

WHITE PAPER

Smart Factory in Europe: 2019 and Beyond

The challenges and opportunities of Smart
Factory today and tomorrow

Lead Analyst:

Jason Stamper

Co-authors: Stefanie Naujoks, Klaus Holzhauser

teknowlogy Group, October 2019

Premium sponsor:



CONTENTS

PREFACE	3
INTRODUCTION	4
WHAT IS SMART FACTORY?	4
KEY FINDINGS	6
SMART FACTORY MATURITY, FOCUS AREAS AND CHALLENGES	8
RELEVANCE OF SMART FACTORY TO OVERALL ORGANIZATIONAL STRATEGY AND FUTURE COMPETITIVENESS	10
FOCUS AREAS	12
CHALLENGES	15
DECISION-MAKING AND SMART FACTORY SPENDING	17
SMART FACTORY SPENDING	19
SMART FACTORY SPENDING: SPECIFIC PROJECTS	20
ROI ON SMART FACTORY INITIATIVES	22
SMART FACTORY TECHNOLOGIES AND COLLABORATION WITH THIRD PARTIES	23
TECHNOLOGIES, IT INTEGRATION AND CLOUD DEPLOYMENT OF SMART FACTORY SOLUTIONS	24
THE FUTURE – A GLANCE AT SOME OF THE BLEEDING EDGE TECHNOLOGIES	26
CONCLUSIONS	28
PAC’S OPINION	29
METHODOLOGY	30
ANNEX	31
DISCLAIMER, USAGE RIGHTS, INDEPENDENCE AND DATA PROTECTION	31
LIST OF FIGURES	32
ABOUT FUJITSU	33
ABOUT TEKNOLOGY GROUP	34

PREFACE



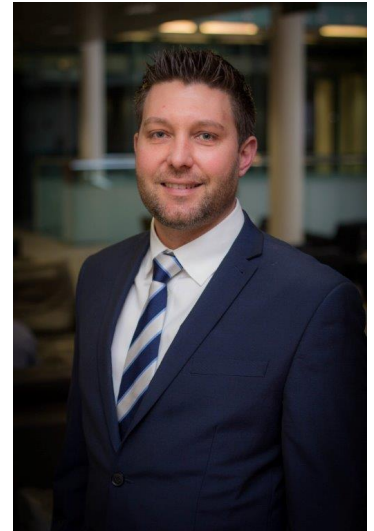
The fourth industrial revolution is upon us and digital technology is creating a hyperconnected world in which end-customers are finding themselves much closer to factory production lines. Suddenly, factories don't just make things, they also produce services which are customized to individuals. Not only this, customers are now demanding to buy at any time, from any place, using any device and they want to know how ethical and environmentally friendly their purchases are. This is the driving force for technological innovation and the reason why implementing a data driven smart factory is so important.

This survey highlights that only 28% of manufacturers are utilising smart factory data today, and a further 29% will be within 3 years. As more and more people realize the potential of the data driven smart factory, manufacturers have the chance to come of age in very tangible (and profitable) ways. What's happening is that IT and OT are coming together within manufacturing organizations to create a smooth and seamless flow of data that customers can connect in to. That, in turn, generates even more valuable data which can be used to fine tune outputs, achieve mass customization and ultimately improve the customer's experience.

There are some good examples of the data driven smart factory already present in the manufacturing space. In the consumer goods industry for example, you can reduce the amount of illicit products on the open market by using digital initiatives such as imbedded NFC tags in products. Big fashion brands on the other hand are offering customers the ability to customize the materials, colors and design of their training shoes. Meanwhile, data driven AI combined with image recognition is helping to improve product quality and worker safety in large heavy metal manufacturing companies. Not forgetting the automotive manufacturers who are leveraging quantum technologies to improve productivity safety with almost zero capital investment.

The survey also concludes that one of the major challenges with Smart Factory projects is the high level of investment required. Fujitsu recognize the uptake of Smart Factory initiatives is relatively slow for large global manufacturers due to the level of investment required. However, we believe that targeting the correct initiatives that deliver the best ROI back to the business and embracing digital solutions that transform the end customer experience will accelerate the uptake significantly and make you the leader in your field.

At Fujitsu, we're helping to pioneer all of these elements. We are, after all, a manufacturer too and we've been manufacturing for over 80 years. We're proud to be at the forefront of this new data driven era. We're actively delivering Industry 4.0 and ensuring that as the manufacturing sector comes of age, we can all harness the benefits.



Johan Carstens

**CTO Manufacturing and
Automotive, Northern and
Western Europe Region**

**Fujitsu
22 Baker Street
London W1U 3BW**

Being smarter about Smart Factory

INTRODUCTION

Manufacturers in Europe today are facing macroeconomic headwinds, with some economists predicting that some European economies may be heading towards a recession.

Under such pressure, many manufacturers are looking to technology, specifically what the industry refers to as Smart Factory or Intelligent Factory, to enable them to be more efficient and profitable.

It will no longer be enough for manufacturers to sell products and innovations to customers and produce them at reasonable costs. In fact, global competition has put a lot of pressure on manufacturers to increase the efficiency of shop-floor operations to further reduce product costs and to be competitive in global markets.

WHAT IS SMART FACTORY?

Smart Factory is a concept borne out of research around 'Industry 4.0' – the name given to the current trend of automation and data exchange in manufacturing technologies.

It includes cyber-physical systems, the Internet of Things (IoT), cloud computing, Artificial Intelligence and more.

The basic principle of the Smart Factory is that by connecting machines and other systems, businesses are creating intelligent networks throughout the manufacturing process that can control each other autonomously, or at least semi-autonomously.

Within modular structured Smart Factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world (a 'Digital Twin') and make decentralized decisions. Over the Internet of Things (IoT), cyber-physical systems communicate and cooperate with each other and with humans in real time, both internally and across organizational boundaries, even extending to suppliers and partners in the value chain.

This Europe-wide survey shines a light on the latest challenges and opportunities around the Smart Factory concept, asks where manufacturing firms are on their journey to the Smart Factory, and questions how companies plan to invest in technologies, skills, and processes to help them transition to a future-ready Smart Factory.

But is the concept even real, and not mere hype from IT and operational technology (OT) vendors?

To find out, teknowlogy Group surveyed IT and OT decision-makers at 204 European manufacturing companies with more than 500 employees, which have at least some Smart Factory initiatives in place. The study was conducted in May and June 2019. Interviewees were drawn from the UK, Central Europe (Germany and France), Southern Europe (Spain and Italy) and the Nordics (Finland, Sweden and Denmark). A detailed breakdown of respondents can be found in the Methodology section.

KEY FINDINGS



Most companies are increasing investment in Smart Factory initiatives

An overwhelming 63% of companies said that they plan to increase their investment in Smart Factory in the next three years.



Smart Factory is a key strategic objective

Smart Factory is a very strategic objective for most companies. Most respondents, 66%, ranked Smart Factory a 7 out of 10 or higher on their list of strategic priorities.



Return on Investment

56% of our respondents are yet to see ROI but many are still in the early stages of their roll-out. 44% have achieved an ROI already, and of those, 45% saw ROI in less than one year.



Many Smart Factory initiatives have already come of age

8% – higher than we had expected – consider themselves to already be in the advanced stages of deployment, where they have an organization-wide Smart Factory initiative.



Maturity of the market overall

37% said that they are in the planning and evaluation stages of their Smart Factory initiatives. 19% consider themselves in a medium phase of deployment, which is what we describe as having the first live Smart Factory initiatives that are generating business impacts.



Edge Smart Factory data analytics is currently limited, but growing

Most companies (46%) analyse Smart Factory data in their own datacentre, while 40% said they analyse data in the cloud. 14% said they analyse data at the edge – i.e. close to plant machinery on the production floor. However, when asked about their plans for the future, 35% said they want to be analysing data at the edge in five years' time – so edge analytics is set to more than double in that time-frame.



Internal goals of Smart Factory strategies

Companies said that they are primarily doing Smart Factory to improve product quality, support digital transformation and enable easier and more efficient customization of products.



External goals of Smart Factory strategies

The number one external benefit of a Smart Factory strategy according to our survey was improving customer satisfaction. Next came improving supply chain management (51%) and better monitoring and management of products after they leave the plant (39%).



Challenges of Smart Factory initiatives

The number one challenge (58%) was the high level of investment required. With manufacturing facing macroeconomic head-winds, perhaps we should not be surprised. After that the challenges included building the business case, lack of skilled staff, complexity of analysing data, the cost of implementing and managing Smart Factory and challenges integrating IT with operational technology (OT).



Smart Factory and the cloud

Most companies' Smart Factory deployments are evenly split between public and private clouds (46%). The rest use multi-vendor public cloud, single-vendor public cloud, or their own private cloud.



