

# *Industry 4.0: Building the digital enterprise*

Engineering and construction key findings



**397**

*engineering and  
construction  
company  
executives  
interviewed in  
26 countries*

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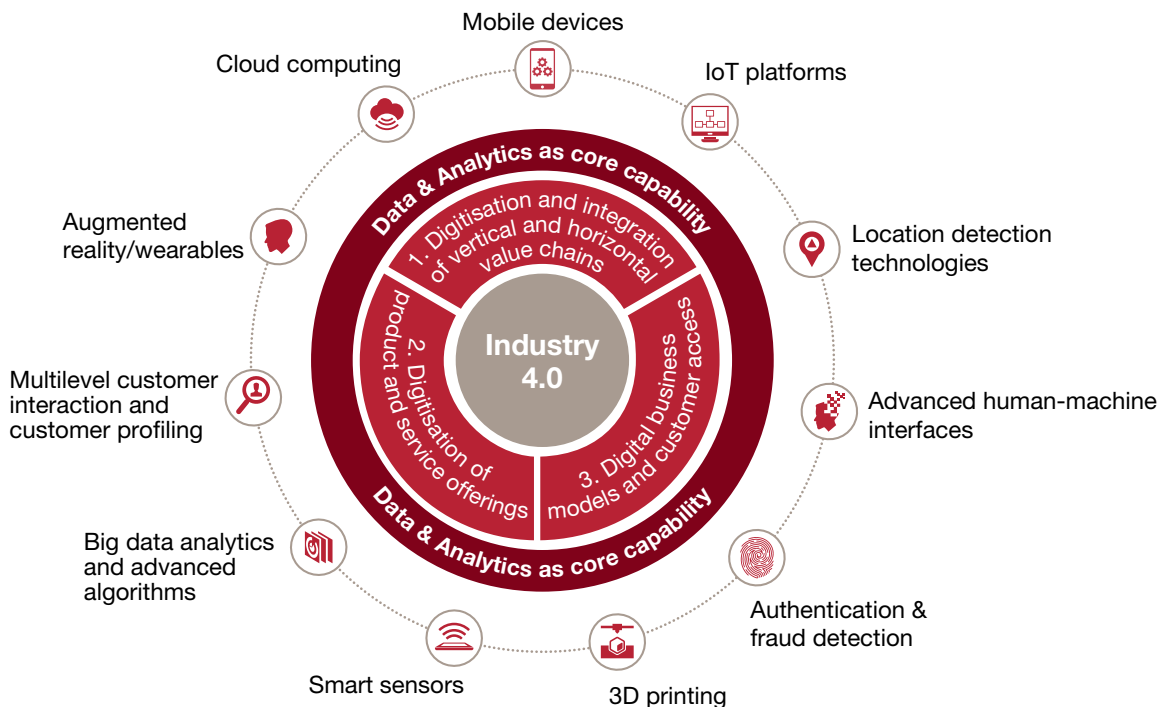
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PwC's 2016 Global Industry 4.0 Survey is the biggest worldwide survey of its kind, with over 2,000 participants from nine major industrial sectors<sup>1</sup> and 26 countries. It goes to the heart of company thinking on the progress of Industry 4.0. The study explores the benefits of digitising your company's horizontal and vertical value chain, as well as building your digital product & service portfolio.

## Industry 4.0 at a glance

We include a detailed description and definition of Industry 4.0 in the main global report on the survey. In summary, Industry 4.0 is being driven by digitisation and integration of vertical and horizontal value chains, digitisation of product and service offerings and the development of new digital business models and customer access platforms.

### Industry 4.0 framework and contributing digital technologies



<sup>1</sup> Aerospace, defence and security; automotive; chemicals; electronics; engineering and construction; forest, paper and packaging; metals; industrial manufacturing; transportation and logistics.

## Overview

Behind the scenes of the world's leading industrial and manufacturing companies, a profound digital transformation is now underway. The engineering and construction sector is no exception. Companies are digitising essential functions within their internal vertical value chain, as well as with their horizontal partners along the supply chain. In addition, they are enhancing their product portfolio with digital functionalities and introducing innovative, data-based services.

