WORLD ECONOMIC FORUM

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System Initiative on Shaping the Future of Digital Economy and Society

Digital Transformation Initiative

Maximizing the Return on Digital Investments

In collaboration with Accenture

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Contents

The Digital Transformation Initiative (DTI) was launched by the World Economic Forum in 2015 as part of the System Initiative on Shaping the Future of Digital Economy and Society. It is an ongoing project that serves as the focal point at the Forum for new opportunities and themes arising from the latest developments in the digitalization of business and society. It supports the Forum's broader activity around the theme of the Fourth Industrial Revolution. More about the DTI is available at http://reports.weforum.org/digital-transformation.

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Foreword

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Digital transformation is occurring at an unprecedented pace. It is a key driver of sweeping change in the world, improving people's lives and creating a more connected world. It also opens new opportunities for businesses to grow and create value.

Companies are using new technologies, such as the internet of things (IoT), robotics, artificial intelligence (AI), big data analytics and mobile/social media to build new business models, enhance customer experiences and drive new efficiencies. While the applications have significant potential, only a few organizations are ready to take full advantage of them, which is fuelling a debate around the productivity impact of digital investments. Organizations must identify where to best take advantage of digitalization and invest in the activities that will have the most positive impact and accelerate their performance in the long term.

Most business leaders understand the potential effect of digital transformation on business and society. However, many do not see a clear path to bridging the gaps that inevitably occur when innovation moves faster than existing organizational and societal frameworks. This creates a gap between leadership's strategic digital intent and its operational execution. This is one of the main inhibitors to unlocking the value of digitalization and to the Fourth Industrial Revolution.

This paper, which forms part of the World Economic Forum Digital Transformation Initiative (DTI), aims to contribute to the debate on the return on digital investments. Through quantitative and qualitative analyses of existing digital investments, it provides a framework to give business leaders the best possible chance of addressing many challenges – driving cultural change, bridging the digital skills gap across workforce levels, changing customer expectations, data privacy and security – and maximizing the return on upcoming investments.

Launched in 2015, the DTI serves as the focal point for new opportunities and themes arising from the latest developments in the digital transformation of business and society. Since its inception, the initiative has analysed the impact of digital transformation on 12 industries and several cross-industry themes to drive engagement on some of the most pressing topics facing industries and businesses today. DTI is part of the World Economic Forum System Initiative on Shaping the Future of Digital Economy and Society and supports the Forum's broader activities around the theme of the Fourth Industrial Revolution.

This paper was prepared in collaboration with Accenture, whom we thank for their support. We would also like to thank the World Economic Forum community of digital leaders and industry experts who helped shape the insights and recommendations.

The paper embodies the World Economic Forum's commitment to helping leaders understand the implications of digital transformation. We are confident that the findings will support them on the journey to shape better opportunities for business and society.

Executive Summary

Digital technologies offer new ways for companies to grow and be more productive. However, it is not completely clear *how* investments in new technologies impact productivity. This White Paper addresses that issue by analysing the **business value impact of new technology investments** and providing recommendations for maximizing that value. It includes an econometric analysis of the productivity impact of new technologies using data from a sample of over 16,000 companies from 14 industries and an analysis, through interviews and workshops with industry leaders, of key enablers and execution principles to maximize the return on digital investments.

The analysis of productivity and new technology investment data led to the following observations:

- Companies in the sample realized **revenue and productivity growth** over the past decade.
- However, these gains were **not evenly distributed**. The growth was driven by a small group of industry leaders (the top 20% of companies by productivity within each industry)[1].
- Companies are investing in new technologies to **accelerate growth and productivity**. From 2016 to 2020, total new technology spend is expected to increase by 13% compound annual growth rate to $2.4 trillion per year, led by the internet of things (IoT) (42% of total spend in 2020)[2].
- These investments are made to drive **new efficiencies, enhanced customer experiences** and **new business models**, with new efficiencies being the most prominent driver to date.
- While there are concerns about technologies, such as artificial intelligence (AI) and robotics process automation, causing worker displacement, overall **employment levels** have remained stable over the past decade.

The quantitative analysis of companies' return on digital investments resulted in four key findings:

1. **The return on investment** in new technologies is positive overall. The productivity increase is three times higher when technologies are deployed in combination.
2. The return on digital investments **varies by industry**, and industry leaders achieve a greater productivity increase from investments in new technology than followers (70% vs 30%). The leaders in a majority of industries tend to be larger companies by revenue.
3. **Asset-heavy industries** realize more value from robotics; asset-light industries realize greater value from mobile/social media, primarily led by efficiency-driven opportunities.
4. While **industry leaders** realize higher overall return from robotics and mobile/social investments, followers have gained more from IoT and cognitive technologies (artificial intelligence and big data analytics).

Five key enablers to maximize the return on digital investments emerged from the discussions with industry leaders:

1. **Agile and digital-savvy leadership:** Maintaining a strategic vision, purpose, skills, intent and alignment across management levels to ensure a nimble decision-making process on innovation
2. **Forward-looking skills agenda:** Infusing a digital mindset in the workforce by making innovation the focus of training and hiring programmes
3. **Ecosystem thinking:** Collaborating within the value chain (e.g. with suppliers, distributors, customers) and outside (e.g. start-ups, academia)
4. **Data access and management:** Driving competitiveness through strong data infrastructure and warehouse capability combined with the right analytics and communication tools
5. **Technology infrastructure readiness:** Building the required technology infrastructure to ensure strong capabilities on cloud, cybersecurity and interoperability

In addition, industry leaders also emphasized that the successful execution of these enablers would require companies to establish clear ownership of the digital transformation, invest in specific use cases (vs individual technologies) and follow an outcome-based approach that is agile and flexible to allow failure at minimal costs.

Objectives and Approach

The Digital Transformation Initiative (DTI) was launched by the World Economic Forum in 2015 to serve as the focal point for new opportunities and themes arising from the latest developments in the digitalization of business and society. Over the past two years, the DTI has analysed the impact of digital transformation across 12 industries and a number of cross-industry themes with inputs from more than 450 subject-matter experts, including over 200 chief executive officers. Now in its third year, the DTI's focus is on driving the global conversation to enhance societal and business value from digitalization.

DTI's latest project, **Maximizing Returns on Digital Investments**, explores the unclear relationship between IT investment and productivity. Some economists believe that new digital technologies will never impact productivity, jobs or growth in the positive way that the steam engine, the assembly line[3] and the computer did in previous industrial revolutions. Others, however, are at least cautiously optimistic.[4]

Companies want to understand how the adoption of new technologies impacts productivity. They have the strategic intent to invest in these technologies, but cannot see a clear path to positive returns because a number of questions remain unanswered:

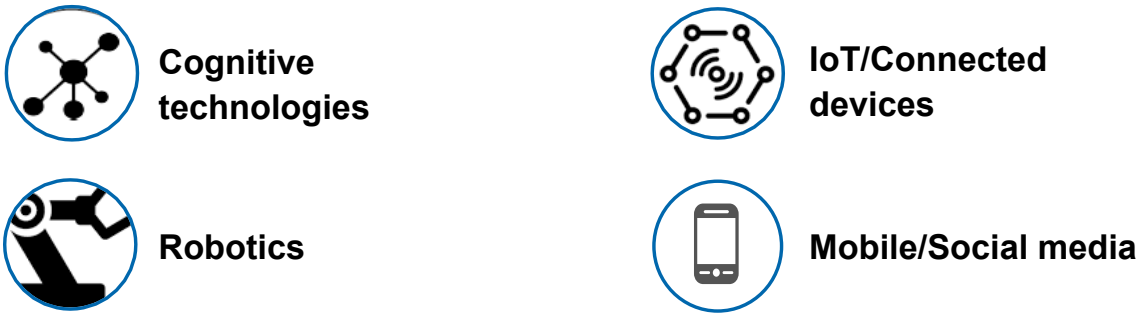
- How much value are companies getting from digital investments?
- How do returns on digital investments vary by company, industry and technology?
- How can companies maximize return from their digital investments?
- How can companies successfully execute on digital investment projects?