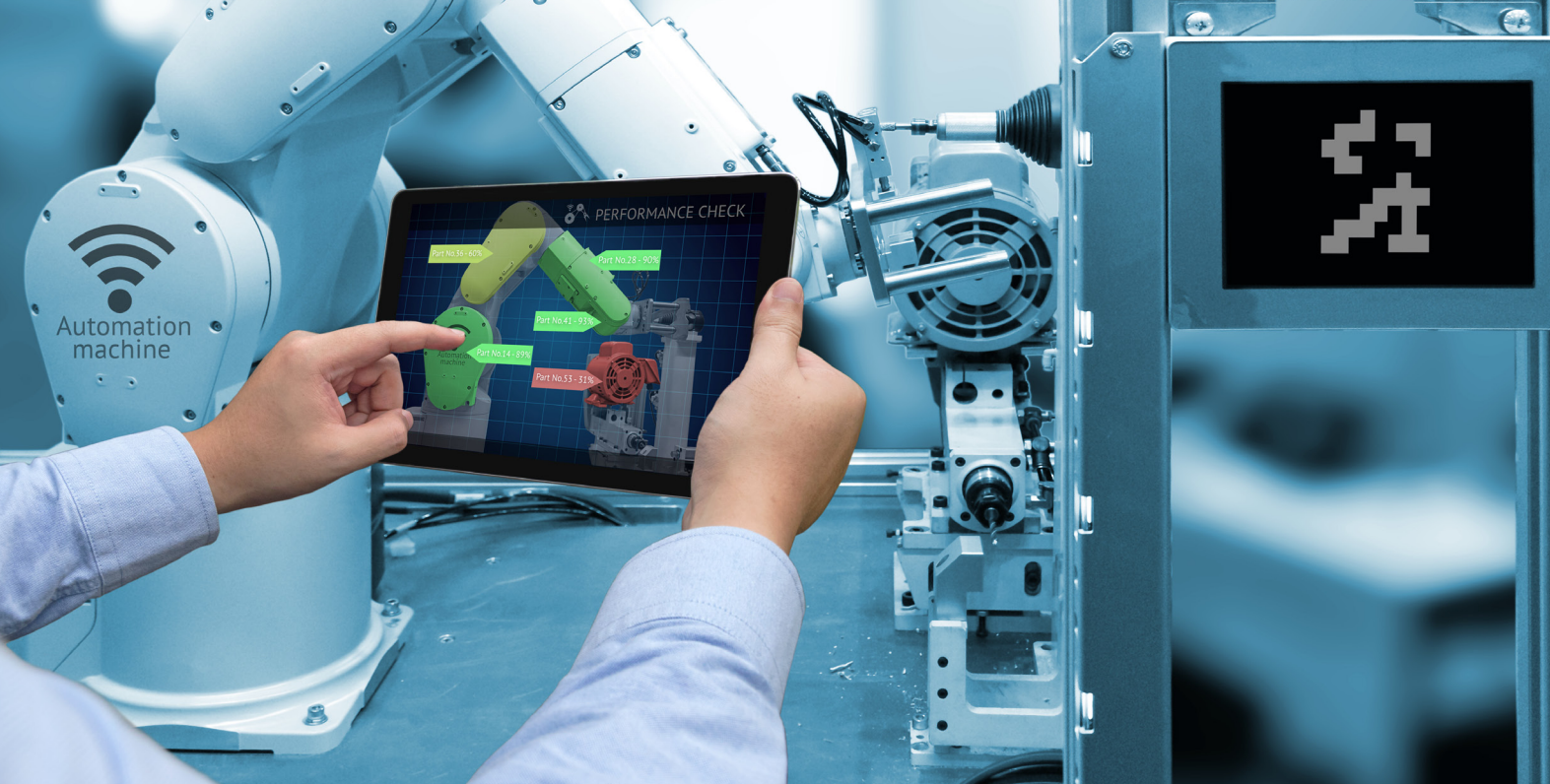
Smart Factory data is not always analysed – yet

When asked if companies are using Smart Factory data in business decision-making, 28% said that they are, and 29% said that they plan to inside three years. Most (69%) analyse less than half of their Smart Factory data. Only 22% said they analyse around two-thirds of their Smart Factory data, and only 9% analyse over 75% of their Smart Factory data. Companies cited cost, complexity and lack of analytics skills as holding them back.



Looking to the future

The organizations that we surveyed already have some ideas about bleeding-edge technologies such as distributed ledger technologies blockchain, deep learning using artificial intelligence and quantum computing. Asked which are of major relevance, 59% said distributed ledger technologies such as blockchain; half said deep learning using artificial intelligence and 19% said quantum computing.



SMART FACTORY MATURITY, FOCUS AREAS AND CHALLENGES

As discussed above, technology argues that the Smart Factory is a concept borne out of research around 'Industry 4.0' – the name given to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of Things (IoT), cloud computing, Artificial Intelligence (AI) and more.

'Industry 4.0' is a project in the high-tech strategy of the German government that promotes the computerization of traditional industries such as manufacturing. The goal is an intelligent factory that is characterized by adaptability, resource efficiency, and ergonomics, as well as the integration of customers and business partners in business and value processes. Its technological foundation consists of cyber-physical systems and the Internet of Things.

As noted earlier, the basic principle of the Smart Factory is that by connecting machines and other systems, businesses can build intelligent networks throughout the manufacturing process that can control each other autonomously, or semi-autonomously.

Within modular structured Smart Factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world around them and make smarter decisions. Over the Internet of Things (IoT), cyber-physical systems communicate and cooperate with each other and with humans in real time, both internally and across organizational boundaries, even extending to suppliers and partners in the value chain.

The first obvious question is, are manufacturing organizations in Europe actually at the stage of merely discussing, piloting, or rolling out Smart Factory initiatives? And do any actually see themselves as having a relatively mature Smart Factory deployment or deployments?

The figures came back loud and clear. 37% said they are in the planning phase of Smart Factory rollouts, which means that they are merely in the planning and evaluation stage. We know that this group of companies, based on their more detailed survey responses, have in some cases done little more than discuss the idea of Smart Factory. We are not hugely surprised, however.

teknology believes that Smart Factory projects are complex technology implementations, that in most cases require some integration and collaboration between IT and operational technology (OT). For this reason we can understand why many companies are in the early stages of their projects, particularly as no one – or at least, very few companies – in the manufacturing sector is in any position to write blank cheques for an investment on this scale.

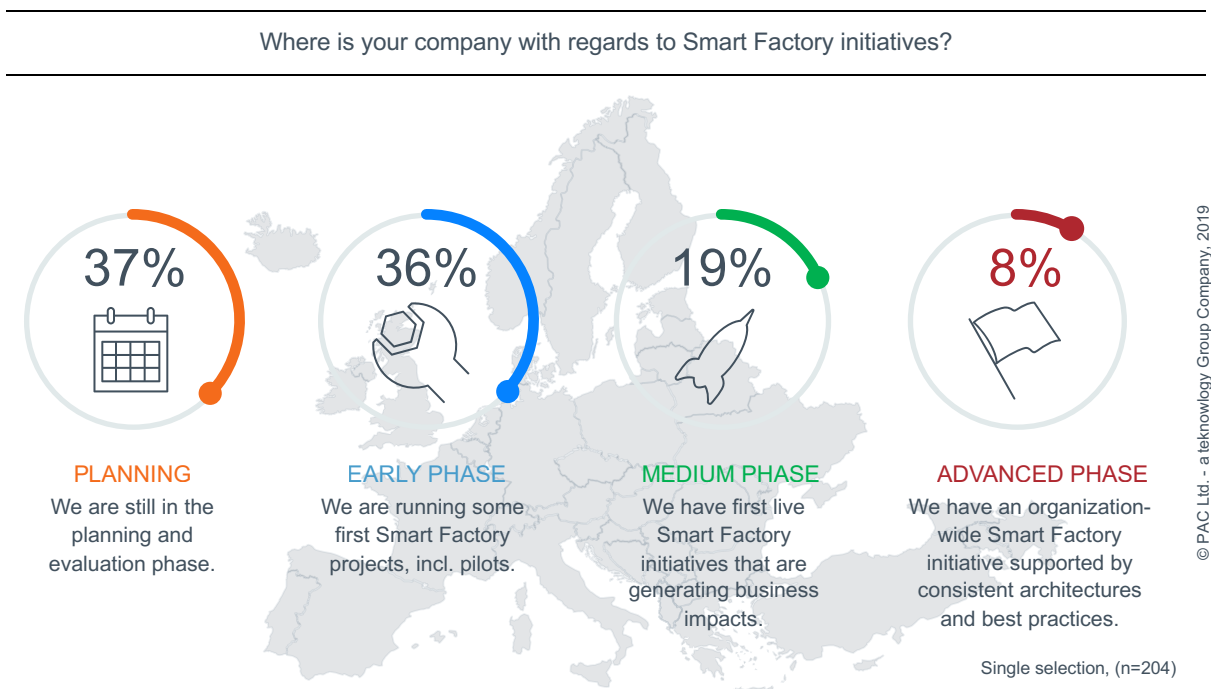


Fig. 1: Status quo of Smart Factory initiatives

Next, 36% said they are in the early phase of Smart Factory rollouts, which means that they are running some Smart Factory projects and pilots. In our experience talking to manufacturing companies, there is a wide range and style of implementations that would fall under this banner. Some companies run pilots for months or even years; others start with a small pilot in only one limited and discrete area (such as predictive maintenance or connected worker – which we shall discuss in more detail later).