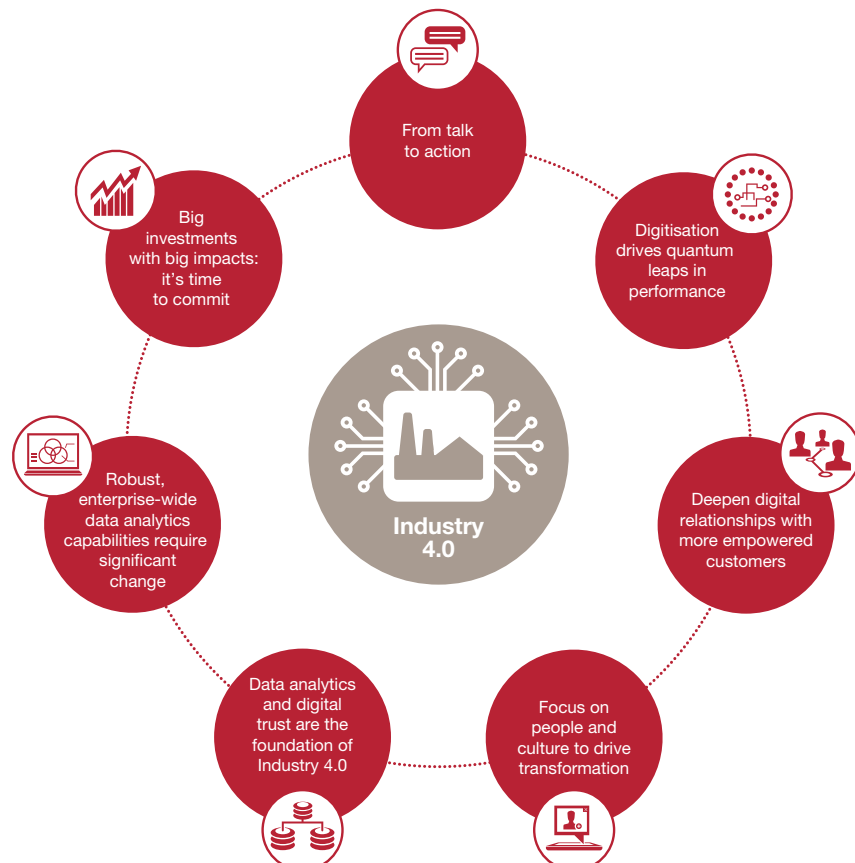
- Engineering and construction companies plan to invest 5% of annual revenue in digital operations solutions per annum over the next five years. And they are setting themselves ambitious targets for the level of digitisation and integration that can be achieved.
- In an industry sometimes characterised as focused on the immediate short-term challenges of demanding clients and complex project delivery, companies are investing in long-term innovation that they expect will unlock significant efficiency, cost-reduction and revenue gains.
- Technologies such as 3D printing, building information modelling (BIM) and the

integration of design and off-site component-based assembly are evolving fast and coming of age. At the same time, new innovations offer future integration and productivity opportunities and the increased ability to monitor assets over the lifecycle rather than just the construction phase. Autonomous vehicles can provide driverless transportation of materials between sites and on-site. Flying robots and drone surveillance offer the prospect of easier planning, design, monitoring and execution of projects as well use in repairs and maintenance activities.

Some of these developments are happening now. Others remain for the future. But far from being laggards in the adoption of Industry 4.0, the engineering and construction companies we spoke to are embracing it at an increasing rate. The digitisation, integration and automation opportunities offered enable companies to collaborate both internally and across their value chains in ways that can provide a step change in productivity as well as design and build quality. And they are opportunities that are increasingly important as companies seek to stay relevant as the era of digitally-connected smart infrastructure develops.

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### Key findings from our survey research



# 01 Industry 4.0 has moved from talk to action

The buzz around Industry 4.0 has moved from what some had earlier seen as PR hype to investment and real results today. Engineering and construction companies in our survey plan to invest 5% of annual revenue each year in digital operations solutions over the next five years, in line with the level of investment reported across all the industries that we surveyed.

This investment is translating into increasingly advanced levels of digitisation and integration. Nearly a third of engineering and construction companies report they have already reached an advanced level of digitisation and integration and more than two thirds expect to be at such a level in five years' time (figure 1).

In common with other sectors, advanced digitisation and integration of the horizontal value chain, with suppliers, customers and other value chain partners, is progressing a little slower than with the vertical value chain. One of the challenges for the engineering and construction sector is that it's a very fragmented supply chain. Trust and cooperation between contractors and a longer-sighted view are essential.