This White Paper addresses these questions by analysing the value impact of investments in new technologies and providing recommendations for maximizing that value.

The research combines quantitative and qualitative analyses of new technology investments. Data from over 16,000 public companies across 14 industries were analysed to estimate the productivity impact of investments in new technologies. The 14 industries covered are: automotive, aviation and travel, chemistry and advanced materials, consumer, electricity, financial services, healthcare, logistics, media, mining and metals, oil and gas, professional services, retail and telecommunications. Data on new information and communication technologies (ICT) spend by companies, industries and technologies were sourced from International Data Corporation (IDC) and Ovum, with company financial data for 2015 and 2016 sourced from Capital IQ.

The return on digital investment impact estimates are based on an econometric regression model for investments in new technologies and the performance measures of top-line growth and labour productivity (earnings before interest, taxes, depreciation and amortization [EBITDA] per employee). The model controls for the effects specific to industries, geographic regions, company size and time trends. To keep the quantitative results tractable, technologies were grouped into four categories (Figure 1) based on investment levels and their place in the production process.

Figure 1: Four Areas of Technological Investment



Source: World Economic Forum/Accenture Analysis

Technology category definitions

- **Cognitive technologies** include artificial intelligence (AI) and big data analytics (BDA). AI uses deep natural language processing and understanding to answer questions and provide recommendations. BDA is a new generation of technologies and architectures designed to extract value efficiently from very large volumes of variform data.
- **IoT/Connected devices** refers to a network of networks aggregating and linking uniquely identifiable endpoints (or "things") that communicate autonomously using internet protocol connectivity.
- **Robotics** encompasses the design, construction, implementation and operation of robots. Robotics process automation, cognitive interfaces and other software applications that are not capable of movement are excluded.
- **Mobile/social media** include mobility solutions and social technologies. Mobility solutions include the devices, software, infrastructure and related services that enable mobile data services. Social technologies facilitate collaboration between internal stakeholders, partners, vendors and customers, as well as the extraction of data from these communications.

In addition to the quantitative analysis, a comprehensive text analysis of leading business and IT publications revealed some key themes around enablers to maximize value from digital investments. The analysis covered articles on topics including IT, product and service development, corporate strategy, regulation and government policy, published between 2012 and 2017. Articles were screened for any mention of the four technology categories in conjunction with the words "enabler" and "inhibitor", and were then weighted by the frequency with which each identified theme was mentioned. The results were consolidated and validated through industry interviews and an executive workshop to arrive at five key enablers and four execution principles for successful digital investments.

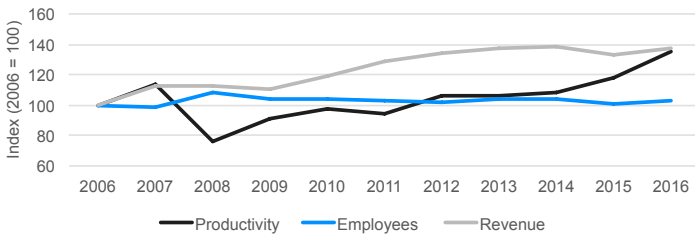
Value Impact of Digital Investments

It is widely recognized that digital technologies help to increase cost effectiveness, enhance existing revenue streams and open new ones. As the costs of new technologies, such as 3D printing and robotics, have decreased over the past decade, companies have increased digital investments to capture the value. Before taking a closer look at the impact of digital investments on productivity and how companies can maximize it, it is important to understand wider technology investment and productivity drivers and trends.

a. Productivity and new technology investment trends

While general macro-level productivity growth is still slow[5], companies in the study sample enjoyed strong overall revenue and productivity growth over the past decade (Figure 2), also driven by an improved business environment and growing consumer demand, particularly since the economic crisis of 2008. It was also observed that, contrary to concerns about such new technologies as AI and robotics process automation causing worker displacement, employment levels for our sample of companies were stable.

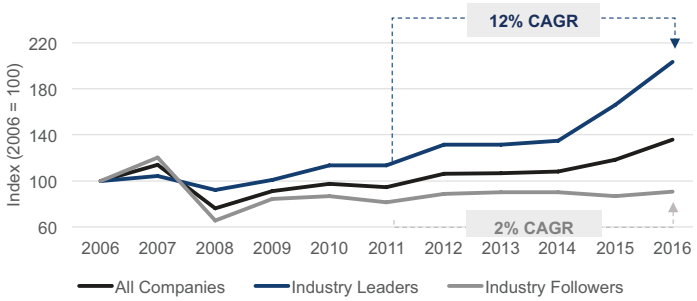
Figure 2: Average Revenue, Productivity and Employment Trend (2006-2016, baseline 2006)



Source: World Economic Forum/Accenture Analysis based on Capital IQ data

However, not all companies realized similar productivity increases. The overall increase in labour productivity was driven by the most productive 20% of companies in each industry. These industry leaders more than doubled their productivity, while the rest (industry followers) saw their average productivity level fall. Even in the period after the economic crisis (2011-2016), industry leaders delivered 12% compound annual growth rate (CAGR) in productivity while followers managed only 2% CAGR (Figure 3). This widening productivity gap confirms the need to find new ways of unlocking productivity growth.

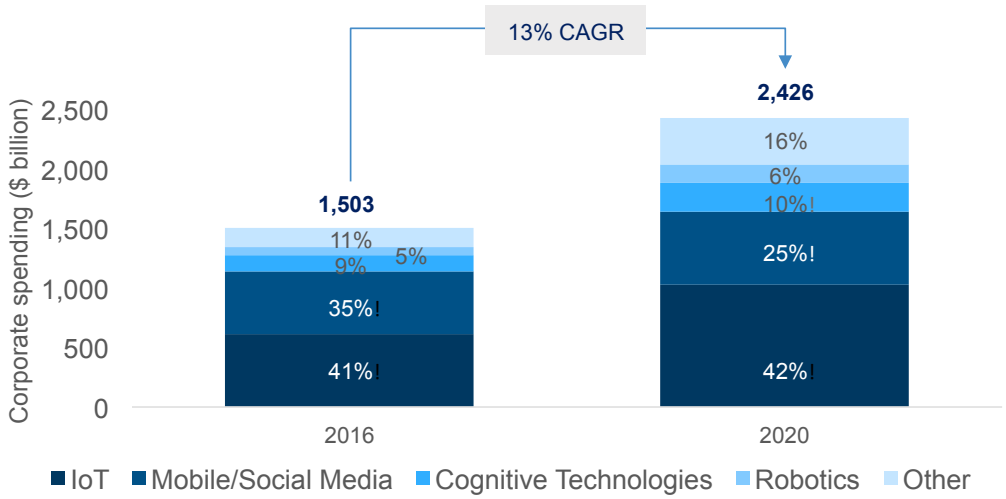
Figure 3: Average Productivity Trend – Industry Leaders vs Followers (2006-2016, baseline 2006)



Note: CAGR = compound annual growth rate
Source: World Economic Forum/Accenture Analysis based on Capital IQ data

With the aim of accelerating growth and productivity, companies are investing more in new technologies. They have been encouraged by the reduced cost of technologies, such as 3D printing and robotics. IDC estimates that, between 2016 and 2020, corporate spending on new technologies will grow by 13% CAGR to $2.4 trillion per year (Figure 4).[6] The growth will be led by investments in IoT, which is estimated to contribute 42% of total new technology spend in 2020 (~$1.0 trillion). Investments in mobile/social media are expected to remain almost stable, sending their share of total investments down from 35% to 25%.

Figure 4: Corporate Spending on New Technologies, $ billion (2016-2020)



Note: CAGR = compound annual growth rate

Source: World Economic Forum/Accenture Analysis based on IDC estimates, excluding cross-industry spend ($80 billion in 2016 and $166 billion in 2020)

b. Drivers of digital investments

Investments in new technologies are driven by company objectives. These drivers cluster around three sources of digital value (Table1).