What about companies that are further ahead with their Smart Factory projects? We found that 19% consider themselves in a medium phase of deployment, which is what we describe as having the first live Smart Factory initiatives that are generating business impacts. We'll talk in a later chapter about the kind of business impacts that companies said they are experiencing from the Smart Factory implementations, and how quickly they find that those business impacts – in particular whether they deliver return on investment (ROI).

“Smart Factory is the new frontier of innovation for our company.”

(Statement of a study participant)

The last group – those that consider themselves to already be in the advanced stages of deployment, where they have an organization-wide Smart Factory initiative supported by consistent architectures and best practices, came in at 8%. We consider this a relatively high number given the complexity of Smart Factory deployments and the fact that it is, as a concept, relatively new.

RELEVANCE OF SMART FACTORY TO OVERALL ORGANIZATIONAL STRATEGY AND FUTURE COMPETITIVENESS

So, we have some idea of roughly where companies are with their Smart Factory initiatives. But how important is Smart Factory to European companies?

Is Smart Factory something that companies do simply because they think they have read some hype in the media – rather than because they believe there are genuine reasons, such as improving efficiency and competitiveness? Remember that in the 1990's vast numbers of companies rushed out to buy the latest and greatest customer relationship management (CRM) software because it suddenly became the in vogue thing to do; the fact that it was often bought yet not deployed was one of the reasons that led to the rise of the term 'shelfware' – the software sat in its DVD case on a shelf in the IT department.

According to our survey respondents, that is absolutely not the case with Smart Factory initiatives – although they are clearly very different from CRM (we don't suggest that you can buy a Smart Factory on a DVD).

How high (on a scale of 1-10 where 10 is the highest priority) do you consider Smart Factory to be on a list of your company's key strategic objectives?

How vital (on a scale of 1-10 where 10 is the most vital) do you consider Smart Factory initiatives to be to ensure your company's future competitiveness?

- Consideration of Smart Factory to be on the list of the company's key strategic objective
- ◆— Vitality of Smart Factory initiatives for the company's future competitiveness

Mean: 6.8; Median: 7

Mean: 7.1; Median: 7

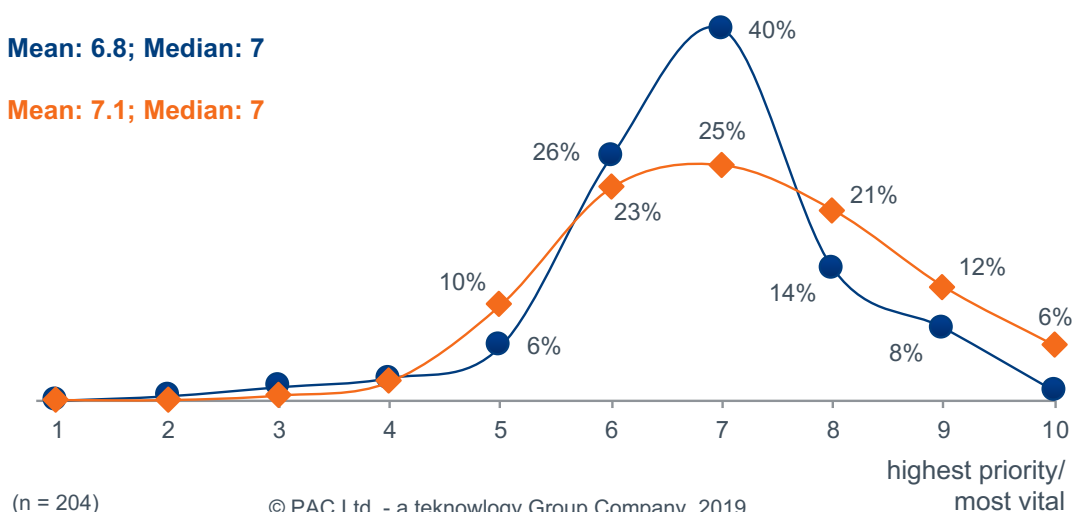


Fig. 2: Relevance and strategic importance of Smart Factory initiatives

Figure 2 goes a long way to answering this question. We asked respondents two questions on this theme, partly to check if there was any correlation between them, which there clearly is.

As can be seen, most respondents (40%) ranked it 7/10. 26% ranked it 6/10 and 14% 8/10 in terms of how strategic it is to the company. Very few ranked it outside of those parameters – only 6% 5/10 and 9% 9/10 (as can be seen on the Figure).

On the same chart, it can be seen that there is a similar but slightly different result when companies were asked to what extent their Smart Factory initiatives are considered to be vital to ensure their company's future competitiveness. It followed a similar trend in general to the question about the significance of the project. But for the question of future competitiveness, most (25%) gave it 7/10. About the same (23%) marked it 6/10 for future competitiveness and 21% gave it 8/10.

“The deployment of a Smart Factory is a key part of our long-term strategy.”

(Statement of a study participant)

Unlike when asked to score it for strategic priority compared to other projects, 12% gave it a whopping 9/10 and 6% even said that they considered it a 10/10 – in other words they consider it the most vital project to ensure their future competitiveness. What conclusions can we draw from this? Well, one is that we certainly do not sense that Smart Factory is merely a ‘vanity project’. Most companies have a very clear view on the high strategic importance of their Smart Factory initiatives compared to other projects in manufacturing.

What other projects are manufacturers engaged in, one might ask. Other strategic initiatives relate to the cross-company consolidation of data, data management and the analysis of data. So for example, creating data lakes from various data sources from the company’s different domains (ERP, CRM, Service, Finance applications and so on).

So, big data/big data analytics are major topics and significant projects in most of the manufacturing companies today.

And, yes, implementation of CRM applications is also a major topic for many manufacturers, but in particular for the SMBs as large manufacturers tend to already have CRMs.

Anyway, our results showed that most companies believe that Smart Factory is very critical to their future competitiveness.

FOCUS AREAS

We have established that companies are progressing their Smart Factory initiatives and that they are seen as highly strategic and key to future competitiveness. So next it was time to ask why companies are doing Smart Factory initiatives.

We split this question into two parts: what are organizations looking for in terms of internal capabilities over the next three years, and what are they looking for in terms of external capabilities?

What is the vision for introducing digital solutions into the factory over the next 3 years with respect to **internal** capabilities,...



Fig. 3: Vision for introducing digital solutions into the factory with respect to internal capabilities

As can be seen in Figure 3, 50% said that they are primarily doing Smart Factory to improve product quality. How does Smart Factory help to improve product quality? Well, just one example is the fact that predictive maintenance of tools and robotics can lead to fewer failures, and therefore fewer product defects. Companies also tell us that they are deploying digital quality control solutions leveraging artificial intelligence (AI) and machine learning (ML) to improve product quality.

Next, 47% said that they are doing Smart Factory to support digital transformation and another 47% said to enable easier and more efficient customization of products. The latter goal is particularly pertinent, we believe, as more and more consumers are looking for product customization, and this is another way that manufacturing companies can attempt to stand out from the crowd. It's no longer good enough to offer cars in a range of interior and exterior colours, for example – consumers want to be able to customize the colours of every panel from the skirt to the roof, the exact interior specifications, engine, gearbox, accessories and more.

Other reasons given were to improve asset utilization and reduce down-time, drive down cost, simplify the IT layer outside the datacentre and increase agility and flexibility. All of these things are good reasons why companies are investing in Smart Factory projects.

Beyond that, smaller numbers of participants said that they are keen to simplify IT in the datacentre, enable a digital workforce and connected workers, reduce energy costs and reduce health and safety risks. Nevertheless, we don't believe organizations should overlook these items as potential benefits of Smart Factory initiatives. For example, the idea of Connected Workers – workers that are connected to the Smart Factory through the use of smart devices (from their phones to augmented reality headsets) can not only reduce health and safety risks but also improve their productivity, so it can have a double benefit.

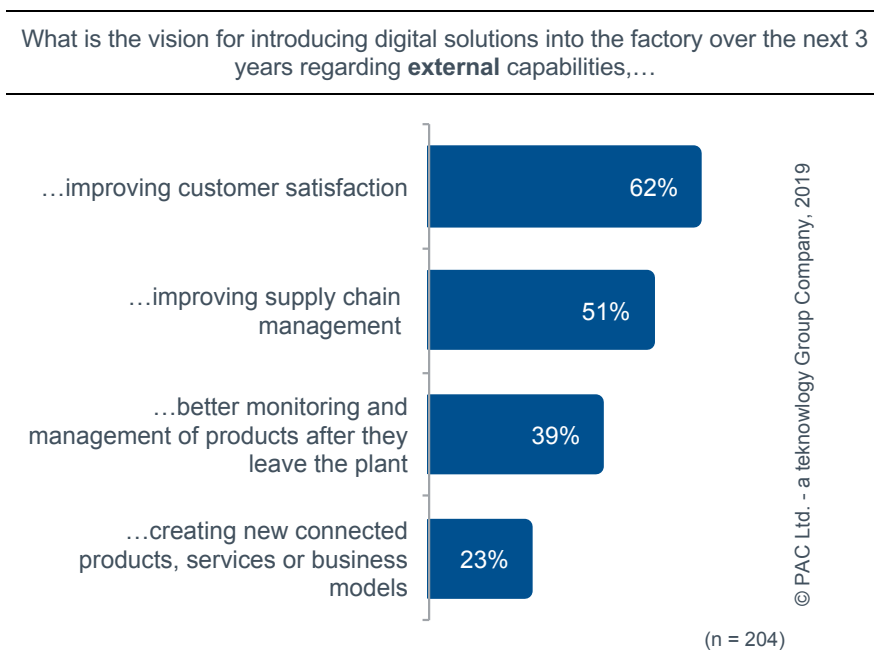


Fig. 4: Vision for introducing digital solutions into the factory with respect to external capabilities

The number one external benefit of a Smart Factory strategy according to our survey respondents? Improving customer satisfaction. Of course, this is likely to be enabled by the other internal benefits outlined above – improved product quality, and easier and more efficient customization of products, for instance.

