

Industry 4.0: Building the digital enterprise

Aerospace, defence and security key findings



38

*aerospace,
defence and
security company
executives
interviewed*

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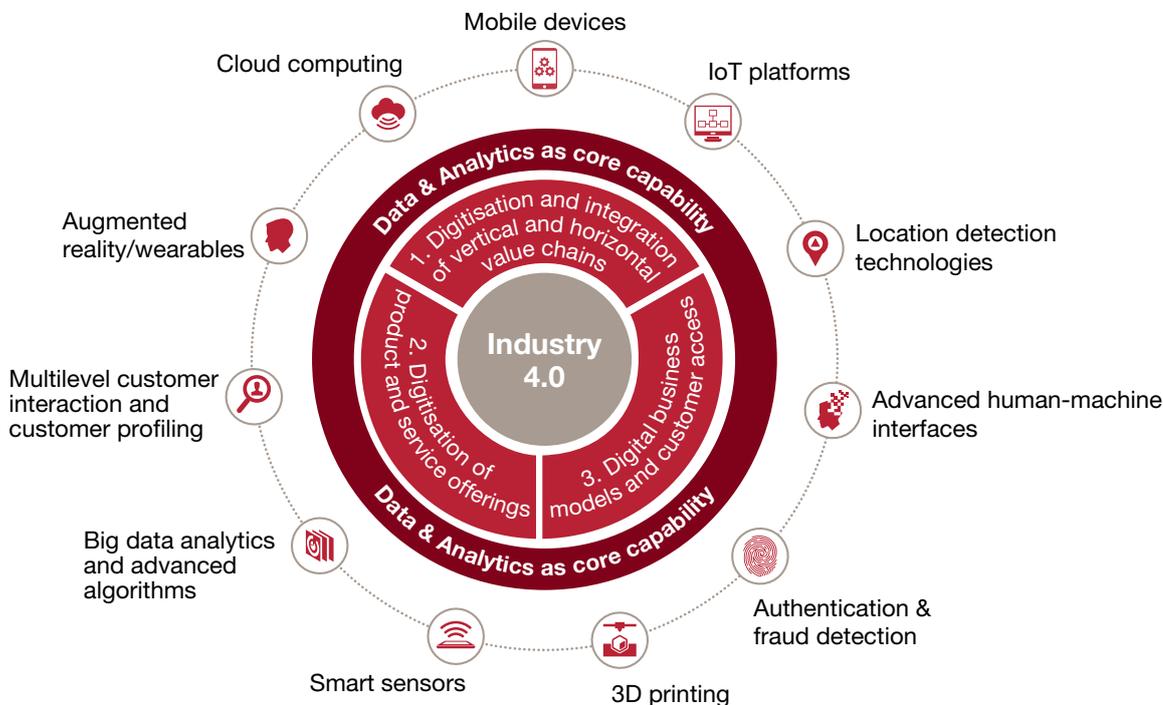
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PwC's 2016 Global Industry 4.0 Survey is the biggest worldwide survey of its kind, with over 2,000 participants from nine major industrial sectors¹ and 26 countries. It goes to the heart of company thinking on the progress of Industry 4.0. The study 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



¹ 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 aerospace, defence and security 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.

