoption of AI has grown 270 percent over the past four years". https://
    www.zdnet.com/article/enterprise-adoption-of-ai-has-grown-270-percent-over-the-past-four-years/

- The global intelligent process automation market size is expected to reach $15.8 billion by 2025, rising at a market growth of 12.5% CAGR from 2020 to 2025.[20]

- The global machine learning market size was valued at $6.9 billion in 2018 and is anticipated to register an annual growth of 43.8% from 2019 to 2025.[21]

- Worldwide RPA software revenue grew by more than 60% in 2019 to $1.3 billion, making it the fastest-growing segment of the global enterprise software market. Global software companies, such as IBM, Microsoft, and SAP, are completing their portfolios of technologies by acquiring RPA software providers.[22] This is expected to increase awareness and potential adoption of this technology within their large customer bases.[23]

The scope of IA's impact represents 84% of the workforce in the US

For most of us, when hearing about automation, the image of a physical manufacturing robot comes to mind. Nevertheless, while the impact of physical robots has been significant in the last two centuries, it only accounts for a small effect on the future of work. In the US, for example, industrial and farming automation only

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20 PR Newswire, 2020. https://www.prnewswire.com/news-releases/the-global-intelligent-process-automation-market-size-is-expected-to-reach-15-8-billion-by-2025--rising-at-a-market-growth-of-12-5-cagr-during-the-forecast-period-301004589

21 Grand View Research, 2020. "Industry analysis". https://www.grandviewresearch.com/industry-analysis/machine-learning-market

22 As an illustration, here is an article on the recent acquisition of Softomotive by Microsoft: https://flow.microsoft.com/en-us/blog/microsoft-acquires-softomotive-to-expand-low-code-robotic-process-automation-capabilities-in-microsoft-power-automate/

23 Gartner, 2019. "Worldwide robotic process automation market". https://www.gartner.com/en/newsroom/press-releases/2019-06-24-gartner-says-worldwide-robotic-process-automation-sof

accounts for 17% of the potential impact of automation on workload. Intelligent automation (the "digital workers") accounts for most of the rest (highlighted under "Services" in Table 0.2). **Due to the large scope, the impact of IA in the coming years is expected to be significant for employment and society**.

The scope of Intelligent Automation

The scope of IA's impact represents 84% of the workforce in the US

Thousands of people, as of May 2019, according to the U.S. Bureau of Labor Statistics

Farming	**3,900**	**3%**
Manufacturing	**21,077**	**14%**
Goods producing, including manufacturing, mining, construction, durable and non-durable goods	21,077	
Services:	**129,997**	**84%**
Trade (wholesale and retail)	21,710	
Transportation, warehousing and utilities	6,097	
Information (e.g., publishing, telecommunications)	2,815	
Financial activities (e.g., banking, insurance, real estate)	8,656	
Professional and business services (e.g., accounting, administrative, management, engineering services, IT, legal)	21,408	
Education and health services (e.g., physicians, teachers, nurses)	24,176	
Leisure and hospitality (e.g., recreation, food services, accommodation)	16,699	
Other services (e.g., repair, maintenance, associations)	5,924	
Government (at federal, state and local levels, including administration, postal services)	22,512	
Total	**154,974**	**100%**

Table 0.2: USA employment breakdown by industry sector
Sources: adapted from the United States Department of Labor[24]

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24   United States Department of Labor, accessed May 2019. "Seasonally adjusted figures for May 2019". https://www.bls.gov/news.release/empsit.t17.htm

IA viewed in parallel with automation in agriculture

Historically, agriculture was the first industry to be automated. The process of automating agriculture took over a thousand years. The outcome today is a thriving and highly efficient agribusiness.

As we can see from Figure 0.4, the level of automation has continued to increase, even since the 1990s. This is represented by the decline in the percentage of the global workforce working in this industry, falling from 44% in 1990 to 28% in 2017. Automation in agriculture has mainly been through the use of tractors, combine harvesters, milking machines, and hay press machines.