New efficiencies are still the primary driver for large companies to invest in new technologies. They use these technologies primarily to improve existing business processes and optimize assets and resources, thus reducing their own costs and enabling savings for their customers.

Siemens – Reshaping the future of manufacturing

The industrial conglomerate Siemens strives to digitalize the complete value chain of discrete manufacturing industries, from product and production design to production and services. As a manufacturing company, it is itself a user of its digitalization and automation products and services.

For example, Siemens digitalized its major electronics plant in Amberg, Germany, which by now has an automation rate of about 75%. The digitalization improved the efficiency of the plant, as the output was increased by a factor of 10 with a consistent number of employees. It also increased production speed and flexibility; currently, about one product is manufactured per second while about 1,200 products are built on the same production line in very small lot sizes. At the same time, only 11.5 defects occur per million products, which is equivalent to a quality rate of 99.99885%.

Enhanced customer experiences are also driven in various forms, depending on how new technologies are utilized. Energy providers, for example, can use smart grids to customize their offerings, and they can also use the data collected by them to enhance services (e.g. inform customers about malfunctions and how to respond).

Marriott – Enhancing customer experience through data

The hotel chain Marriott uses digital technologies to prioritize customer relationships and personalize customer experiences. It believes that data drive great customer experiences. It aims to build 360º customer profiles and make them available to personalize the entire travel journey, which requires accurate data collection and analysis. To further drive customer satisfaction, Marriott automates processes such as booking, check-in and checkout, to free up employees for more sophisticated engagement with customers. As a result of these initiatives, Marriott has experienced stronger customer loyalty, boosting its revenue and market share.

Our research suggests that, particularly for large companies, investing in **new business models** is the most difficult and least frequently targeted of the three drivers. The hesitancy in moving to new business models is based mostly on the fear of cannibalizing existing business models and the difficulty of identifying new models. Fostering an environment that encourages the introduction and scaling of new business models can be challenging too. It requires a cultural change that makes innovation the focus of business strategy, which in turn demands greater ownership of the investment by senior leadership, more autonomy for business units to innovate without fear of failure, and strong governance and accountability to ensure tangible business outcomes.

Kuehne + Nagel – Becoming its own disruptor

Logistics provider K+N's subsidiary LogIndex produces and commercializes its digital services. Using big data from over 50 sources (including proprietary data sets from K+N) and predictive analytics based on more than 25,000 time series and 200 million messages processed daily, LogIndex's gKNi provides nowcasts of economic indicators for the largest economies and delivers real-time insights into supply chains around the globe.

This helps customers improve decision-making and allows K+N to monetize data. This new revenue stream is still very small compared to K+N's group revenues of $20 billion, but LogIndex is paving the way for K+N to stay ahead of the competition by finding new ways to increase employee productivity and enhance its services for existing and new customers (e.g. financial institutions).

> **Companies need to learn how to overcome the innovator's dilemma – the fact that new ideas that cannibalize the existing business can see slower adoption within organizations. Senior management can be protective of their existing businesses, but they need to overcome this to make the most of digital opportunities.**
>
> Paul Mitchell, General Manager, Technology Policy, Microsoft Corporation, USA

Table 1: Overview of the Drivers of Digital Investments

Investment Drivers	Enable Bottom-line Efficiencies	Enable Top-line Growth	
	New Efficiencies 	Customer Experiences and Outcomes 	New Business Models 
Key Investment Areas	– Automation of the entire value chain, from decision-making to operations – Efficient use of resources, such as time, energy, raw materials and assets – Initial specific efficiency objectives with potential to expand to new business models and customer experiences	– Customized offerings to create "moments of truth" and support decision journeys – Integrated customer information across platforms to increase transaction speed – New experiences rooted in privacy and trust, customer relationship management, digital marketing and access to the right talent/skills	– Address market needs with a combination of new and existing data and technologies – Build deep understanding of the value chain and the scalability potential of opportunities – Address the cannibalization of existing business by concentrating on overall consumer demand and the opportunity cost of not investing
Enabling Technologies (examples)	– IoT and robotics to automate processes and collect data – Combination of big data analytics, AI, 3D vision and digital platforms to analyse data to identify incremental efficiencies	– Big data analytics for personalization – Cloud to reinforce data management – Social media and mobile technologies to improve engagement	– Big data analytics to identify new areas of customer demand – Social media and mobile technologies for engagement
Complexity	– Typically low, similar to traditional investments – Relatively clear business case	– Typically medium-high – Impacting customer experience metrics with eventual top-line growth	– Typically high – Relatively uncertain business case

c. Return on digital investments – Key findings

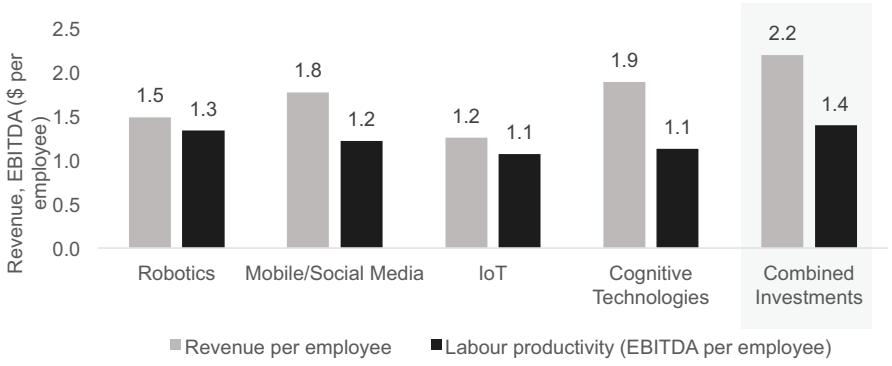
The econometric regression model used in this research estimates the revenue and productivity impact of investments in four technology categories: robotics, IoT, cognitive technologies and mobile/social media. After validation from industry experts, the model revealed four key findings:

1. The return on investment in new technologies is positive overall. The productivity increase is three times higher when technologies are deployed in combination.

The average return on investment is positive for each technology category (Figure 5). Cognitive technologies have the highest stand-alone impact on top-line growth, followed by mobile/social media. However, robotics yields the highest productivity increase. IoT, which draws the largest share of total new technology spend by companies (42%), makes the smallest stand-alone revenue and productivity impacts.

Combined investments, when technologies are deployed in combination, are estimated to deliver labour productivity increases that are three times higher than those for stand-alone technology investments (weighted by share of investments in each technology).

Figure 5: Return on Investment by Technology (2015-2016)
Impact of a $1 new technology investment on revenue per employee and labour productivity at the average company (e.g. $1 invested in combined new technologies has yielded $2.2 – a 120% increase in revenue per employee. "Combined Investments" shows the impact of investment in all four technology categories combined).



Note: EBITDA = earnings before interest, taxes, depreciation and amortization
Source: World Economic Forum/Accenture Analysis based on IDC, Ovum and Capital IQ data

The higher productivity impact of robotics and mobile/social media could be explained by their higher maturity compared to IoT and cognitive technologies. They have better defined use cases and clearer expected returns, and companies seem to have been more effective in translating bottom-line efficiencies from robotics and mobile/social media into higher operating margins. The less mature technologies appear to start creating value only when associated capabilities, such as data infrastructure, skills and other intangible investments, are in place. For example, extracting value from the data generated via IoT solutions requires a well-built data and technology infrastructure.

The difference in returns between stand-alone and combined investments suggests that companies benefit from a clear strategic objective, a long-term approach to new technology investments and an understanding of how to combine these technologies to maximize their impact.

2. The return on digital investments varies by industry, and industry leaders achieve a greater productivity increase from investments in new technology than followers. The leaders in a majority of industries tend to be larger companies by revenue.

Productivity returns from digital investments vary across industries (Figure 6). The highest productivity increase was seen in two asset-heavy industries: chemistry and advanced materials, and mining and metals. Asset-heavy industries are those with a capital expenditure (capex) that is more than 7% of the sum of capex and operating expenditure (opex). Among asset-light industries (those with a capex that is less than 7% of the sum of capex and opex), professional services and financial services realized the highest productivity returns.