After improving customer satisfaction (by far the highest segment at 62%), as an 'external' goal of Smart Factory, came improving supply chain management (51%) and better monitoring and management of products after they leave the plant (39%). A smaller group, 23%, said that the goal was to create new connected products, services and business models.

These results underpin what we said at the beginning: It will no longer be enough for manufacturers to sell products and innovations to customers and produce them at reasonable costs. What adds to those challenges today, and will do so even more in the future, are increasingly complex customer requirements: markets are becoming ever more transparent, while customers are ever more price sensitive.

And, they have increasingly complex requirements related to individualization as well as shorter delivery times, for example. This all drives the need for manufacturers to constantly keep customer satisfaction levels high and to improve their supply chain operations, followed by offering additional customer value-add by offering data-based services such as predictive maintenance or new “as-a-service” business models, which allow their customers to transform CAPEX to OPEX.

CHALLENGES

Of course, like any major strategic project, Smart Factory rollouts are not without their challenges. Remember, 37% of our respondents have only got as far as the planning stages, and a further 36% would describe themselves as at early stage of Smart Factory. So for many it is very early days.

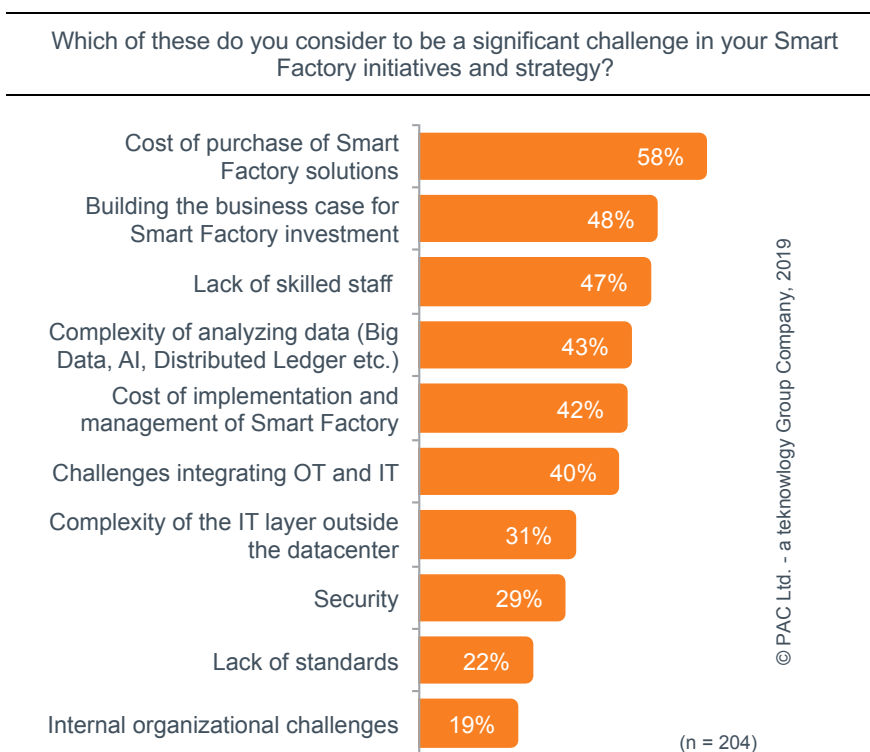


Fig. 5: Challenges regarding Smart Factory initiatives

We have already mentioned in this report just how challenging the macroeconomic environment is for companies in the manufacturing sector.

So perhaps we should not be surprised that respondents said that the biggest challenge to Smart Factory rollouts is the cost of purchase of Smart Factory solutions. To some extent this is an over-simplification though, because we don't believe you can simply purchase a Smart Factory solution ‘off the shelf’. It is a

complicated project with many facets, so what we really mean here is that the high investment required in Smart Factory solutions is the major issue.

You might say that since later in the report we find that many companies are seeing Return on Investment (ROI) from their Smart Factory rollouts that companies would not see the cost as an inhibitor – but they still need to find the up-front investment. What's more, next on the list of challenges is building the business case for Smart Factory investment – at 48% of respondents.

In other words, lots of companies can't identify a pressing business need, and as a result even more see the high investment as being prohibitive. We think this is a finding that vendors of software and services in the Smart Factory might wish to take note of, because it suggests that more work needs to be done to help end user manufacturing companies build a business case for Smart Factory investment.



DECISION-MAKING AND SMART FACTORY SPENDING

So where are decisions made about Smart Factory investment? The results are perhaps not hugely surprising, but they are nevertheless illuminating for IT services and software vendors, because it gives them some idea of where they should be applying their resources.

DECISION-MAKING

Most companies (62%) said that the primary decision-making force is the CxO office, and during the survey we found that people here meant the CEO, CFO, COO and CIO predominantly. Of course, the CIO is aligned to the IT department, which had its own category for respondents to choose. But we understand from the responses that when they said the CxO office they meant that decisions were being made in a top-down manner. If they chose the IT department, even if the CIO was involved, it meant that the strategy was being driven more from a bottom-up direction.

Next was a 'Digital Business Unit'. This is a relatively new phenomenon in the past few years but one that is becoming increasingly popular. For example, we know from speaking with Volvo that their digital business unit used to report into the CIO, but a couple of years ago was considered so strategic to their competitiveness that the head of digital now reports directly to the CEO.

The production department, which includes those in charge of operational technology (OT) is relatively down the line when it comes to Smart Factory decision-making. Only 24% of respondents said that it is the production department that makes the Smart Factory decisions. It seems likely from respondents' answers that the operational technology team are primarily concerned with robotics and other plant floor machinery.

The IT department made up the final 32% of respondents when it came to Smart Factory decision-making. In a Smart Factory one of the key elements is being able to analyse all of the data that comes from connected machinery, people and other assets (such as the building and environmental variables that affect production). Since data storage, management and analytics comes under the remit of the IT department, it is with good reason that 32% of respondents said that Smart Factory decision-making comes from the IT department.

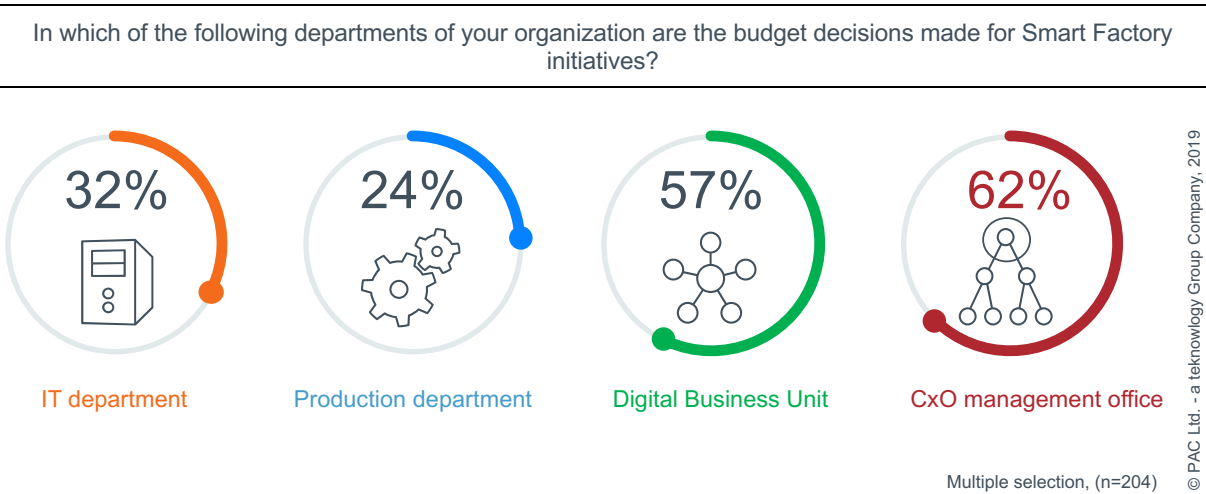


Fig. 6: Budget decision making regarding Smart Factory initiatives

SMART FACTORY SPENDING

Will your Smart Factory investment increase, stay the same or decrease in the next 3 years? If there is an increase: to what extent do you expect your organization to increase its investments in Smart Factory?