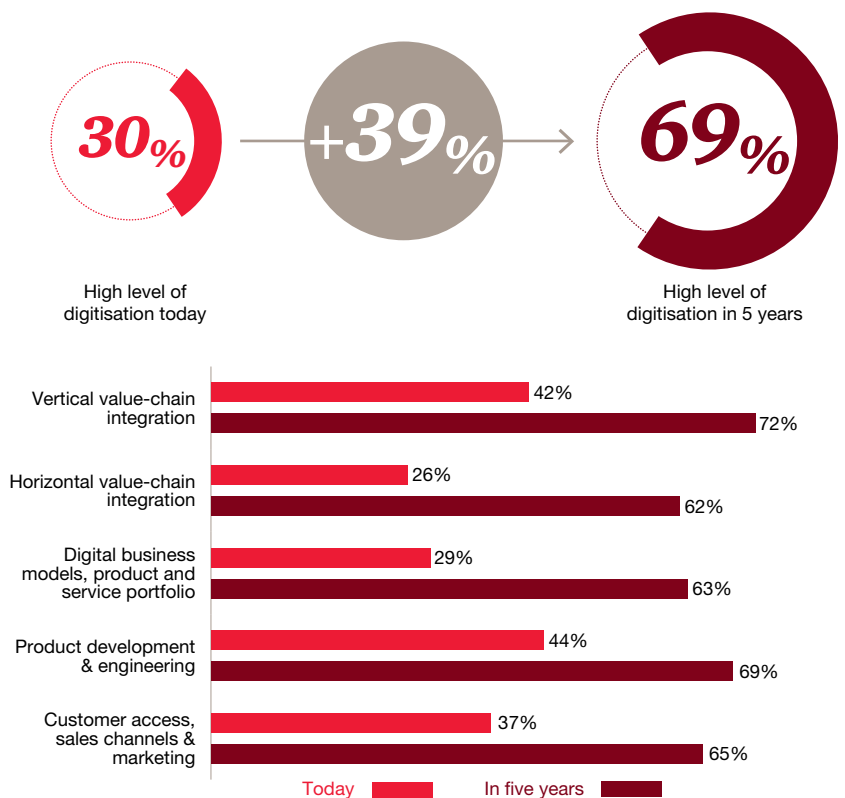
Given the many different parties involved in even small- to medium-sized construction projects, achieving greater horizontal integration offers potentially significant project benefits in terms of cohesiveness, scheduling, materials flows and collaboration. More than some other sectors, engineering and construction companies are already used to working in consortia and sometimes through joint ventures. This collaborative working could give an added impetus to the development of Industry 4.0 in the sector.

Product development and engineering is the area where engineering and construction companies rate themselves as furthest advanced down the digitisation and integration road. This reflects the importance of the growth of digital design and engineering in the construction sector. Digital solutions include features such as automated data acquisition, storage and access; 3D drawing; construction sequencing; progress monitoring; and virtual rehearsal.

But they also reach further into the built environment with the advent of built-in sensors and automation enabling engineering and construction companies to develop products and services that cover the lifecycle of buildings and infrastructure assets, integrating with energy management, repair and maintenance and wider smart building and smart city applications. Drone powered solutions are also likely to become increasingly prevalent for the collection of data.<sup>2</sup> They are ideally suited to large scale capital projects and infrastructure maintenance, sectors that require mobility and a high quality of data.

**46%**  
of engineering and construction respondents say they have already reached advanced levels of digitisation in product development & engineering

**Figure 1: Industry 4.0 is beyond the hype – it has arrived at the strategic and operational core of many engineering and construction companies**



Shown: Percentage of companies reporting advanced levels of digitisation and integration

**Q: How would you classify the current level of digitisation and integration in the following areas in your company? What levels of digitisation and integration are you expecting in the next five years?**

<sup>2</sup> PwC, Clarity from above: global report on the commercial applications of drone technology, May 2016.

## 02 Digitisation is driving quantum leaps in performance

Our survey respondents anticipate significant gains over the next five years from the implementation of Industry 4.0 initiatives. On average, companies across all sectors that we surveyed expect to reduce costs by 3.6% per annum. Engineering and construction companies are nearly as optimistic with only a marginally smaller projection for cost savings.

The spread of the industrial internet and sensors has the potential to transform the construction industry in many respects - from equipment monitoring and repair, management and ordering, energy conservation, tagging and tracking to safety. Better availability of relevant information, rapid issue resolution, collaboration technologies with suppliers and customers, collaborative working in the design, construction and operation of projects are among the key ways in which digitisation is improving efficiency and resource use.