At the company level, industry leaders by productivity – who tend to be larger companies by revenue in most industries – realized greater productivity increases than followers.

Figure 6: Return on Investment by Industry (left), Average Company Size by Revenue (right) (2015-2016)
Productivity change after a $1 increase in investment for the average company in 14 industries. Investments reflect the impact in all four technologies combined.

Note: EBITDA = earnings before interest, taxes, depreciation and amortization
Source: World Economic Forum/Accenture Analysis based on IDC, Ovum and Capital IQ data

The variance in performance across industries (asset-heavy vs asset-light) and companies (leaders vs followers) can be better understood by breaking down their investments by technology.

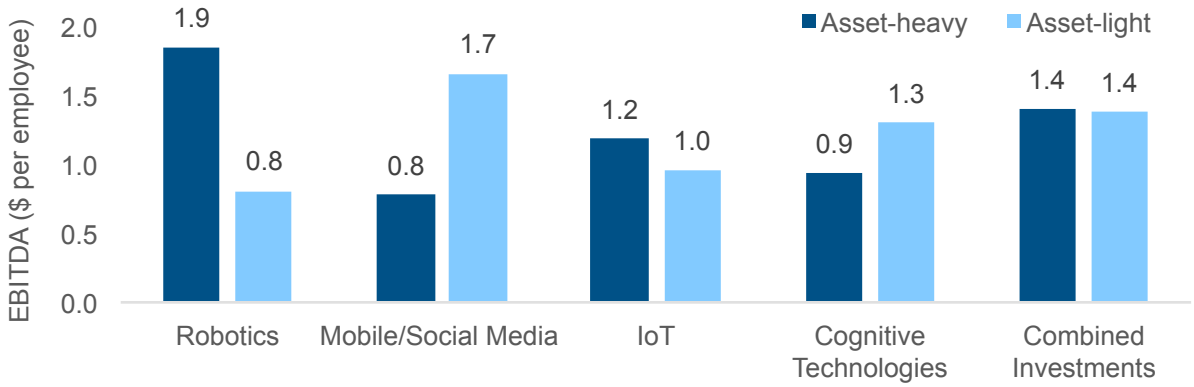
3. Asset-heavy industries realize more value from robotics; asset-light industries realize greater value from mobile/social media.

In asset-heavy and asset-light industries, an average firm realizes similar productivity gains from digital investments (Figure 7). However, it makes these gains by investing in different technologies.

Asset-heavy industries make greater investments in hardware-based technologies, such as IoT and robotics (~80% of total new technology spend, 2016-2020 average, based on IDC estimates). They have achieved greater productivity gains from robotics than IoT. Their investments in mobile/social media and cognitive technologies have so far resulted in negative productivity returns.

Asset-light industries make greater investments in software-based technologies, such as mobile/social media and cognitive technologies (~70% of new technology spend, 2016-2020 average). They have achieved greater productivity gains from mobile/social media than cognitive technologies.

Figure 7: Return on Investment: Asset-Heavy vs Asset-Light Industries (2015-2016)
Productivity change for the average company after a $1 increase in investment for each technology (e.g. $1 invested in new

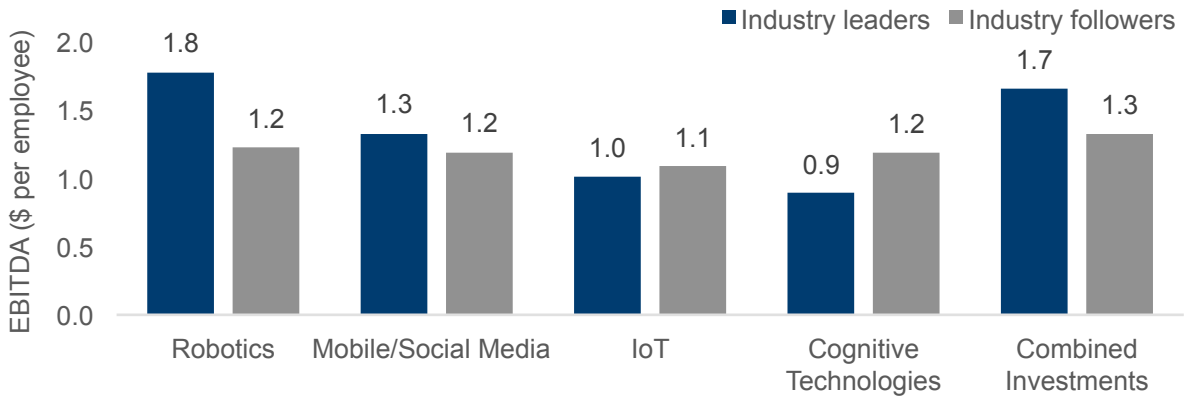


technologies overall has yielded $1.40 – a 40% increase in labour productivity – for asset-heavy companies).
Note: EBITDA = earnings before interest, taxes, depreciation and amortization
Source: World Economic Forum/Accenture Analysis based on IDC, Ovum and Capital IQ data

4. While industry leaders realize higher overall return from robotics and mobile/social investments, followers have gained more from IoT and cognitive technologies.

For industry leaders, the overall productivity increase from digital investments is more than twice that for followers (70% vs 30%). The difference is primarily due to their investments in robotics and mobile/social media (Figure 8). Leaders, who tend to be larger organizations, might have delivered a higher return on robotics because it is a comparatively mature technology for which integration with existing systems and processes is simpler. Cognitive technologies and IoT have yielded lower returns for industry leaders than followers, perhaps because strong data management and legacy system integration are challenges at larger organizations.

Figure 8: Return on Investment: Leaders vs Followers (2015-2016)
Impact of a $1 new technology investment on labour productivity at industry leaders and followers (e.g. for leaders, $1 invested in combined new technologies has yielded $1.7 – a 70% increase in labour productivity).