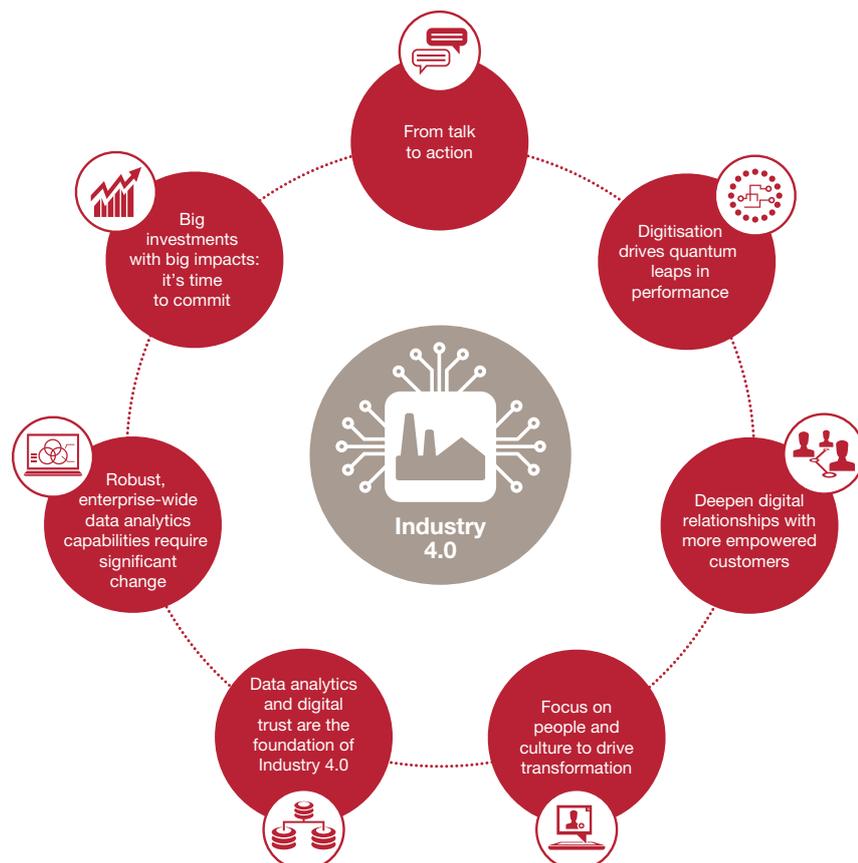
- Aerospace, defence and security companies report they are already investing in digital operations solutions and three quarters (76%) expect to have achieved an advanced level of digitisation and integration in five years' time – higher than any other sector we surveyed.
- Industry 4.0 is giving companies the opportunity to tighten global supply chains, drawing suppliers into the network, getting them more coupled and using new technological opportunities to link them through a wide range of design, supply chain, demand and other forms of data. They are also developing new products and tools based around data and data analytics, in some cases

opening up potential for new data-driven business models that can widen value-chain positioning.

- Technologies such as 3D printing are already being put to use in production and in repair and maintenance. The focus is on flexible systems that reduce cost, improve quality and boost productivity. Automation is also taking off with greater adoption of robots, automated guided vehicles and other technology such as autonomous smart riveting crawlers in aerostructure assembly. At the same time, innovations such as virtual and augmented reality, drones, flying robots and natural language computing offer both future productivity and product opportunities.

Some of these developments are happening now. Others remain for the future. The digitisation journey in the aerospace, defence and security sector is already well underway and is set to accelerate in the immediate period ahead. It is changing the possibilities for customer interaction, productivity within the enterprise as well as for new products and services development. And it is enabling companies to collaborate both internally and across their value chains in ways that can provide a step change in doing business.

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 hype to investment and real results today. The aerospace, defence and security participants in our survey plan to invest 5% of annual revenue in digital operations solutions over the next five years, in line with the level of investment reported across all the industries that we surveyed.

It is a significant amount in the context of a sector where margins can be tight. Although the commercial aerospace side of the industry has the benefit of a very long-term order book and production horizon, it also has the need for very tight near-term delivery discipline. Investing in capacity-boosting innovation carries risk and uncertainty, particularly for smaller and medium-sized companies below tier one level. And on the military side, investment continues to be framed by constraints and uncertainties in government spending.

But there is no lack of ambition about digitisation. Nearly a third of aerospace, defence and security survey respondents report they have already reached an advanced level of digitisation and integration, and three quarters expect to be at such a level in five years' time (figure 1) – the highest expectation of all the sectors that we surveyed.