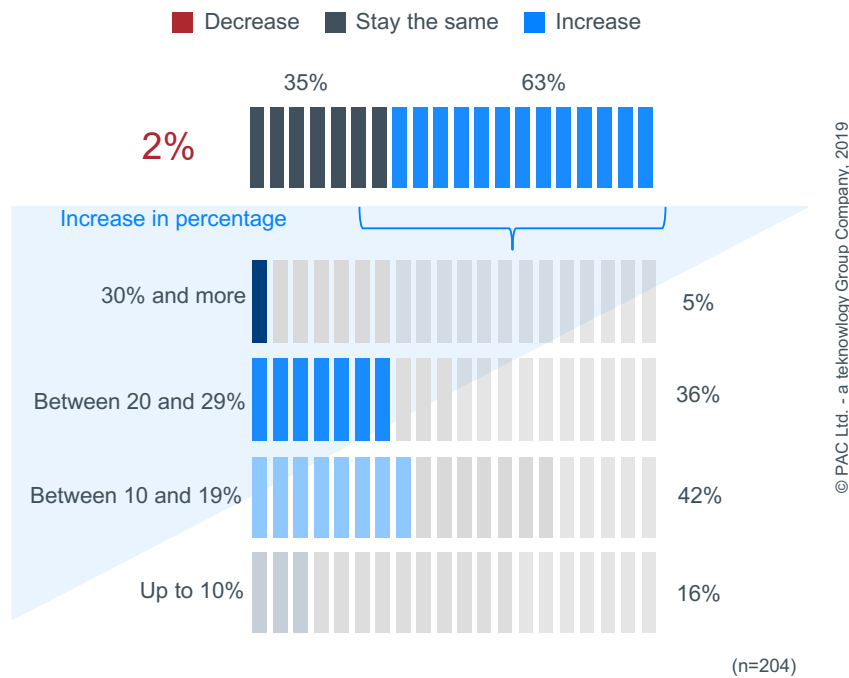


Fig. 7: Smart Factory investments

As highlighted in the Key Findings chapter above, Smart Factory spending is very clearly on the increase. In fact, a huge 63% of respondents said that they expect Smart Factory spending to increase over the next three years. 35% said that they expect it to remain at the same level – no doubt concerned by the uncertainty around macroeconomic headwinds.

But let's be clear – despite all of these challenges only 2% of our survey respondents said that they expect Smart Factory investments to reduce in the next three years.

But if most say spending on Smart Factory is to increase, how much is it likely to increase by? A few (16%) said it would increase by up to 10%. The biggest group (42%) said it will increase between 10- and 19%.

But 36% said that their investment in Smart Factory will increase between 20- and 29% in the next three years. Economic headwinds? They don't seem to be dampening the spirits of those particular manufacturing companies in terms of their Smart Factory investment plans.

A very small number of companies (5% of those who are increasing investment in Smart Factory) are brave enough to invest 30% more in their Smart Factory initiatives in the next three years. Foolish? We'll find out what companies say about how well Smart Factory initiatives pay off in terms of ROI in one of the later chapters.

SMART FACTORY SPENDING: SPECIFIC PROJECTS

There are numerous types of Smart Factory projects, which can either be adopted on a one-off basis or combined in multiple ways. teknowlogy Group believes that a pragmatic approach is to start with some 'low-hanging fruit' – a project that is likely to solve a particular business need, have demonstrable results and therefore potentially act as a spur to other projects (remember, the biggest decision-making group for Smart Factory projects is not IT, OT or a digital business unit, but the CEO, CFO and COO). So, which projects are gaining most traction in Europe?

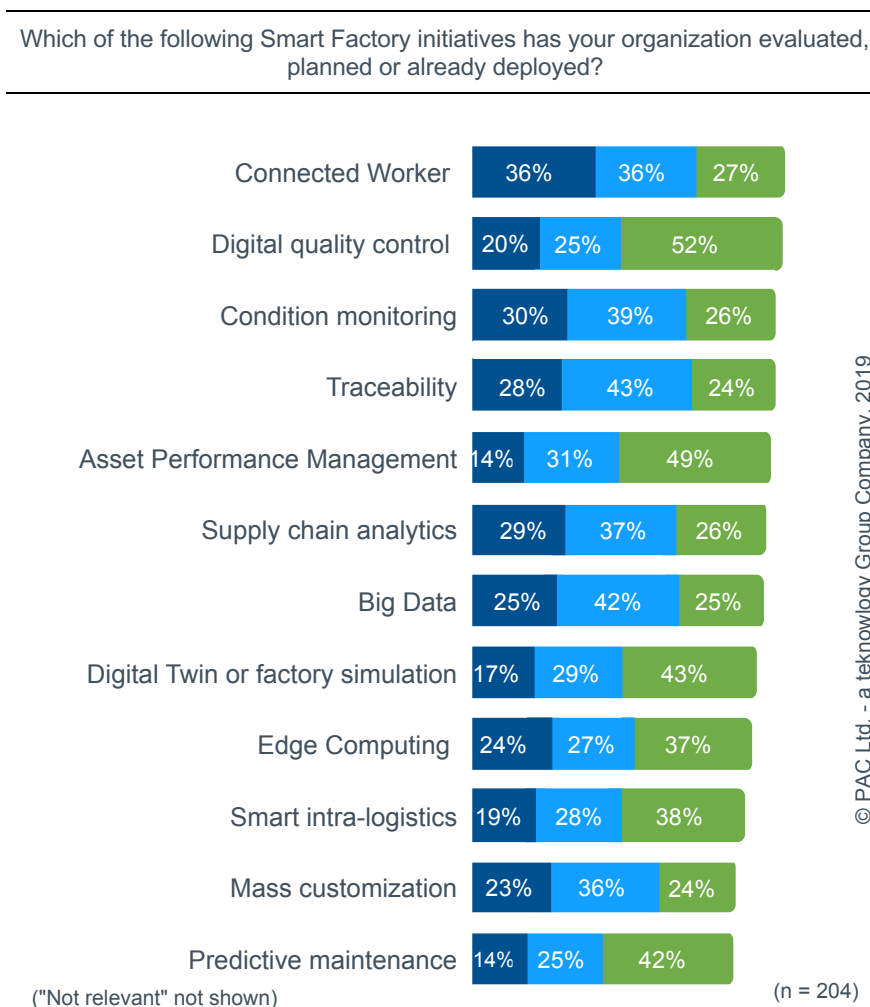


Fig. 8: Status Quo of Smart Factory projects

So what do these different projects involve? Let's take a look in order of the most popular (adding up deployed, planned and evaluated) according to our survey respondents. You can see from the diagram above the more detailed findings in terms of which are deployed, planned and merely only evaluated.

1. Connected Worker

Connected Worker uses digital worker support systems such as augmented reality, tracking and wearable sensors or devices to improve working decisions, quality and efficiency). It can also play a role in health and safety and reducing risk. 36% have already deployed it and 36% more are planning to.

2. Digital quality control

This is the automatic adjustment of the production process; monitoring of the production/assembly process based on sample specifications and the analysis of data collected by sensors such as images or video data to lower the number of defective products.

3. Condition monitoring

This refers to monitoring equipment's key metrics such as energy consumption, vibration, energy consumption, etc. as well as environmental condition data via sensors. 30% have deployed it and a sizeable 39% more are planning to.

4. Traceability

Is the use of digital technology within the production process and supply chain to verify the history or location of raw materials, components, tools, products, etc.

5. Asset Performance Management

Asset Performance Management is the analysis of machine data as well as data from other sources by leveraging pattern recognition, predictive analytics, artificial intelligence and machine learning.

6. Supply chain analytics

This is using digital technologies to improve visibility of the supply chain – helping to ensure that parts are received on time (or just in time) to maximize the production throughput without building up excess parts supply or inventory.

7. Big Data

This generally refers to the use of information processing and storage such as Hadoop to gain better insights from data.

8. Digital Twin or factory simulation

Digital Twin allows the virtual development, testing, production and maintenance of a physical product or an asset such as the plant itself, using digital technologies such as virtual reality.

9. Edge Computing

Edge Computing means doing some data processing/filtering at the edge of the network, such as on gateways or near to robots or other machinery. Our findings were that while edge analytics is relatively small today, it is set to more than double in the next five years.

10. Smart intra-logistics

By this we mean sensor-controlled vehicles that act as autonomous delivery systems within a factory.

11. Mass customization

Mass customization is exactly as it sounds – the use of intelligent, digital production processes that allow customization on a large scale.

12. Predictive maintenance

Predictive maintenance refers to the up-front scheduling of maintenance thanks to automatic alerts when exceeding certain machine performance metrics or predictive analytics. We were very surprised that more companies have not yet made this part of the Smart Factory plans – with only 14% having deployed it but 25% saying they are planning it.

ROI ON SMART FACTORY INITIATIVES

Has your Smart Factory initiative so far delivered a Return on Investment (ROI)? If yes, how quickly do you think that your Smart Factory projects delivered ROI?