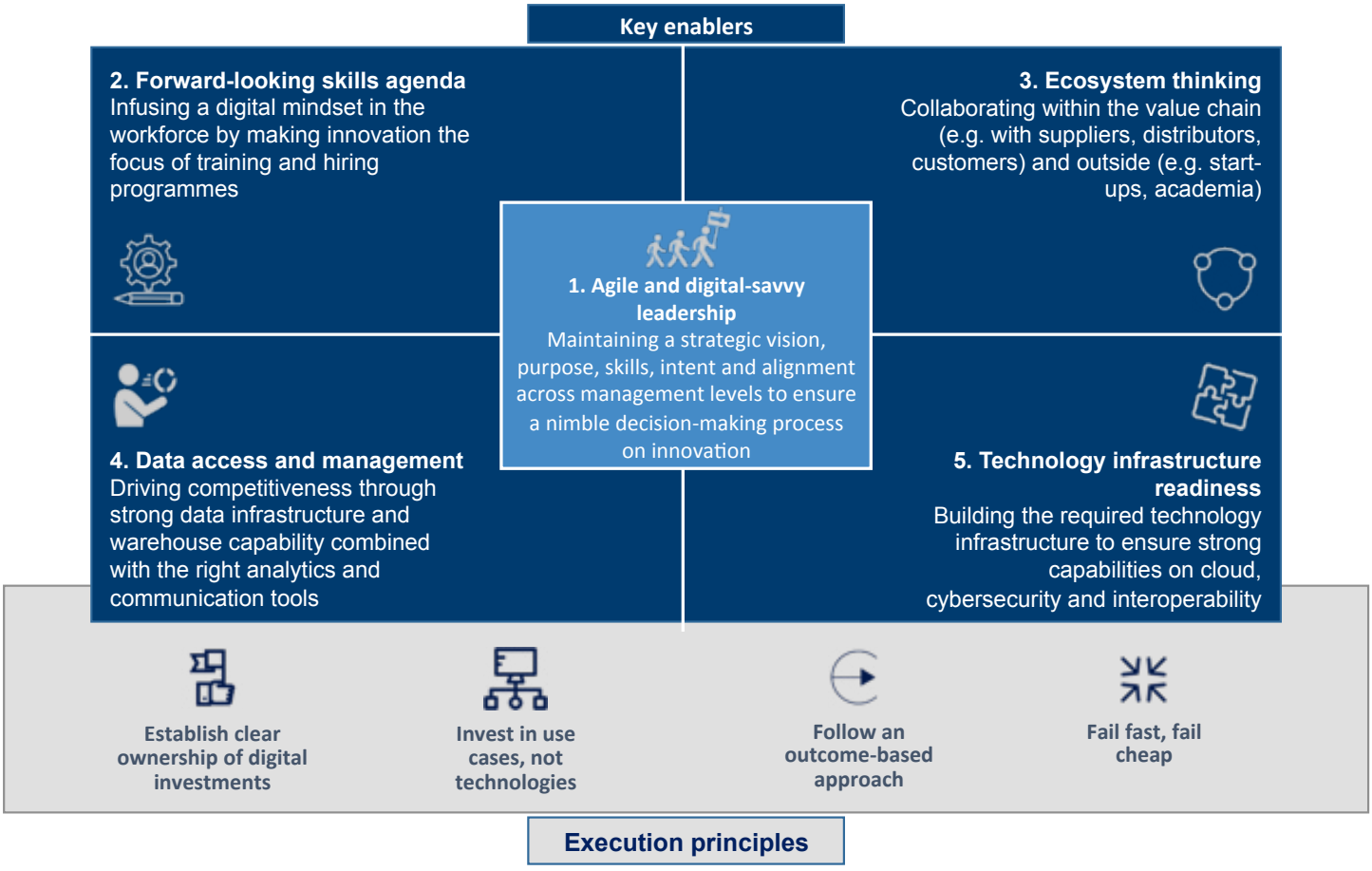


Note: EBITDA = earnings before interest, taxes, depreciation and amortization
Source: World Economic Forum/Accenture Analysis based on IDC, Ovum and Capital IQ data

Maximizing Value from Digital Investments

The return on digital investments varies greatly between technologies, industries and companies. To uncover the themes companies have been focusing upon to maximize value from new technology investments, a comprehensive text analysis was performed. By mining articles from more than 30 business and technology publications and journals over the past five years, several enabling (and inhibiting) themes emerged. These formed the starting point for in-depth interviews and collaboration with industry leaders that led to a framework of five key enablers and four underlying execution principles. Discussions with industry leaders also confirmed that most companies still struggle to measure the value impact of new technologies at the company level, which seriously hinders their ability to unlock that value.

Figure 9: Key Enablers and Execution Principles Framework



Source: World Economic Forum/Accenture Analysis

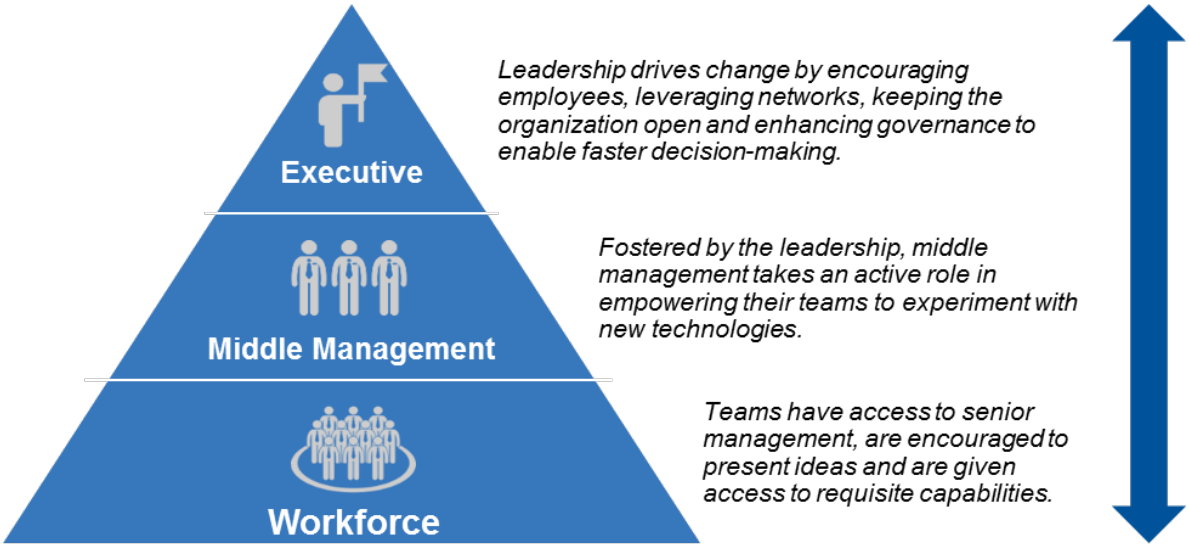
a. Key enablers to maximize the return on digital investments

The five enablers identified by the text analysis and discussions with industry leaders (Figure 9) require a company to rethink its approach to fundamental topics, such as leadership, workforce development and competition.

1. **Agile and digital-savvy leadership**
   Maintaining a strategic vision, purpose, skills, intent and alignment across management levels to ensure a nimble decision-making process on innovation

Significant uncertainty exists around digital transformation, and positive returns are not guaranteed. Preparing for digitalization does not mean making small adjustments to existing rigid business processes; it requires a deep cultural shift to embrace continuous change. The best leaders recognize this and build strong knowledge on digital technologies and how they change their business. They form a clear communication loop across workforce levels to share their digital vision. To remove ambiguity, they explicitly define roles at every level (Figure 10).

Figure 10: Digital Leadership Roles



Source: World Economic Forum/Accenture Analysis

While innovation is ingrained in new companies and start-ups, traditional players need to find ways to embed it into their businesses. Because digital transformation is not achieved instantly across an organization, established companies should start with a small segment, learn, build expertise and then scale up. Leaders have the key role of uniting the stakeholders (business units, workforce, customers and shareholders) behind the overall vision and purpose of digital transformation. Focusing on four areas can help them move digital transformation forward:

– **Provide a vision and purpose**
  Based on their strategic understanding of the risks and opportunities arising from the digital disruption of their value chain, leaders should lay out a vision and purpose for their firm's digital journey. Transparent and ongoing communication on how this vision will be achieved, and the successes and failures along the way, alleviate uncertainty about transformational changes.

– **Cultivate a company-wide digital culture**
  Ideas are the roots of innovation. They can come from anywhere, so capturing – and exploring – all of them requires a company-wide culture of entrepreneurialism. Among digital leaders, the most commonly identified aspects of that culture were team-based engagement, risk-taking, and lifelong skill development and learning. To encourage them, leaders must be trained to foster collaborative approaches and cross-functional understanding (e.g. appreciating both the business and technology aspects of digital use cases).

  Flat hierarchies can also help employees to think creatively and innovate. Giving new roles to middle management (e.g. as mentors and experts) can encourage ideas from junior staff. However, to maintain objectivity, the performance of such structures needs to be evaluated in line with expected business goals.

– **Infuse a start-up mentality**
Digital leaders quickly move away from structured, predetermined development processes towards a "start-up" mentality. Digital teams are encouraged to work separately from the main business – to reduce resistance to change – and are empowered to fail through a trial-and-error approach. They still, however, keep long-term business goals in mind and focus on minimizing the cost of failure.

– **Drive efficient and transparent decision-making**
Whether they are about investments in digital initiatives or performance feedback on business goals, leadership decisions need to be taken and communicated efficiently and transparently. Access to organized, detailed business data and clear key performance indicators (KPIs) enable leaders to make the best decisions faster.

Royal Dutch Shell – Fostering an innovation-led culture

Royal Dutch Shell started its digital journey with the objectives of protecting margins, reducing costs, increasing productivity and finding new revenue streams. Now digitalization is a board-level topic rooted in the overall company strategy. Each line of business is tasked with driving value from data at a working level, supported by a central team of technology experts in solving digital challenges. To drive digital innovation and unlock its business value, design thinking workshops are used as the basis to understand the business friction, and agile development methodologies are applied to prototype, build and scale digital solutions.