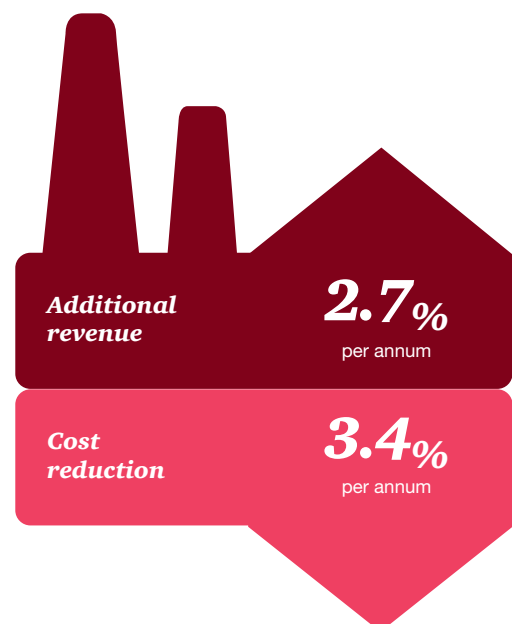
Survey participants also expect additional significant revenue growth to flow from their digitisation and integration initiatives. Again, the expectations of engineering and construction companies are only slightly less ambitious than those of companies in all the sectors covered in the survey. They anticipate a revenue gain of 2.7% per annum compared to 2.9% in the survey as a whole.

These are substantial simultaneous revenue-adding and cost-saving gains. Gains of the magnitude uncovered by our survey have the potential to change the competitive landscape within a very short space of time. If even half of the expectations outlined above are realised, some companies may find it difficult to compete. In an increasingly cost-competitive market, no engineering and construction company can afford to lose out in operational efficiency against their market peers. The next two to three years will be crucial for companies looking to catch up.

***If even half of the expectations outlined are realised, some companies may find it difficult to compete. In an increasingly cost-competitive market, no engineering and construction company can afford to lose out in operational efficiency against their market peers.***

**Figure 2:** High expectations of cost savings, increased revenue and efficiency gains (engineering and construction)

***Expected benefits from digitisation over the next five years***



Q: What benefits from digitisation do you expect in the next five years?

### 03 Deepening digital relationships with more empowered customers

As Industry 4.0 develops, it will greatly enrich the opportunities to retain and grow the client relationship but it will also make the fight for the customer more intense. Clients and customers will be at the centre of the changes to value chains, products and services. Services will be able to be increasingly customised to customer needs, and many of our survey respondents say they plan to use data analytics to understand and address these needs better.

Most companies we spoke to are expecting to strengthen their digital offering to customers, either by digitising existing products or by developing new digital products. The opportunity is there not only to greatly increase the ability to respond flexibly and more rapidly to customer demands, but also to anticipate demands, helping customers get ahead of themselves in a range of predictive ways. Improved 3D modelling of housing developments, for example, can demonstrate the positive impacts of schemes more clearly to residents and investors.

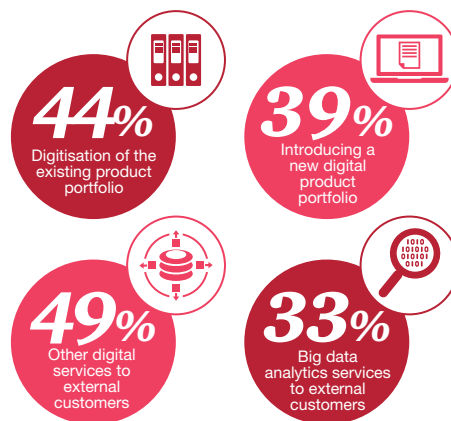
Engineering and construction companies plan to expand their digital portfolio, starting with the digitisation of their existing offering but also expanding into new products and data services (figure 3). Building information monitoring (BIM), for example, is already offering considerable potential to minimise costly project overruns, through earlier engagement in design by all parties. There is also the opportunity offered by modular design

**Data about the functional and design characteristics of a building are being put at the heart of project planning and execution and being used to deepen collaboration.**

to construct building components off-site in safer, more controlled environments as well as using 3D printing directly in the construction process.

By putting data about the functional and design characteristics of a building at the heart of project planning and execution and using this to deepen collaboration, companies can reduce waste during project execution and minimise disruptive changes to project design. With feedback loops about the performance of existing projects and structures increasingly becoming possible, BIM and other data-gathering processes become self-enriching processes to inform future project design. And companies engaged in long-term frameworks covering maintenance and repair, for example, can utilise data about the actual use of the asset to inform maintenance decisions.