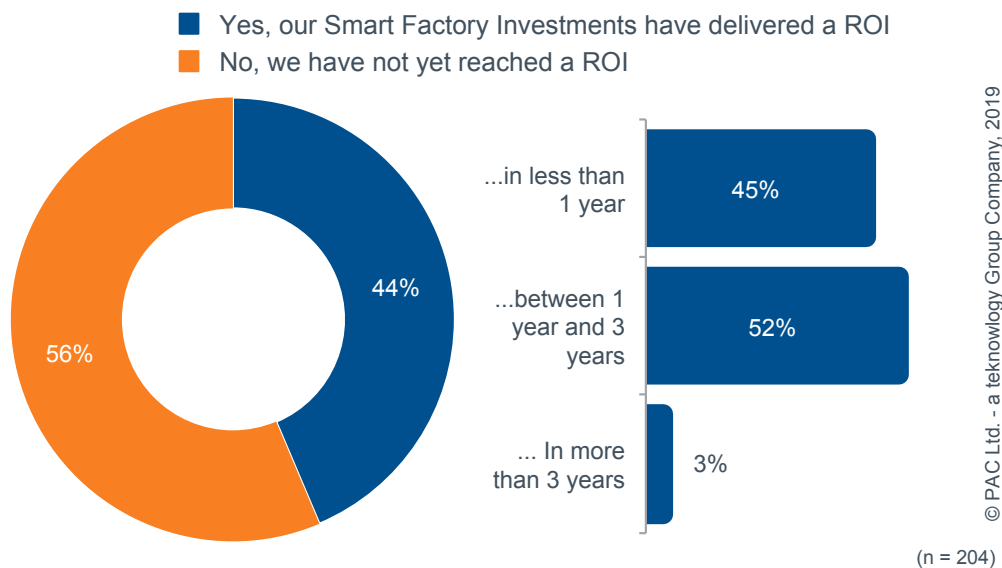


Fig. 9: ROI on Smart Factory investments

Most (56%) of our survey respondents reported that their Smart Factory initiatives are yet to deliver a Return on Investment (ROI). But while that is not great news, it must be noted that that leaves 44% of projects that have. Remember also that many companies are only in very early stages of Smart Factory rollouts, where you would not yet expect an ROI.

There was better news when it came to how quickly those in our survey, who said that they have already achieved ROI, achieved it: 45% said in less than one year, and 52% said between one and three years. In fact, only 3% who said that they achieved ROI said that it took more than three years.

We think these findings are interesting, because it means although most companies in our survey are yet to see an ROI from Smart Factory, of those that have, 97% achieved ROI in under three years. Yet on the other hand, the biggest challenge to Smart Factory was seen as the high cost of investment.



SMART FACTORY TECHNOLOGIES AND COLLABORATION WITH THIRD PARTIES

The next question that we asked our survey respondents was about the kind of third parties that they turn to help them with their Smart Factory initiatives.

Which of the following Smart Factory initiatives has your organization evaluated, planned or already deployed?

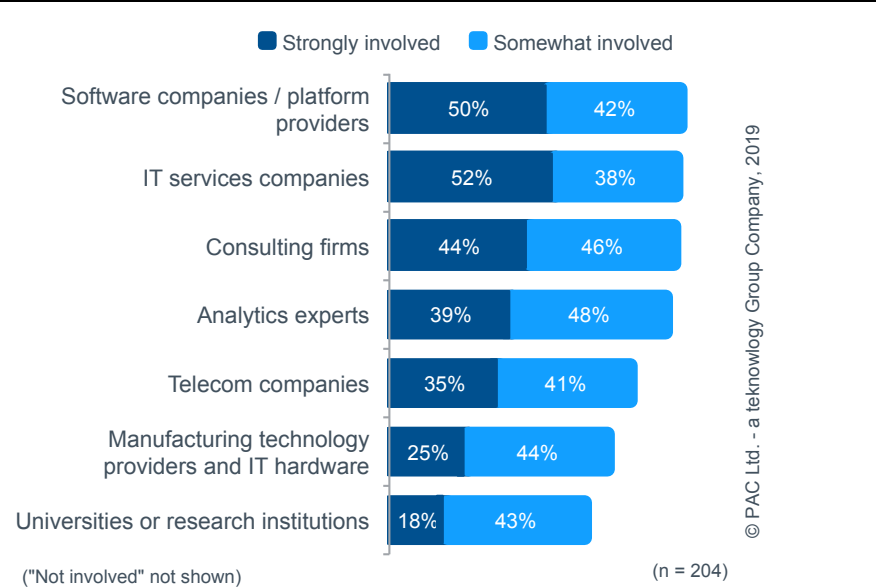


Fig. 10: Third party involvement

As can be clearly seen in the figure above, software companies/platform providers were the biggest group at 92% of companies involving them. We know from the respondents that the major software companies in Europe, including but not limited to SAP, Oracle and Microsoft, are major players in Smart Factory.

Not far behind though were IT services companies, who help organizations to plan, implement, manage and maintain their Smart Factory projects. This group were strongly or somewhat involved in Smart Factory according to 90% of companies.

Further down the list we saw companies turning to consulting firms, analytics experts and telecoms companies. The telecoms aspect often comes on the back of the need to better connect different assets across IT and operational technology as well as workers and smart devices.

We also asked which areas of collaboration third parties will consider going forward. Companies said they are considering Smart Factory as a service (75%); analysis of Smart Factory data (62%); and solution design and proof of concepts (62%) as their top three. This resonates well with our earlier finding that one of the big challenges for organizations around Smart Factory is building the business case.

TECHNOLOGIES, IT INTEGRATION AND CLOUD
DEPLOYMENT OF SMART FACTORY SOLUTIONS

What about the venue, or destination of organizations' Smart Factory deployments?

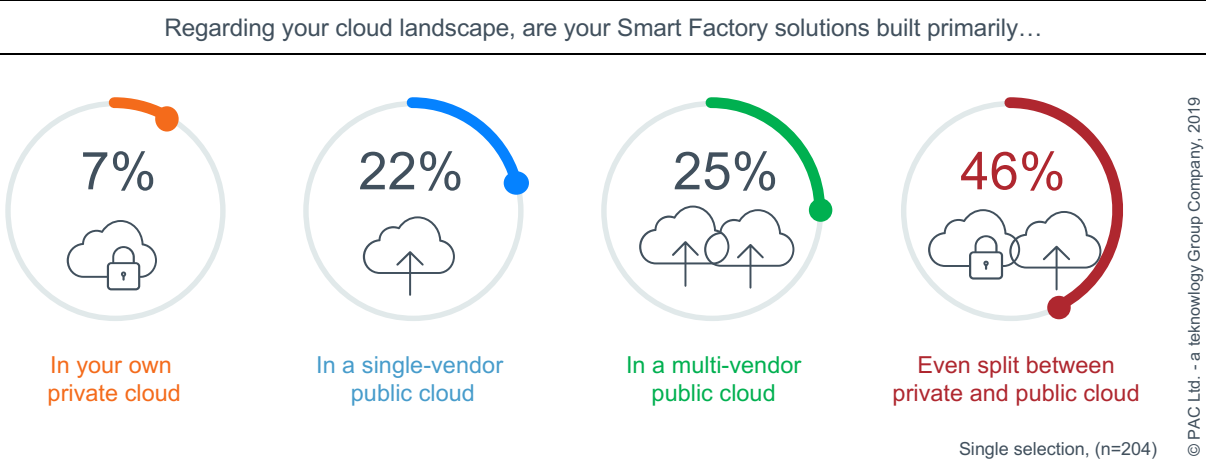


Fig. 11: Cloud-based deployment of Smart Factory solutions

teknowlogy Group is a strong believer in the concept of the 'best execution venue' – by which we mean how and where Smart Factory solutions are deployed really depends on the precise project, the current in-house availability of compute skills and resources as well as security considerations and cost calculations.

But today, most companies we surveyed (46%) said that there was an even split between private and public cloud, with 25% using a multi-vendor public cloud. This speaks partly to the fact that for many companies in our survey, they do not consider themselves to have enterprise-wide Smart Factory capabilities (only 8% said that they did in an earlier chapter).

Most have numerous projects that have often been started by IT or operational technology (OT) and evolved in different clouds, often for little more than historical reasons, or because a certain services provider has an affinity to one or another public cloud (the biggest three still being Amazon Web Services, Microsoft Azure and, quite far behind them but growing, Google Cloud Platform).

Behind those venues came single vendor cloud (22%) and a company's own private cloud (7%). To be fair, fewer and fewer companies these days make much of a distinction between 'on-premises' and 'private cloud', as they nearly all now have some degree of virtualization/private cloud infrastructure, so the distinction is becoming moot.

But what about where the data is actually analysed? This led to a slightly different picture. When asked where companies analyse their Smart Factory data today, most (46%) said in their own datacentre, which didn't surprise us as a lot of manufacturing data is highly sensitive, and companies are traditionally conservative about storing much of it outside their own four walls.

Nevertheless, 40% said they analyse data in the cloud today. 14% said they analyse data at the edge – i.e. close to plant machinery on the production floor.