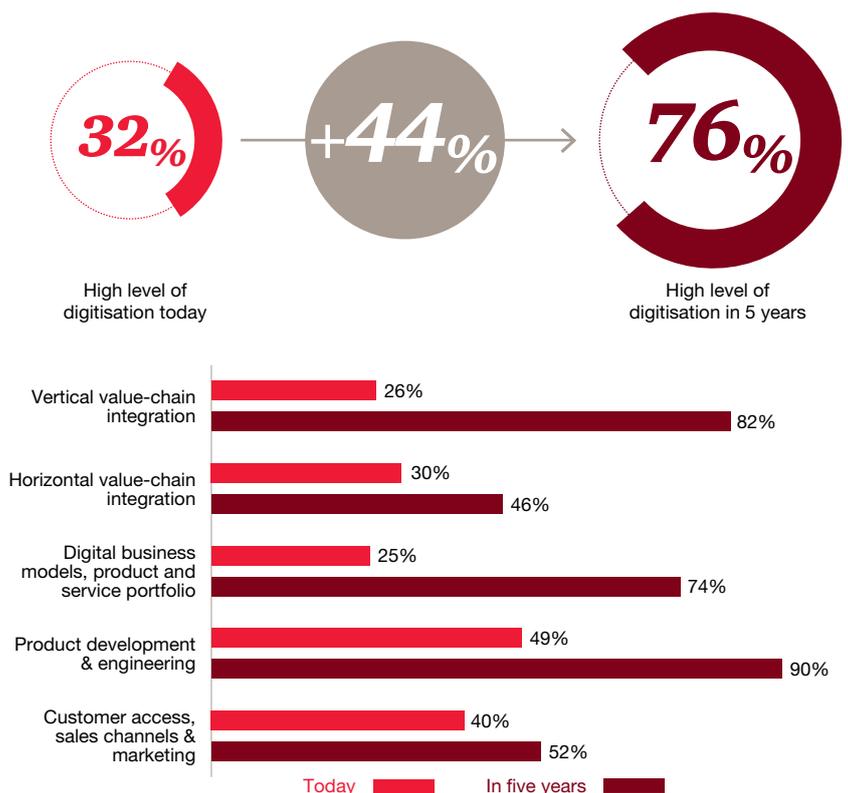
In common with other sectors, advanced digitisation and integration of the horizontal value chain, with suppliers, customers and other value chain partners, is progressing a little slower than with the vertical value chain. Companies are putting a lot of effort into creating greater transparency within their manufacturing and vertical supply chain environment, but the horizontal supply chain for many companies is highly fragmented. Here, digitisation and integration challenges can be considerable and less than half (46%) the companies we interviewed expect to be advanced in five years' time.

In contrast, the proportion expecting to have reached an advanced level of digitisation in their vertical value chains and in product development by 2020 is much higher – 82% and 90% respectively. New approaches to product development adopted from the IT industry, like scrum engineering, or rapid prototyping and launch and learn processes, will have a major impact on how products are developed and at what speed. In the space sector, the emergence of SpaceX as the world's fastest-growing provider of launch services is an example of how these approaches are taking root. New business models based on digital technology are a big priority for many aerospace and defence companies, and three quarters expect to have reached an advanced level of digitisation in five years' time. We discuss this further later in this report.

54%

of Aerospace, defence and security 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 aerospace, defence and security 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?

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 the sectors that we surveyed expect to reduce operational costs by 3.6% per annum. Aerospace, defence and security companies are similarly optimistic, with a slightly higher expectation of cost savings, of 3.7%.

Survey participants also expect additional revenue growth to flow from their digitisation and integration initiatives. Again, the expectations of aerospace, defence and security companies are broadly in line with 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.

The potential of data analytics, in particular, to boost the revenue models of aerospace, defence and security companies is considerable. In the security sector, the use of data from CCTV, smart city infrastructure, mobile and internet-connected devices translates directly into new possibilities for security products and services. Companies producing aircraft and other hardware are increasing the ways they use the enormous amount of data generated in the design, construction and operation of modern aircraft and other aerospace, defence and security hardware to explore new data-driven business models. Predictive maintenance is just one example, but the use of data is extending into other areas such as onboard data from passengers.