**Figure 3: Revenues from digitising the product and service portfolio will grow significantly in future (engineering and construction)**



Note: Companies achieving 10% or more additional revenue in the following areas over the next 5 years. Multiple answers possible

**Q: Which of the following new digital products or services do you plan to introduce and expect will generate more than 10% of your future revenue over the next 5 years?**

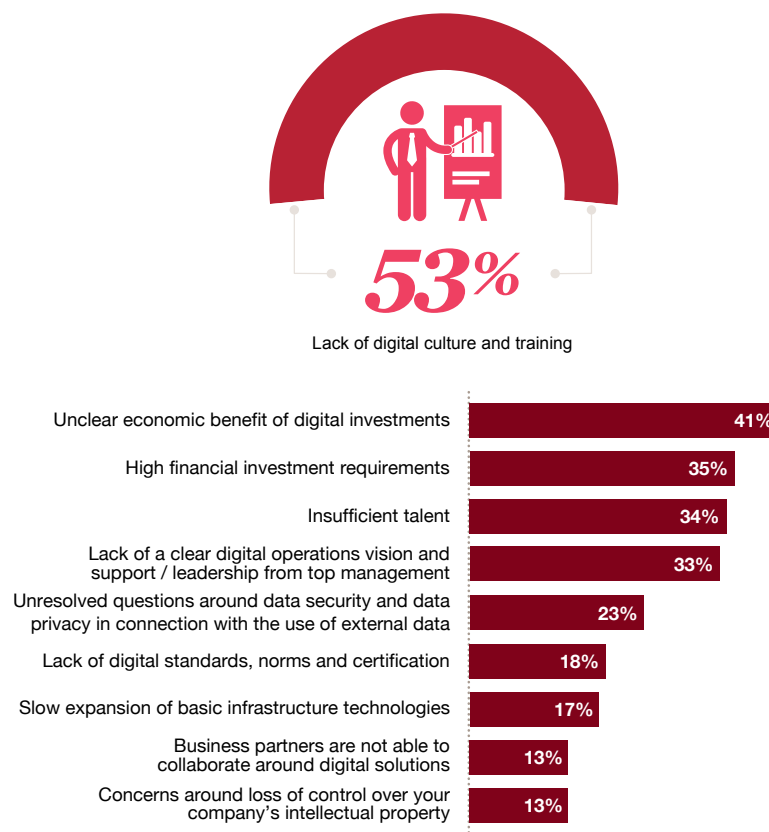
## 04 Focus on people and culture to drive transformation

Industry 4.0 has significant implications for the nature of how a company chooses to organise itself and its delivery model. Companies will need to make sure staff understand how the company is changing and how they can be a part of it. From our interviews with engineering and construction companies, the biggest challenges revolve around internal issues such as culture, organisation, leadership and skills, rather than external issues such as whether the right standards, infrastructure and intellectual property protection are in place or whether concerns about data security or privacy concerns can be overcome.

The absence of a digital culture and the right training was identified as the single biggest challenge by more engineering and construction companies than any other. Over half (53%) put it in their top three challenges. In this respect, they are in good company as changing the culture was a lead issue across all the sectors we surveyed.

For many companies, culture is linked closely with the need to have clear vision and leadership from top management about the direction of digital operations. This is also an issue for engineering and construction companies although, in contrast to most other sectors, it was eclipsed into second place by concerns that the economic benefits of digital investments still remain unclear. Clearly all these factors go hand in hand, and one important way of establishing momentum in changing the culture will be for top management to communicate clearly the benefits that they see ahead, and to ensure they are identified and celebrated as they are achieved.

**Figure 4: Lack of digital culture and training is the biggest challenge facing engineering and construction companies**



Note: Included as one of three possible responses

**Q: Where are the biggest challenges or inhibitors for building digital operations capabilities in your company?**

## 05 Data analytics and digital trust are the foundation of Industry 4.0

Data lies at the heart of the fourth industrial revolution, but the massively growing information flow brings little value without the right analytics techniques. The rapidly growing number of sensors, embedded systems and connected devices as well as the increasing horizontal and vertical networking of value chains result in a huge continuous data flow.

Data is coming from multiple sources, in different formats, and there is a need to combine internal data with data from outside sources. Expert and effective data analytics are essential

to using data to create value. And with so many points of entry, companies need to take a rigorous, proactive approach to data security and related issues and work to build digital trust.

Our survey data show that many engineering and construction companies already understand the vital importance of data analytics. Four in ten view it as important or very important to their companies today, and this rises to 72% when they are asked to look five years ahead (see figure 5).