However, when asked about their plans for the future, 35% said they want to be analysing data at the edge in five years' time – that's more than a 100% increase. That saw a knock-on reduction in those analysing data in the cloud (down from 40% to 35%) and their own datacentre (down from 46% to 30%). We see growing interest in the use of data analytics at the edge to reduce saturation of the datacentre, and because some data from machinery – if it falls within a normal range for example – can be filtered out, making it easier to analyse the data that is of real value (the anomalies).

The figure below, meanwhile, shows that there is room for improvement in just how much data is being analysed to aid business decision-making. Only 28% say they are analysing Smart Factory data for business decision-making. Meanwhile, the total amount of factory data that is being analysed is relatively low – one third say that they analyse less than one third of their data, while 38% say they analyse between 26- and 50%.

A) Are you currently analysing and using your data which you gained from your Smart Factory solutions in business decision-making? Is it planned within the next 3 years, or at least discussed, or is it currently not relevant? B) Approximately what percentage of total factory data is currently analysed?

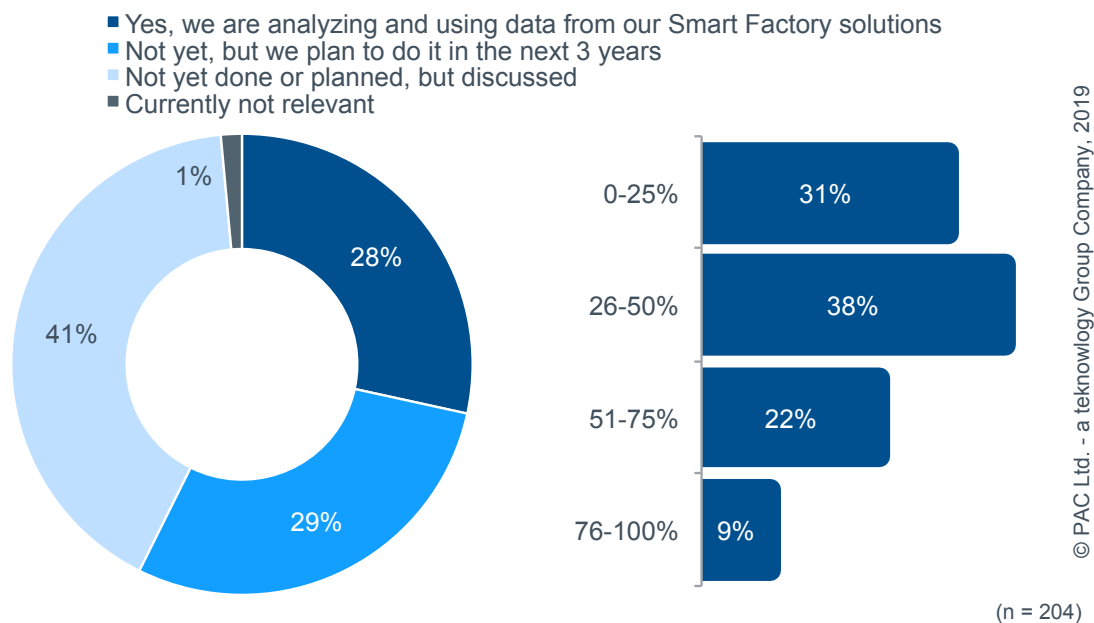


Fig. 12: Analysis of Smart Factory data

THE FUTURE – A GLANCE AT SOME OF THE BLEEDING EDGE TECHNOLOGIES

We have talked in quite some detail about what companies are already doing in Smart Factory. We have identified that most companies are increasing investment in Smart Factory, that around half of the companies surveyed are already seeing an ROI from Smart Factory, and that nevertheless, many face challenges in terms of the high investment, integration with legacy technologies and the ability to analyse data across silos.

But what about the future? We asked respondents if three 'bleeding edge' technologies have relevance to their Smart Factory plans: distributed ledger technologies like blockchain and similar; deep learning using artificial intelligence (AI) and quantum computing.

All three are considered of considerable interest. Distributed ledger technologies are of major interest to 59% of manufacturing companies that we surveyed. We believe distributed ledger technologies will be deployed in an effort to get stricter controls and visibility on how materials and products move around the factory and the extended supply chain. This will be particularly valuable in industries where there has historically seen supply chains being incomplete (raw materials 'disappearing' or products being counterfeited or tampered with), such as pharmaceuticals and agriculture/food processing.

Deep learning using technologies such as artificial intelligence (AI) was of major relevance to 50% of our survey respondents. Once again, we believe that since data is so critical to any Smart Factory initiative, being able to analyse it more efficiently (and with fewer highly-skilled staff) is a key goal.

Quantum computing was ranked as of major significance by 19% of respondents, while about another half (49%) said that it is of minor relevance. Quantum computing could be drawn on in future to answer questions such as how to most efficiently move materials and tools around a warehouse and how to optimize a supply chain. So while quantum computing might not be here just yet, the quantum message is being heard loud and clear among our sample of manufacturing respondents.

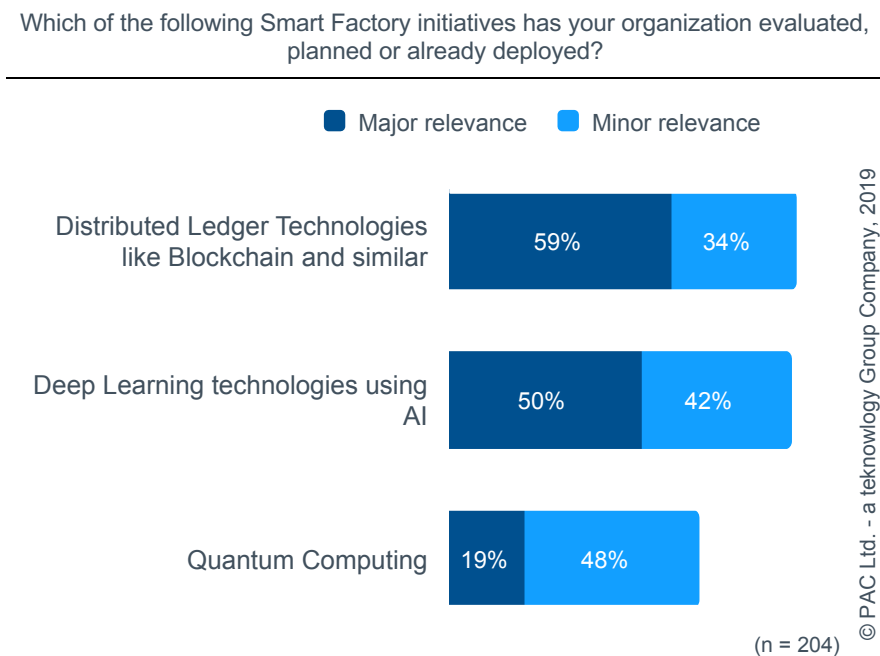


Fig. 13: Relevance of technologies for Smart Factory initiatives

CONCLUSIONS



Most companies (63%) are increasing investment in their Smart Factory initiatives.



A small but growing proportion of Smart Factory initiatives have already come of age and are enterprise-wide.



Smart Factory is a key strategic objective – most respondents rated it 7/10 where 10 is most strategic of all their projects.



Most companies said that they are primarily doing Smart Factory to improve product quality, support digital transformation and enable easier and more efficient customization of products.



The number one external goal of Smart Factory strategies is to improve customer satisfaction.



The biggest perceived challenge with Smart Factory projects is the high level of investment required.



Smart Factory projects are said to produce ROI in under three years for 44% of respondents; 56% are yet to see ROI but many are in the early stages of their rollouts.



Smart Factory data is not always analysed, partly due to a lack of internal resources. When asked if companies are using Smart Factory data in business decision-making, 28% said that they are, while 29% said that they plan to inside three years.



Organizations are already investigating Distributed Ledger Technologies, Deep Learning/AI and Quantum Computing as part of their Smart Factory plans.

PAC'S OPINION

Despite the macroeconomic challenges that manufacturing companies are facing, 63% still said that they plan to increase investment over the course of the next three years, while 35% said that they expect their level of investment to stay about the same. That left of course only 2% that expect their investment in Smart Factory to decrease.

Perhaps given the macroeconomic trends that we have referred to, we should be less surprised that asked about the challenges of implementing Smart Factory, most respondents said it was the high cost of investment in Smart Factory projects. Of course, a 'high' cost of investment is not the same for every company. But there were plenty of other challenges too, with many finding it difficult to build a business case, and others citing lack of skilled staff, difficulties analysing Smart Factory data, and difficulties integrating between IT and operational technology (OT) silos.

Most respondents consider their Smart Factory initiative to be a key strategic project, and most also consider it to be vital to their continued competitiveness in the market. There was more good news when it came to Return on Investment (ROI) because while 56% are yet to realize ROI (many are in the early stages of their projects) those that did, saw it relatively quickly. Of those seeing an ROI, 45% saw it in less than a year, and 52% between one and three years.

The reasons for doing Smart Factory projects were varied, with improving product quality, supporting digital transformation and enabling easier and more efficient customization of products coming top of the list of internal goals. The biggest external goal was considered improving customer satisfaction, improving supply chain management (51%) and better monitoring and management of products after they leave the plant (39%).