A corporate culture is fostered in which innovation can emerge from anywhere: from senior or middle management to creative, entry-level employees. That culture relies on communication, workforce-wide alignment on the company vision and effective change management.

In summary, deploying new technologies is not enough to drive digital transformation. There is also an onus on leadership to orchestrate an environment in which digital investments can realize their full potential. That means not only setting a digital strategy and vision, but empowering people throughout an organization to be innovative and entrepreneurial.

Challenges here include the unavailability of digital leadership skills and competency, long vertical chains of command, cultural inertia to change and risk aversion. To overcome these challenges, leaders must fortify their organizations with each of the four further enablers that follow.

2. Forward-looking skills agenda

Infusing a digital mindset in the workforce by making innovation the focus of training and hiring programmes

The right skill set is imperative to successfully execute digital opportunities. Often, those digital opportunities are closely linked to one another and the full range of associated opportunities can only be uncovered if people have the skills to identify them.

According to a study by the Technical University of Munich and SAP, 64% of companies do not have personnel with the skills necessary for digital transformation.[7] A recent Accenture report states that only 3% of organizations plan to increase investment[8] in training programmes significantly in the next three years. Getting the right people means assessing skill requirements through the lens of an overall digital vision, then reskilling employees, hiring new talent and taking advantage of a liquid workforce. Whichever strategy it pursues, an organization must offer its workforce an engaging work environment that enhances the employee experience, incubates ideas and encourages creative thinking.

– **Reskilling**
Understanding that they need to enhance their workforces' digital and technical skills, companies are taking greater responsibility for helping employees keep pace with industry-wide digital transformation. Ensuring employees are lifelong learners is of the utmost importance and companies should encourage them to learn and work in parallel in order to meet the ever-evolving requirements of new technologies.

– **Attracting new talent**
While existing employees gradually acquire digital skills, companies are also aligning new hiring efforts with their digitalization needs. Looking at the combinatorial effects of new technologies, and not just at isolated digital initiatives, has led them to review new talent at all levels. For example, companies investing in AI and machine learning are building their big data and analytics functions. Such new roles need to give employees a better sense of purpose based on clear goals, greater accountability or self-directed growth.

> **"Encouraging people to focus on innovation – e.g. taking out a few days in a month for innovative thinking, activities and working as a team – helps in building a digital-ready workforce. Instead of resisting technology, we have found that employees often come up with suggestions on creating and testing innovative solutions."**
>
> Henrik Hahn, Chief Digital Officer, Evonik Industries, Germany

– **Utilizing a flexible workforce**
Companies have traditionally kept freelancers or part-timers on the fringes. As those workers move towards the core with their critical new skill sets, organizations need a detailed approach for integrating all forms of new talent and offering a consistent employee experience. Because of these trends and the dynamic skill requirements of digital transformation projects, concepts such as the liquid workforce are becoming more prominent.

Liquid organizations can seamlessly access the best talent and assets, whether they lie inside or outside traditional company boundaries. They identify the skills and capabilities they need to produce an outcome, then source, develop and manage appropriate talent via internal and external employment models.

– **Building accountability**
Business leads should be given digital-specific metrics or KPIs to monitor the digital readiness and associated capabilities of employees. These should be included in annual reviews and incentive plans to ensure progress.

With the rapid development of new technologies, it can be difficult for businesses to keep their skills agenda clearly aligned with the company strategy. Another major challenge for traditional players trying to build a workforce with the right digital skills is the tough competition from digital-native companies for scarce talent. Even the digital-native firms of Silicon Valley increasingly report that competition for talent is fierce.

AT&T – Preparing the workforce for digital transformation

Between 2007 and 2015, 150,000% growth in data traffic on its network forced telco giant AT&T to move towards software-defined systems. To address the need for new required skill sets, it started a programme called Workforce 2020 and, since 2013, has invested $250 million in education and professional development programmes while spending $30 million annually on tuition assistance. The programme started with an in-depth assessment of required skills, where each manager was asked to document existing gaps and formulate future role profiles.

An average AT&T employee stays with the company for 12 years, which means that education, foundational job training and initial role profile stem from a different era. Regularly, employees who are experts in technologies that become obsolete need to move to new roles (e.g. from maintaining emergency lines to becoming a data scientist). To enable that transition, AT&T created an online self-service platform for career tools (e.g. support to make informed career decisions, and organized workshops, for example on virtualization and cloud computing). It also offers individual courses on emerging technologies, education bundles ("nanodegrees") in cooperation with the online academy Udacity, and even a fully accredited online master's degree in computer science in cooperation with Udacity and Georgia Tech.

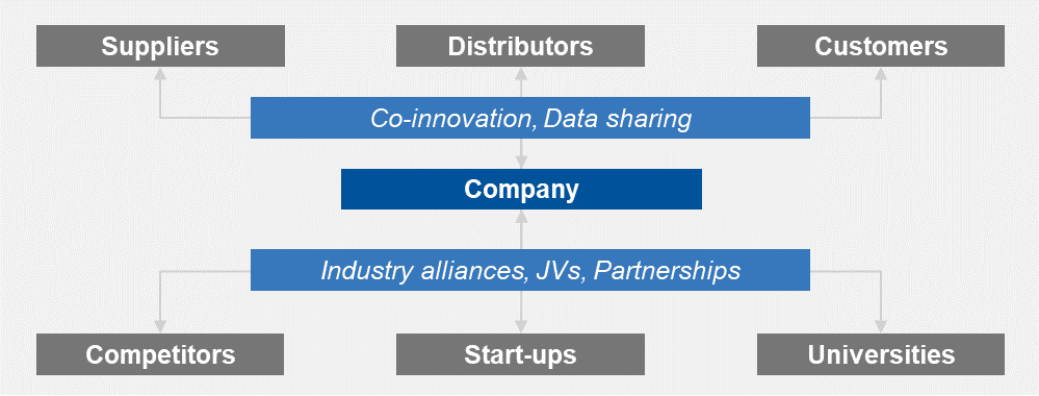
AT&T estimates that, so far, about 50% of its ~270,000 employees are actively engaged in acquiring skills for newly created roles. As of 2016, AT&T credits reskilling with a 40% decrease in its product development cycle and a 32% decrease in time to revenue.[9]

3. Ecosystem thinking

Collaborating within the value chain (e.g. with suppliers, distributors, customers) and outside (e.g. start-ups, academia)

As technology revolutionizes the way products and services are produced, distributed and consumed, visionary enterprises are stretching their boundaries and tapping into other digital businesses, providers, customers and even competitors to create "digital ecosystems" that harness ingenuity from across industries and disciplines. Using different models, they drive open collaboration with other participants in their ecosystem to make the most of data-driven opportunities (Figure 11).

Figure 11: Ecosystem Participants and Options for Collaboration (Illustrative)



Source: World Economic Forum/Accenture Analysis

– **Open collaboration**
Only organizations that can look beyond their own walls and navigate digital ecosystems will ride the next wave of strategic growth. Operating in isolation, they may find it impossible[10] or expensive to capitalize on digital opportunities. Successful digital companies are the most advanced in leveraging skills and capabilities that lie beyond their core organization.

Global results from Accenture Technology Vision 2017 indicate that 75% of C-level executives believe their competitive advantages will not be determined by their own organization, but by the strength of the partners and ecosystems they choose[11]. These leaders foresee the importance of business networks growing exponentially in the next five years with 74% even believing that ecosystems will be the basis for new partnership models, and suggest that platforms have shared responsibility for a brand by 2021.

– **Data based value co-creation**
The final stage of digital transformation usually means switching to a new business model and the monetization of data assets. The largest data-driven opportunity to capture value involves creating new products and services, improving user experiences, managing risk and increasing productivity. Ecosystems can be both a source of data and a means to utilize them through collaboration with value-chain participants (e.g. suppliers, customers). According to Accenture Technology Vision 2018, already 36% of businesses report working with double or more partners than they had two years ago.[12] Successful digital ecosystem collaborators achieve a balance: generating and using data within their ecosystem, while still protecting it from external misuse and maintaining their own competitive edge.