The gains opening up to companies from digitisation and data analytics have the potential to change the competitive landscape within a very short space of time, if they are in addition to the continuous improvement gains that companies would expect to achieve regardless of Industry 4.0. Those who are slow to explore them may find it difficult to compete. In an increasingly cost-competitive market, no company in the aerospace, defence and security sector can afford to lose opportunities to improve their cost and revenue position against their market peers. The next two to three years will be crucial for companies looking to catch up.

Those who are slow to explore digitisation and data analytics may find it difficult to compete. In an increasingly cost-competitive market, no company in the aerospace, defence and security sector can afford to lose opportunities to improve their cost and revenue position against their market peers.

Figure 2: High expectations of cost savings, increased revenue and efficiency gains (aerospace, defence and security)

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. Products and services will be able to be increasingly tailored to customer needs, and many of our survey respondents say they plan to use data analytics to understand and meet these needs.

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 in a range of predictive ways. Most companies we spoke to are expecting to strengthen their digital offering to customers, either by using big data analytics to offer services to external customers, digitising their existing products or by developing new digital products (figure 3).

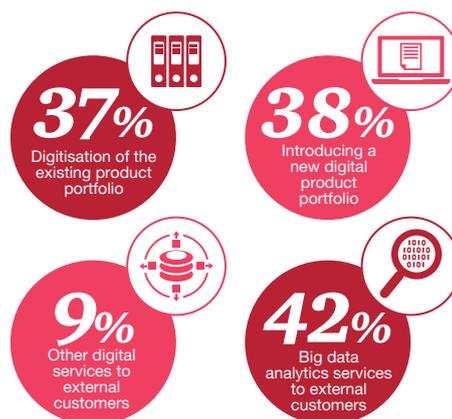
On the military side, for example, manufacturers are able to use the data set from an aircraft to create immersive and experiential simulation software and training programmes that can transform the training economics for fighter and other flight crews. Wear and tear on the airframe can be minimised and reserved for the missions that matter, reducing substantially the overall cost of operations.

Commercial airline manufacturers are extending their digital products in a range of ways. A typical aircraft has millions of parts. The amount of data output is immense and is increasing rapidly with a new generation of aircraft. The Airbus A320, for example, produces 20,000 data parameters but the latest A350 has 400,000 and a data output of some 250GB per flight.² This data is being put to use to improve flight operations, safety and efficiency, enhance the passenger experience and deliver better predictive and customised maintenance.

The gains for customers are substantial. For example, combining external weather data with in-flight route data and planning can improve fuel efficiency. A gain of just one percent in fuel efficiency is worth around

US\$2bn for airlines. In both the civil and military sectors, data analytics and digitisation offer considerable scope for companies to extend their end-to-end fleet lifecycle solutions for customers.

Figure 3: Revenues from digitising the product and service portfolio will grow significantly in future (aerospace, defence and security)



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?

Most companies we spoke to are expecting to strengthen their digital offering to customers, either by using big data analytics to offer services to external customers, digitising their existing products or by developing new digital products.

2 Laurent Martinez, SVP and Head of Services Business Unit, Airbus: managing aviation complexity with the Internet of Things, <http://ibm.com/IoT>