**Only 19% of engineering and construction companies have advanced data analytics capabilities**

**Figure 5: Engineering and construction companies: in five years from now a significant importance will be placed on data analytics**



**Q: What significance does the gathering, analysis and utilisation of data for decision making have for your company?**

There's still a long way to go before companies reach the level of sophistication needed to really drive Industry 4.0 applications. Only 19% of engineering and construction companies rate the maturity of their data analytics capabilities as advanced – a result that is in line with other sectors.

A key challenge is skills. It's an issue for all companies but is felt even more acutely by those in engineering and construction. Nearly three fifths (59%) pinpoint lack of data analytics skills in their own workforce as a particular data analytics challenge compared with 53% across all the sectors we surveyed. And nearly three quarters (72%) cite increasing in-house data analytics technology and skill levels as the single biggest improvement route to boost their data analytics capabilities (versus 69% in the survey as a whole).



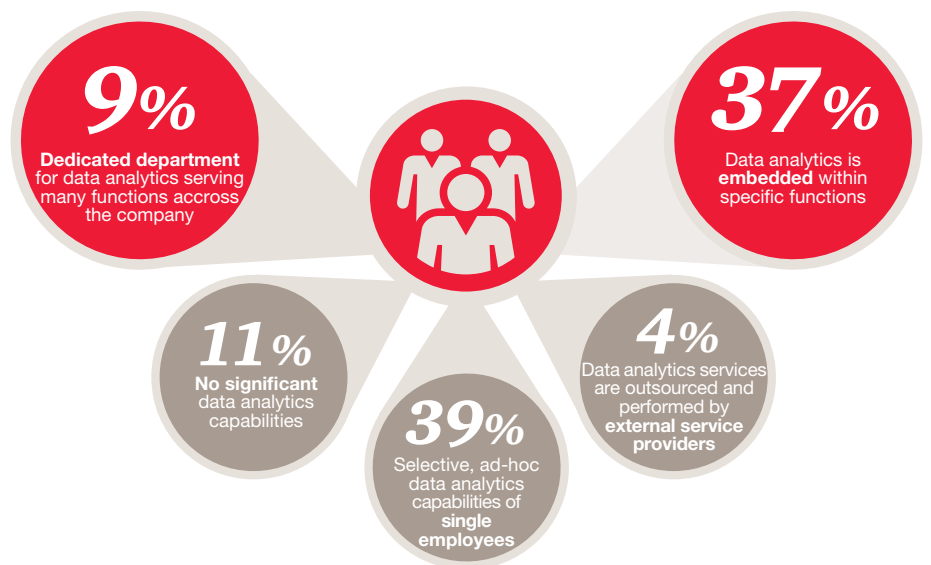
## 06 Robust, enterprise-wide data analytics capabilities require significant change

Another challenge lying in the way of companies establishing strong data analytics capabilities is getting robust organisation and governance frameworks in place. We found that many companies still have 'ad hoc' approaches. Around half lack a structured approach to data analytics organisation and governance. Many (39% of engineering and construction companies) rely on the selective, ad-hoc data analytics capabilities of individual employees, while another 11% per cent have no significant data analytics capabilities at all.