Larger organizations tend to be sceptical about opening up to new ways of collaboration. Customers are often not seen as equal business partners; trust in competitors is usually low after years of competition; and the unfamiliar culture of start-ups can be daunting. According to Accenture research, the success rate of ecosystem collaboration today is only 44%, due to poor forward planning and hitting avoidable issues.[13]

Successful digital collaborators overcome prejudices and established silo-thinking by building strong relationships and focusing the collaboration on specific and transparent outcomes. Structural changes are also required to ensure open ecosystem collaboration: companies should make their operating model fit for digital collaboration beyond traditional corporate boundaries, and align with their partners on shared languages and communication standards.

Iberdrola – Investing in multichannel collaboration for innovation

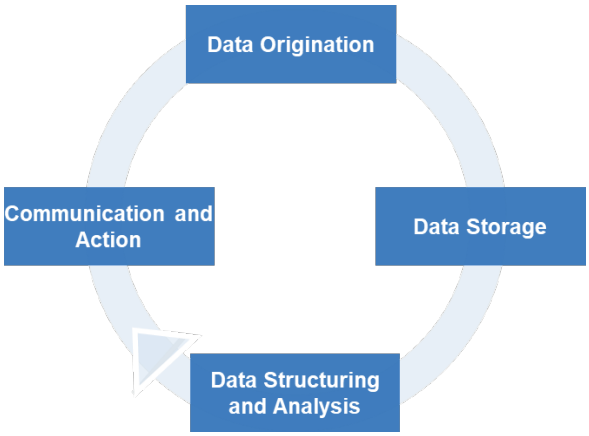
Iberdrola invests in collaborations within the value chain (mostly with suppliers) and outside the value chain (with universities and entrepreneurs) through a number of channels. For example with suppliers, the company engages in proof of concept initiatives and programmes to develop innovative procurement models from small and medium-sized enterprises. Further, Iberdrola engages with start-ups in their ecosystem by promoting young entrepreneurs via university programmes or with the help of its corporate venture capital programme, which has €70 million available to invest in disruptive technologies and businesses. In addition, it also collaborates in research with universities (e.g. a $10.3 million collaboration with the Massachusetts Institute of Technology to advance technologies that contribute to the energy transition).

4. **Data access and management**
Driving competitiveness through strong data infrastructure and warehouse capability combined with the right analytics and communication tools

Matching robust data infrastructure, plus warehousing and analytics capabilities, to strong communication tools can help companies actualize the full potential of technologies such as IoT, which can generate enormous amounts of data that offer highly beneficial insights.

Building those insights in real time is impossible without intelligent and connected data infrastructure that helps firms keep pace with actual business requirements while allowing for potential new revenue streams (e.g. data monetization). Balancing these objectives has proven difficult. Even with a strong, modern data architecture in place, it can be a struggle to find use cases for AI and machine learning. For companies wanting to strengthen their data access and management capabilities, the data-management life cycle includes four focus areas (Figure 12).

Figure 12: Data Management Life Cycle



Source: World Economic Forum/Accenture Analysis

– **Strong data infrastructure to enable origination**
Modern data architecture can support data-driven digital environments that are aligned to business requirements. Creating tangible and unique data lakes, for example cookies, creditworthiness, health and lifestyle (derived data), can provide significant competitive advantage. Enabling customer and employee devices/assets to generate and store data is a good way to build this capability.

– **Robust data warehousing to enable storage**
Carefully designed data warehouses that mix centralized and decentralized systems, and align with business requirements, are critical. Combinations of on-premise, cloud and hybrid models usually deliver the necessary storage capabilities.

– **Capabilities to structure and analyse data**
Efficient ways of processing data and extracting relevant elements for decision-making stop companies from drowning in huge amounts of low-value data. A focus on data quality over data quantity is recommended, and strong analytical tools help make best use of that data.

– **Tools and assets to communicate and take action on insights**
Communication tools such as Slack, Trello and Collabee enable smooth data sharing and collaboration across teams. This supports decision-making and helps communicate insights effectively. Decision-making is further supported by structured and analysed data.

With an increasing reliance on data, their quality and efficient management become key success factors for businesses. Over three quarters (79%) of executives responding to the Accenture Technology Vision 2018 survey agreed that organizations are basing their most critical systems and strategies on data, yet many have not invested in the capabilities to verify the truth within it[14]. Key challenges to that include maintaining the quality and uniqueness of data, building technology and workforce capabilities to draw meaningful insights, and maintaining data privacy amid ever-increasing customer expectations around trust, privacy and security. Platform owners, specifically, must safeguard usage and data rights, and ensure all participants conform to local regulations for the jurisdictions in which the platform operates. Another consideration is around the process of managing data, which can be very resource intensive; therefore, it is important to properly align it with business objectives and use cases.

> **Customer data that do not meet privacy regulations must be removed. The real insight within the data also has to be identified, which means distinguishing what's actionable from the noise around it.**
>
> Adam Malamut, Global Chief Customer Experience Officer, Marriott International, USA

Evonik – Developing a data-focused digital strategy
Specialty chemicals company, Evonik, has developed its Digital Lab to improve data management and give it all the prerequisites for building and scaling cognitive solutions. These prerequisites range from data quality and structuring to good use cases and business questions. Best practices in internal data management are the foundation for Evonik's outward-facing digital innovation activities, such as a strategic partnership with IBM and the University of Duisburg-Essen. In July 2017, its first pilot project developed a cognitive Evonik-specific chemical and life-science knowledge[15] corpus based on data analysed by IBM's Watson AI.

5. **Technology infrastructure readiness**
Building the required technology infrastructure to ensure strong capabilities on cloud cybersecurity and interoperability

The digital technologies analysed in this paper rely on a core set of underlying technologies that were not available a decade ago. For example, investing in analytics will not lead to optimal results without a data-management system that removes data silos. Similarly, IoT would not be possible without the cloud, connected devices, data-management technologies and high-speed broadband. There was excitement around AI in the late 1980s, but it died down a few years later due to the unavailability of enabling technologies. Today, AI is exciting again because of the exponential growth in processing power and the explosion of big data and cloud. Intelligent networks and modern architecture are also fundamental to agile businesses, allowing them to scale up and down quickly.

– **Cloud**
Digital companies no longer debate whether to use the cloud, only how much to use it. Most firms now invest in cloud capabilities to increase data-storage capacity and manage greater data-management requirements. As of 2017, 58% of companies already use cloud services to support some aspect of their business.[16]

– **Cybersecurity**
Anyone using digital technology to store or transfer data knows that robust cybersecurity is essential. Yet estimates suggest that 60% of digital businesses will suffer major service failures by 2020 due to the inability of IT security teams to manage risk[17]. Cybersecurity is also an enabler for building new business models around data monetization.

– **Interoperability**
Companies must ensure new systems can integrate with legacy systems to make seamless processes and data flows. They can typically do that via application programming interfaces, standard formats and harmonization of systems.

– **Transparency**
The legal and ethical implications of new technologies must be made clear to all stakeholders. Understanding and ensuring that digital solutions comply with regulation can help with transparency, as well as reduce the cost of digital investments.

The high cost of building and maintaining ready-to-use, state-of-the-art technology infrastructure is often a big challenge for companies preparing to invest in digitalization. Gartner estimates that, through 2018, integration and security will account for 50% of the cost of implementing IoT solutions.[18] To ensure transparent and legal behaviour, a continuous assessment will help companies keep up with unclear and changing requirements.