When asked where companies analyse their all-important Smart Factory data, and to what extent, there was a very mixed bag. It will be of considerable interest to software and services vendors in this space that companies really are choosing the best execution venue for each project, and there is no near-term rush to change where they analyse data (in public cloud, multi-cloud or private cloud). But equally, we found that a large amount of factory data is not analysed at all today. Only 9% of companies were able to say that they analyse over 75% of their data.

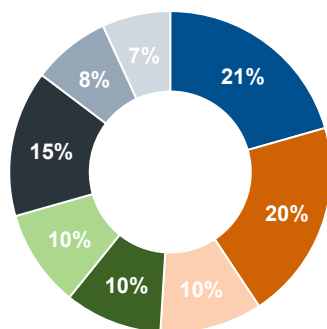
Meanwhile, over half of those surveyed cited distributed ledger technologies and deep learning/AI as of major relevance, while 19% said quantum computing is of major relevance going forward.

METHODOLOGY

This study is based on interviews with IT and OT decision-makers at 204 European manufacturing companies with more than 500 employees which have at least Smart Factory initiatives in plan. The study was conducted in May and June 2019.

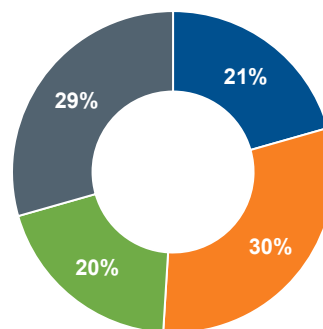
Repondents by country

■ UK ■ Germany ■ France ■ Spain
■ Italy ■ Finland ■ Sweden ■ Denmark

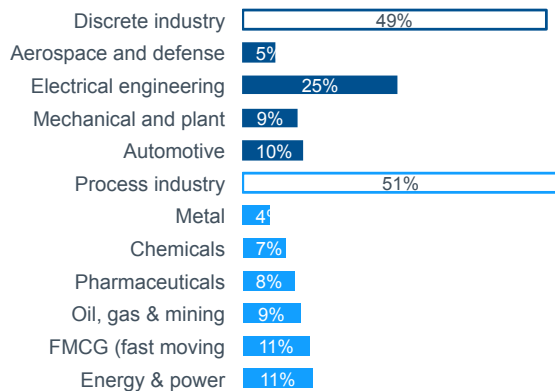


Repondents by region

■ UK ■ Central Europe (Germany and France)
■ Southern Europe (Spain and Italy) ■ Nordics (Finland, Sweden, Denmark)

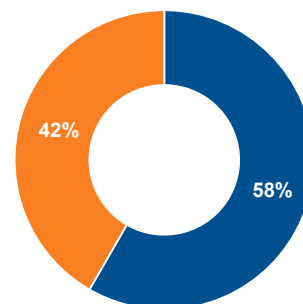


Repondents by industry

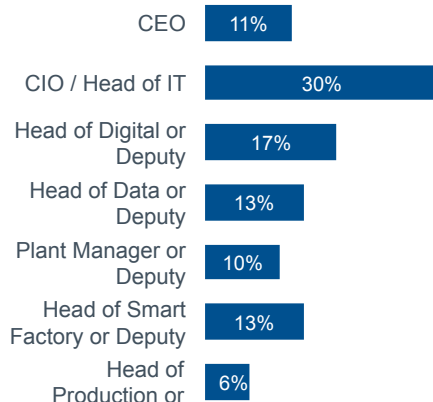


Repondents by company size

■ 500 and 2,500 employees ■ 2,500 and more employees

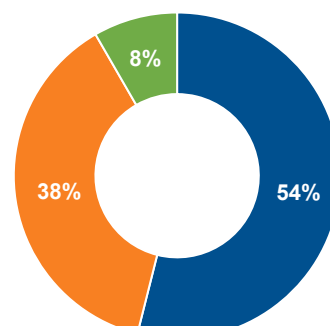


Repondents by position



Repondents by responsibility

■ IT (Information Technology) ■ OT (Operational Technology) ■ Roughly an even split between the two



ANNEX

DISCLAIMER, USAGE RIGHTS, INDEPENDENCE AND DATA PROTECTION

The creation and distribution of this study was supported by premium sponsor Fujitsu.

For more information, please visit www.pac-online.com.

Disclaimer

The contents of this study were compiled with the greatest possible care. However, no liability for their accuracy can be assumed. Analyses and evaluations reflect the state of our knowledge in October 2019 and may change at any time. This applies in particular, but not exclusively, to statements made about the future. Names and designations that appear in this study may be registered trademarks.

Usage rights

This study is protected by copyright. Any reproduction or dissemination to third parties, including in part, requires the prior explicit authorization of the ordering parties/the sponsors. The publication or dissemination of tables, graphics etc. in other publications also requires prior authorization.

Independence and data protection

This study was produced by Pierre Audoin Consultants (PAC). The ordering parties/sponsors had no influence over the analysis of the data and the production of the study.

The participants in the study were assured that the information they provided would be treated confidentially. No statement enables conclusions to be drawn about individual companies, and no individual survey data was passed to the ordering parties/sponsors or other third parties. All participants in the study were selected at random. There is no connection between the production of the study and any commercial relationship between the respondents and the ordering parties/sponsors of this study.

LIST OF FIGURES

Fig. 1: Status quo of Smart Factory initiatives.....	9
Fig. 2: Relevance and strategic importance of Smart Factory initiatives.....	11
Fig. 3: Vision for introducing digital solutions into the factory with respect to internal capabilities.....	13
Fig. 4: Vision for introducing digital solutions into the factory with respect to external capabilities.....	14
Fig. 5: Challenges regarding Smart Factory initiatives.....	15
Fig. 6: Budget decision making regarding Smart Factory initiatives.....	18
Fig. 7: Smart Factory investments.....	19
Fig. 8: Status Quo of Smart Factory projects	20
Fig. 9: ROI on Smart Factory investments	22
Fig. 10: Third party involvement.....	23
Fig. 11: Cloud-based deployment of Smart Factory solutions.....	24
Fig. 12: Analysis of Smart Factory data	26
Fig. 13: Relevance of technologies for Smart Factory initiatives.....	27

ABOUT FUJITSU



Fujitsu is the leading Japanese information and communication technology (ICT) company, offering a full range of digital services, solutions and technology products. Approximately 132,000 Fujitsu people support customers in more than 100 countries. We use our experience and the power of ICT to shape the future of society with our customers.

Fujitsu customers cover both the public and private sectors, including retail, financial services, transport, manufacturing, government and defence. With an annual R&D spend of 135 billion yen (€1.23 billion), we create innovative world-leading digital technology, services and end-to-end solutions that enable our customers to digitize with confidence.

As a world-class manufacturer ourselves, we have over 80 years of experience and understand the challenges manufacturers face on the road to digital factory transformation. Using a blend of our own and partner technologies, we develop connected solutions to continuously optimize our own manufacturing and operating environment. We know how to apply new technologies such as IoT, AI, machine-learning, RPA and Cloud services. Connecting industrial machines and devices to the internet through the Cloud is a major step in simplifying business processes, and with our range of trusted cloud solutions, we make it easy for our customers to adopt Cloud in a cost-effective and well-governed way.

We work in close partnership with our customers to co-create the most effective solutions. Through the implementation of data analytics, mobility technology, and machine-to-machine connectivity, we enable customers to gain insight from the operational data they generate every day. We help to transform processes and proactively manage all aspects of manufacturing operations - live and in real-time.

Contact: Johan Carstens

**CTO Manufacturing and
Automotive, Northern and Western
Europe Region**

Email:
johan.carstens@uk.fujitsu.com

**Fujitsu
22 Baker Street
London W1U 3BW**

ABOUT TEKNOLOGY GROUP



teknowlogy Group is the leading independent European research and consulting firm in the fields of digital transformation, software, and IT services. It brings together the expertise of three research and advisory firms, each with a strong history and local presence in the fragmented markets of Europe: [Ardour Consulting Group](#), [CXP](#) and [PAC \(Pierre Audoin Consultants\)](#).

We are a content-based company with strong consulting DNA. We are the preferred partner for European user companies to define IT strategy, govern teams and projects, and de-risk technology choices that drive successful business transformation.

We have a second-to-none understanding of market trends and IT users' expectations. We help software vendors and IT services companies better shape, execute and promote their own strategy in coherence with market needs and in anticipation of tomorrow's expectations.

Capitalizing on more than 40 years of experience, we operate out of seven countries with a network of 140 experts.

For more information, please visit www.teknowlogy.com and follow us on [Twitter](#) or [LinkedIn](#).

Contact: Jason Stamper

PAC – a teknowlogy Group Company
15 Bowling Green Lane
EC1R 0BD London
United Kingdom

+44 207 251 2810

+44 207 490 7335

info-uk@teknowlogy.com

www.vendor.teknowlogy.com

www.sitsi.com

A blue-tinted photograph of an industrial robotic arm in a factory setting. The arm is positioned diagonally across the frame, with its end effector holding a small blue cylindrical object. The background shows various industrial structures and equipment, all rendered in shades of blue.

tekno**logy**

GROUP

Ardour
CXP
PAC