04 Focus on people and culture to drive transformation

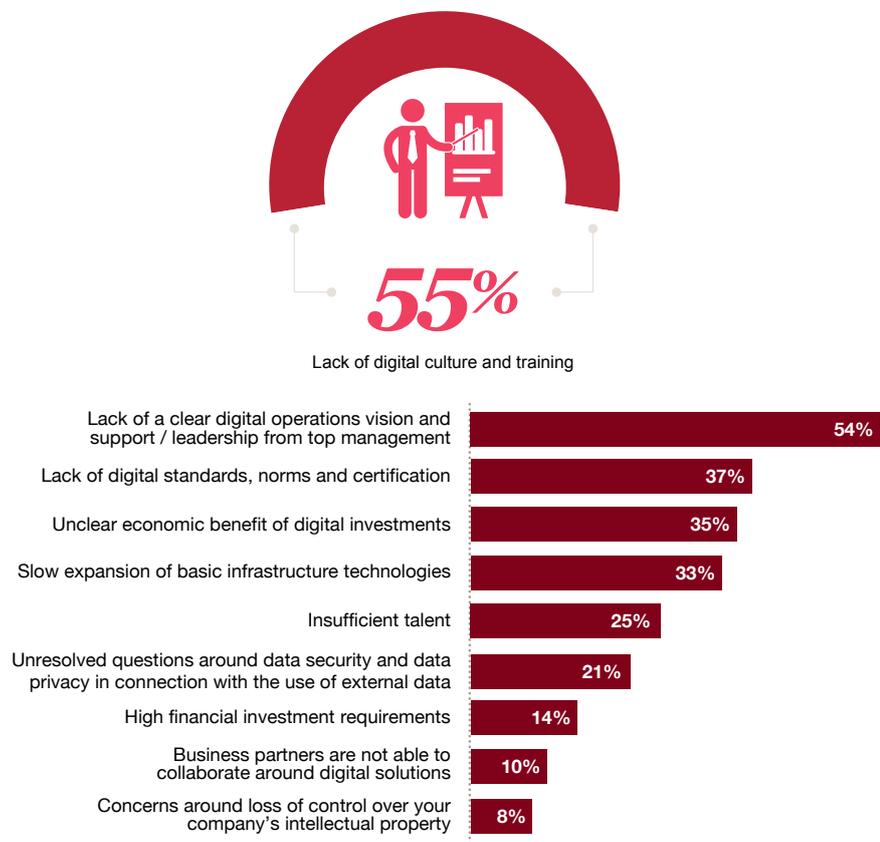
Industry 4.0 has significant implications for the way in which a company chooses to organise itself and its delivery model. Companies will need to make sure staff understand how the company is changing and how they can be a part of it. The new potential for digital products is taking most aerospace, defence and security companies into a more service-oriented and software-focused environment that stands in contrast to their engineering roots and core culture.

From our interviews with aerospace, defence and security companies, the biggest challenges to digital operations centre 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 aerospace, defence and security companies. Over half (55%) 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 aerospace, defence and security companies. 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 aerospace, defence and security 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 is 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 shows that many aerospace, defence and security 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 82% when they are asked to look five years ahead (see figure 5) – the biggest leap in all the sectors we surveyed.

The biggest leap in the importance of data analytics came from aerospace, defence and security companies.

Figure 5: Aerospace, defence and security 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?

But there's still a long way to go before companies reach the level of sophistication needed to really drive Industry 4.0 applications. Only 16% of aerospace, defence and security survey participants rate the maturity of their data analytics capabilities as advanced – a result that is in line with other sectors.

A key challenge is skills. Nearly two fifths (38%) of survey participants from the sector pinpoint the lack of data analytics skills in their own workforce as a particular data analytics challenge. This is the lowest figure from the industries

we surveyed and compares with 53% in the survey as a whole. In part, this may reflect the fact that large parts of the AD&S workforce are typically highly skilled in statistics and mathematics, which are foundational elements for data analytics. Nonetheless, 63% of survey respondents from the sector still cite increasing in-house technology skill levels as the single biggest improvement route to boost data analytics capabilities (versus 69% across the whole survey).