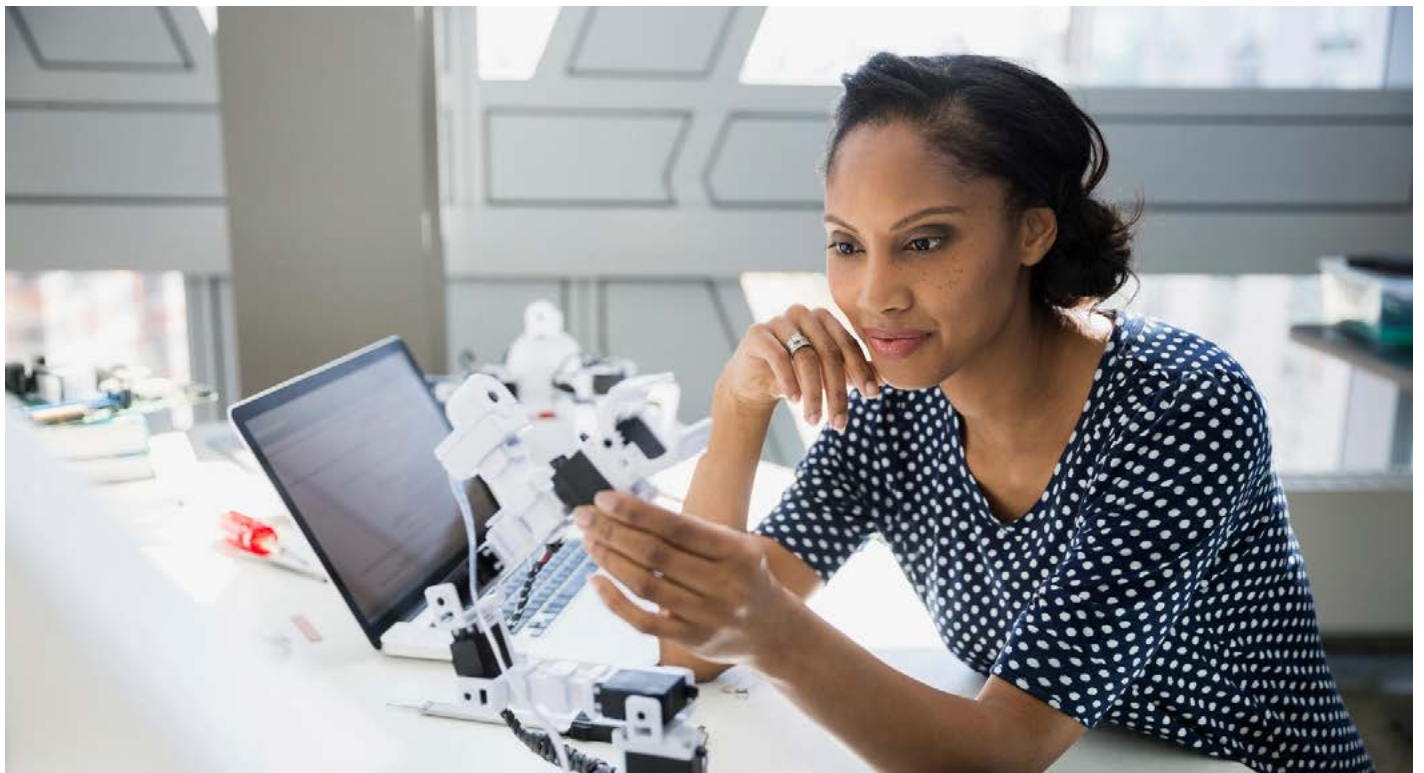
In contrast, just over a third (37%) have embedded data analytics into specific functions, giving themselves the flexibility and proximity to business knowledge to fully utilise the potential of data analytics. Another 9% of companies have a dedicated department for data analytics serving many functions across the company.

Across all sectors, our survey found that companies who consider they have advanced data analytics capabilities are much more likely to have pursued these two options – 43% have embedded their data analytics in specific functions and 24% have a dedicated department.

**Figure 6: Engineering and construction: organisation of data analytics capabilities**



**Q: How are data analytics capabilities organised in your company?**



## 07 Big investments with big impacts and rapid returns

Big investments are being made in Industry 4.0 initiatives. The prize for companies is a very special one – the prospect of achieving significant revenue gains while simultaneously reducing costs.

This golden prize of higher revenues and lower costs is in reach because the advanced connectivity and automation of Industry 4.0 allows companies to gather and analyse data from across a wider range of activities and from partners, suppliers, collaborators, end uses and end customers in ways that enable faster, more flexible processes to produce higher-quality output, sometimes highly customised, at reduced costs. Heightened connectivity and automation gives companies the opportunity to add value to products and to develop new kinds of offerings to address their markets.

The pace at which engineering and construction companies expect to accrue benefits from Industry 4.0 investment leads a majority (56%) to estimate a return on investment (ROI) timescale of two years or less (figure 7). Just over a third (35%) of companies anticipate a longer timescale of two to five years but relatively few (9%) think that it will take any longer than five years for Industry 4.0 investments to pay for themselves.

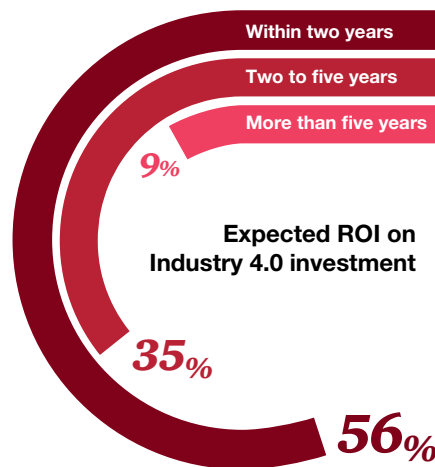
***It simply won't be possible for companies to achieve advanced digitisation without making a step change in investment, given the continued rapid progress anticipated by companies who are already leading***

### **Catching up is getting increasingly difficult**

Looking ahead, many of those who haven't invested significantly in the past two years plan to step up investment in the coming five years. That's one way to close the gap. But just over a third of companies still expect to keep their future investment relatively low. Some of these companies may be waiting for the 'perfect' technology. That's short-sighted. As we've already shown, the biggest challenge companies face isn't buying the right technology, it's transforming their people and culture. These require long-term change programmes.