> **Software accounts for a minor share of the total cost of a digital transformation. The majority of the effort is in getting data, technology infrastructure and digitalization processes ready**
>
> Jan Mrosik, Chief Executive Officer, Digital Factory Division, Siemens, Germany

Sedicii: Making data secure
Ireland-based data-security start-up Sedicii has developed and patented a technology based on the Zero Knowledge Proof Protocol that eliminates the transmission, storage and exposure of private user data during authentication or identity verification. This reduces the risk of impersonation and any fraud resulting from identity theft, while addressing increasing consumer demand for more secure and transparent authentication methods. Although it is primarily a cybersecurity measure that helps to build digital trust and thereby enable monetization, it also helps to improve customer service and experience.

b. Guiding principles for execution

As well as confirming a set of enablers that companies must focus on, industry experts also emphasized the importance of the approach to execution. From DTI interviews and workshops, four guiding principles for executing digital opportunities emerged (Table 2). These principles share the objective of reducing inefficiencies and mitigating financial and operational risks while preparing an organization for either long-term digital transformation (e.g. work on the aforementioned enablers) or investment in short-term digital opportunities.

Table 2: Overview of the Guiding Principles for Execution

Establish clear ownership of digital investments	Invest in use cases, not technologies	Follow an outcome-based approach	Fail fast, fail cheap
– Build clear ownership and hierarchy for each investment at the organization and project levels – Set goals and incentives for investment owners that align with the overall digital vision	– Ensure each digital investment is built upon a clear use case that is integrated with an existing company function (e.g. marketing, sales, supply chain) – Create digital-specific KPIs and metrics, then track performance on how they help to achieve traditional business objectives	– Take an outcome-based approach, and be clear about the issue to solve and the relevant digital solution – Focus leadership on the digital strategy and capabilities, and understand key stakeholders' long-term digital demands and assessments of technology infrastructure readiness	– Use trial-and-error methods, prototypes and dynamic structures to optimize project life cycles and associated investments – Reduce the costs of failure by dividing projects into identifiable, short-term goals and defined stage-gates

c. Measuring the performance of digital investments

The average company enjoys positive revenue and productivity returns on digital investments, but for many firms it is still a challenge to measure the value impact of new technologies at the company level. Having such a measure is particularly important when building the business case for investing in a new technology or monitoring the performance of a newly implemented technology.

Traditional performance metrics such as free cash flows and net present value often fall short when it comes to digital investments, because those investments involve long payback cycles and uncertain or intangible outcomes (at least in the short term). Companies must therefore think about alternatives.

Limitations of net present value (NPV) in a digital context

NPV is one of the most used metrics for initial investment evaluation, but it is an unsatisfactory measure of innovation-led projects because of three major limitations:

- Calculations assume that cash flows are predictable.
- It emphasizes internal costs of capital, an increasingly arbitrary metric.
- It assumes that returns from existing businesses are steady and unchallenged.[19]

The three key approaches to consider while evaluating digital investments are to:

1. **Incorporate life-cycle thinking** into NPV calculations. For example, take diminishing returns from an existing business into account if it is already at the end of its maturity or in the decline phase.

2. **Use options thinking**, which assumes that an investment in digital technologies is always an investment in increasing options in a world of uncertainties. Under this assumption, if investment projects are designed to be continuously monitored and can easily be stopped, the new options they open can be more valuable than the initial investment. For example, implementing AI for a given business model may quickly prove unsuccessful, but the AI expertise acquired during this process could be a launch pad for exploring dozens of other more valuable opportunities.

   By applying this approach to multiple projects, companies can lay out an "opportunity portfolio". Projects are evaluated in terms of their market and technical uncertainty, their resource intensity and their upside potential. The aim is to cover a range of projects across different levels of uncertainties[20].

3. **Combine financial and non-financial metrics**, an approach adopted by leading companies. Having identified clear business objectives for their projects, they use a tailored mix of financial and non-financial metrics to control and evaluate them (Table 3). Well-suited non-financial metrics include measures of customer satisfaction and loyalty, such as the Net Promotor Score, a metric that is relatively easy to obtain and is based on one simple question to the customer: "what's the likelihood that you would recommend our company to a friend or colleague?"[21] Another suitable set of non-financial metrics includes efficiency metrics such as overall asset utilization. These metrics, however, need to be very specific to the digital solution and the way they address company and customer needs.

Table 3: Traditional Financial and Digital Metrics

Traditional Financial Metrics	Digital Metrics
– Revenue growth – Cost savings – EBITDA margin – Free cash flows – NPV	– NPV incorporating life-cycle thinking – Options portfolio value – Operational, project-specific (financial or non-financial) metrics – Digital traction metrics (e.g. Net Promotor Score)

Digital traction metrics are often used for digital platforms or business models. In simple terms, they provide proof that someone wants a company's product or service. Through a combination of behavioural metrics (e.g. frequency of use, customer engagement, number of users), they can communicate both popularity and momentum in market adoption.

> **Non-traditional, non-financial metrics are important, but digital investments must still be measured against how they help to achieve our business objectives.**
>
> Rob Monk, Global Director, Enterprise Architecture and IT Digital Innovation, Heineken, Netherlands

Kaiser Permanente – Developing goals for digital initiatives

When US-based healthcare maintenance organization Kaiser Permanente needed to implement an integrated digital platform, and realized that it might not break even for more than 10 years, it developed a clear set of over 25 specific operational goals. These goals were used to demonstrate the projects' value to the leadership team and to monitor them from development through deployment and scaling. New metrics, such as electronic drug prescriptions, online requests for appointments, video visits or online laboratory results[22], are now part of Kaiser Permanente's annual report.

Morgan Stanley – Using new metrics for customer engagement

When financial services provider Morgan Stanley introduced its wealth management platform, direct financial returns based on usage fees were not an option. The clear business objective was to give clients more options and increase customer engagement, which resulted in its use of performance metrics, such as net acquired assets and transactional revenue. With those metrics, it was realized that just six contextual emails over five months were sufficient to enhance engagement with existing clients.

Adobe – Adjusting executive incentive plans to new business models

Adobe changed its business model from selling boxed software to providing a cloud subscription model and adjusted its Executive Incentive Plans accordingly. It moved from using revenue and operating profits to using the value of bookings for Adobe marketing cloud and digital media cloud subscriptions as key metrics for executive incentives.[23,24]

Questions for Further Investigation

The Fourth Industrial Revolution is under way. Many industries have begun to digitally transform, and companies that have successfully implemented digital initiatives are already considering their next steps. To catch up with these digital leaders, other firms must now anticipate the next wave of disruptors in their sector. As organizations launch or overhaul their digital investment strategies, analyse the performance of new technologies and track the status of key enablers, they have several questions to consider:

Drivers of digital investments

- **Digital coverage:** How much of your business is driven by digitally enabled products or services?
- **Digital agenda:** Are your digital investments serving your overall strategic objectives as well as tactical needs? Are these projects scalable?
- **Digital investment portfolio:** Does your investments in new technologies have a balanced focus on driving new efficiencies, enhanced customer experiences and new business models?

Key enablers to maximize the return on digital investments

Agile and digital-savvy leadership:

- How are you reskilling your leadership team on the applications of new technologies?
- Do they have the right mix of business and technology skills?
- Is the purpose of digital transformation clearly communicated across management levels?

Forward-looking skills agenda:

- Does the entire workforce understand the case for change and the significance of augmenting skill sets by combining technology applications with human ingenuity?
- Does the leadership have a clear view of the skills gap and required skill sets for digital transformation?
- How does your organization enable and incentivize lifelong learning?

Ecosystem thinking:

- Are your value-chain participants, such as suppliers and customers, already identified and approached as partners for data-based value co-creation?
- How do you engage start-ups as part of your ecosystem collaboration efforts? Is there a clear approach to measure the value impact of their engagement?

Data access and management:

- Are you already capable of accessing data in the required quality and structure to support investments in technologies such as IoT?
- Do you have the ability to make data-based decisions in real time?

Technology infrastructure readiness:

- Do you have a sufficiently strong technology infrastructure to support digital investments?
- How do you assess the technology infrastructure readiness?

Measuring the performance of digital investments

- **Digital performance metrics:** How do you measure performance on your digital investments? Are they part of management rewards?
- **Stakeholder engagement:** Is the objective of your digital investments clearly communicated to stakeholders? Are the performance incentives aligned to the achievement of that objective?

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