In parallel, the share of undernourished people in the global population has also decreased from 19% to 11%. This evidences how automation was instrumental in reducing the proportion of the world population suffering from hunger. **Thanks to automation, the agriculture industry has been able to increase its productivity continually, solving one of the most pressing world issues.**
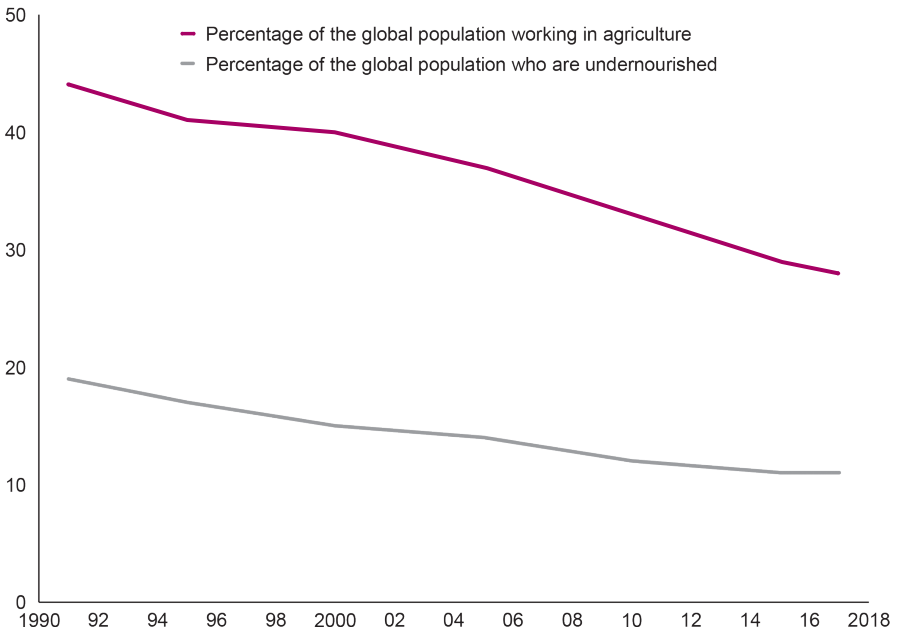
The impact of automation in agriculture

Figure 0.4: The impact of automation in agriculture
Source: adapted from the International Labour Organization, FAO SOFI, and World Bank[25]

We believe IA will have a similarly significant impact not only on employment but more broadly on our society. It will follow a similar trend of increasing the output produced while reducing the human workforce needed.

We expect IA's impact to have even higher velocity and magnitude. Algorithms are to white-collar workers what tractors were to farmers: a tool to dramatically increase the productivity of each worker, and

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25   Number of people undernourished: FAO SOFI (2018) & World Bank (2017) https://ourworldindata.
      org/hunger-and-undernourishment; Global percentage of population working in agriculture:
      International Labour Organization, ILOSTAT database, 2018. https://data.worldbank.org/
      indicator/SL.AGR.EMPL.ZS?end=2018&start=1991&view=chart

thus shrink the total number of workers required to produce the same output. But unlike tractors, algorithms can be shipped instantly around the world at no additional cost. Once an algorithm has been sent out to millions of users, it can be continuously updated and improved with no need to create a new physical product.

Key definitions

Table 0.3 shows the definitions of key terms we used throughout the book. We have written these definitions leveraging our experience, as well as the information coming from the survey we conducted amongst IA experts.

Table 0.3: Key definitions

Artificial intelligence (AI): a combination of technologies able to reproduce human behavior and intelligence. It includes the capacity to sense the environment, analyze it, learn from it, and act on it. AI has applications in automating work (this is where it intersects with IA). However, unlike IA, AI also has applications in gaming, arts, education, and many other areas not connected to knowledge work. In addition, AI does not include the capability to execute actions or support workflows of tasks or data.

Automation: the action of a software program or machine which performs tasks usually performed by human workers. In the case of IA, which is about knowledge work automation, we will mainly refer to software-based automation.

Deep learning: a subfield of machine learning. It is a recent technology that enables machine learning to process complex data; for example, data that involves a large number of features and highly complex patterns, typically unstructured, such as pictures, movies, and language. This technology works on a similar basis to the structure and functions of a human brain. The deep learning model uses networks of neurons presented in superposed layers, with each layer performing a level of analysis of the input data (for example, to classify or recognize a pattern) and providing its output to the next layer.

Digital workforce: a digital version of the workforce, which is otherwise usually composed of human workers. When using digital robots and programs to automate processes, companies create a digital workforce. As IA automates more and more processes, the size of the digital workforce grows.

Machine learning: a subfield of artificial intelligence. It enables computers to learn and improve on their own, from experience, without being explicitly programmed. A machine learning algorithm can identify patterns in observed data (e.g., a growth trend in monthly sales revenue), build models that explain them (e.g., sales seem to be correlated to weather conditions), and predict future data (e.g., estimate future growth of sales considering the weather). Out of the different technologies used in the context of IA, machine learning has become the most used one.

Robot: This term is commonly used to describe an automation program, independently of the technology used. In the context of IA, we mainly refer to software robots (non-physical robots, also called "digital robots"). A robot is a program in charge of automating a specific work task or process. For example, a chatbot is a robot able to dialogue with users on their computers or smartphones.