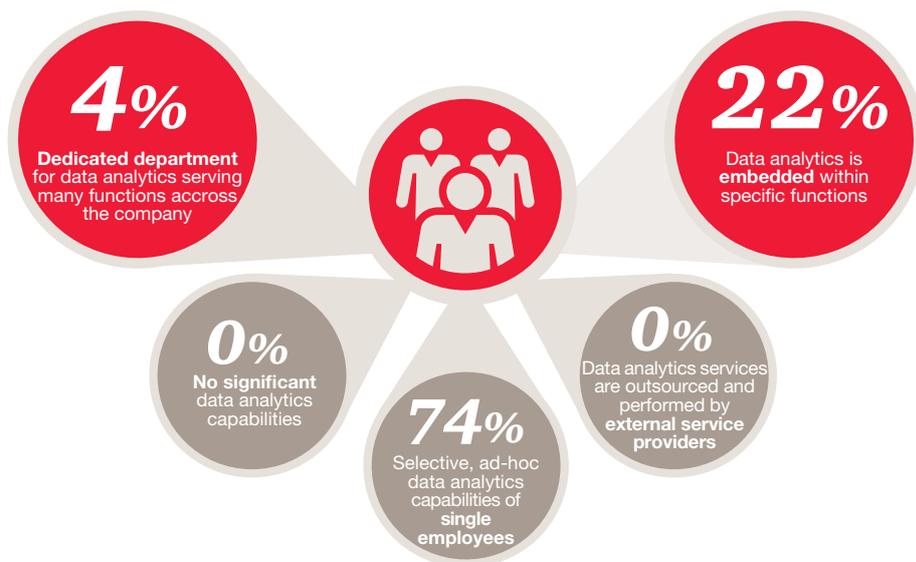
06 Robust, enterprise-wide data analytics capabilities require significant change

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 to data analytics. Nearly three quarters lack a structured approach to data analytics organisation and governance, relying on the selective, ad-hoc data analytics capabilities of individual employees. This proportion is the highest of all the sectors we surveyed.

We would expect larger, technology-rich companies to have a much more robust approach to data analytics in place. Indeed, just under a quarter (22%) of the aerospace, defence and security executives we interviewed said their companies have embedded data analytics into specific functions, giving themselves the flexibility and proximity to business knowledge to fully utilise its potential. Another 4% 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: Aerospace, defence and security: 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 aerospace, defence and security survey participants expect to accrue benefits from Industry 4.0 investment leads a majority (51%) to estimate a return on investment (ROI) timescale of two years or less (figure 7). Over a third (38%) of companies anticipate a longer timescale of two to five years but relatively few (11%) think that it will take any longer than five years for Industry 4.0 investments to pay for themselves.

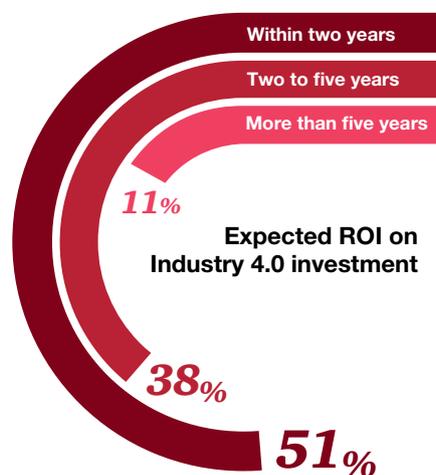
Companies who try to jump in too late will find that their internal cultures have lagged behind.

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 and reflects in a way the fundamental cultural challenge. Instead of accepting failure by adopting a 'launch and learn' approach, too much time is lost in risk minimisation and searching for the 100% solution – a culture which is deep-rooted in the security-driven environment of AD&S.

It simply won't be possible for companies to achieve advanced digitisation without making a step change in investment and the way it is allocated, 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 which 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: Aerospace, defence and security: 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. Define new revenue models and cost-reduction opportunities. 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. Make a special effort to define and communicate your digital vision. Do not just define a digital strategy, but also the digital levers to enable and drive your strategy.

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. Data security is mission-critical for the aerospace, defence and security sector and you cannot afford to have failed to look ahead or, even worse, have to manage a breach of standards. 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 and data governance, 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 and retain 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. Be clear about the resources you need; the targets that you'll set communicate clearly your

achievements along the way. Look to set "tone from the top", with clear leadership, commitment and vision from the C-suite and financial stakeholders. Foster a digital culture: many of 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



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