It simply won't be possible for companies to achieve advanced digitisation without making a step change in investment, given the continued rapid progress anticipated by companies who are already leading. The investment required to catch up is likely to be too costly, and faster-moving companies will have a significant advantage when it comes to positioning their offerings as a "platform of choice" within digital ecosystems. Perhaps most importantly, companies who try to jump in too late will find that their internal cultures have lagged behind and no amount of advanced technology acquired later on will bring them up to speed.

**Figure 7: Engineering and construction: most companies expect Industry 4.0 investments to pay back within two years**



Note: Answers shown are rounded

Q: Which return on investment period (ROI) do you expect from your digital investments?

## Blueprint for digital success

To move forward with Industry 4.0, digital capabilities are all-important. These take time and concentration; a step-by-step approach is important. But move with deliberate speed, so that you don't lose the first-mover advantage to competitors.

### 1) Map out your Industry 4.0 strategy

Evaluate your own digital maturity now and set clear targets for the next five years. Prioritise the measures that will bring the most value to your business and make sure these are aligned with your overall strategy. Make sure company leadership is ready and willing to champion your approach.

### 2) Create initial pilot projects

Use them to establish proof of concept and demonstrate business value. Target a confined scope, but highlight the end-to-end concept of Industry 4.0. Not every project will succeed, but they will all help you to work in a cross-functional and agile approach with customers and technology partners - the new norm of the future. With evidence from early successes, you can also gain buy-in from the organisation, and secure funding for a larger rollout. Design pragmatically to compensate for standards or infrastructure that don't yet exist. Collaborate with digital leaders outside your organisation, by working with start-ups, universities, or industry organisations to accelerate your digital innovation.

### 3) Define the capabilities you need

Building on the lessons learned in your pilots, map out in detail what capabilities you need to achieve your vision. Include how enablers for Industry 4.0, like an agile IT infrastructure, can fundamentally improve all of your business processes.

Remember to develop strategies for attracting people and improving

processes as well as for implementing new technologies. Your success with Industry 4.0 will depend on skills and knowledge. Your biggest constraints may well be your ability to recruit the people needed to put digitisation into place.

### 4) Become a virtuoso in data analytics

Consider how you can best organise data analytics; cross-functional expert teams are a good first step. Later these capabilities can be fully embedded in your functional organisation.

Learn to get value out of data by building direct links to decision-making and to intelligent systems design. Use the data to improve products and their use in the field to offer and build new service offerings. Think big, but start small, with 'proof of concept' projects.

### 5) Transform into a digital enterprise

Capturing the full potential of Industry 4.0 often requires company-wide transformation. Look to set "tone from the top", with clear leadership, commitment and vision from the C-suite and financial stakeholders. Foster a digital culture: all your employees will need to think and act like digital natives, willing to experiment with new technologies and learn new ways of operating.

Remember that change doesn't stop once you've implemented Industry 4.0. Your company will need to re-invent its capabilities at faster rates than in the past to stay ahead of the game.

### 6) Actively plan an ecosystem approach

Develop complete product and services solutions for your customers. Use partnerships or align with platforms if you cannot develop a complete offering internally. You may find it difficult to share knowledge with other companies, and you may prefer acquisition. But look for ways to bridge this gap - perhaps with technical standards - so that you can profit from being part of platforms that you don't fully control.

Real breakthroughs in performance happen when you actively understand consumer behaviour and can orchestrate your company's role within the future ecosystem of partners, suppliers and customers.

**Don't buy the hype. Buy the reality. Industry 4.0 will be a huge boon to companies that fully understand what it means for how they do business. Change of this nature will transcend your company's boundaries - and probably the national boundaries of the countries where you do business.**

## Blueprint for digital success



Map out your Industry 4.0 strategy

1



Create initial pilot projects

2



Define the capabilities you need

3



Become a virtuoso in data analytics

4



Transform into a digital enterprise

5



Actively plan an ecosystem approach

6

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