



The Manufacturer Industry 4.0 UK Readiness Report

Researched by

THE Manufacturer
www.themanufacturer.com

In association with

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Editor's welcome

"Big data and advanced analytics, the Internet of Things, digital modelling, additive manufacturing, computer integrated manufacturing. Industry 4.0 not only embraces each of these - and more - but combines them together in order to make a whole that is vastly greater than the sum of its parts."

When looking at the major change drivers likely to have a dramatic effect on the UK manufacturing landscape in the coming years, all too often we are unable to see the wood for the trees. Rhetoric up until now has largely been in this vein, focusing on one particular piece of technology instead of contemplating the idea that each individual element could be part of a much greater puzzle.

These puzzle pieces include; looking at the growing use of additive manufacturing; deliberating on the importance of capturing, analysing and leveraging huge amounts of data; and understanding how machine-to-machine communication can improve production efficiencies.

But now the conversation must change. We must discuss and realise the potential of the whole.

As manufacturers across the globe begin to leverage the potential of the individual components of the fourth industrial revolution, it will no doubt come with warranted concerns over security, trust and clear data ownership. These issues should not be an afterthought. When considering the real opportunities involved with Industry 4.0 manufacturers must also anticipate the risks - and plan to mitigate as they prepare for the future.

It seems this is exactly what they are doing. In this report, compiled by The Manufacturer in partnership with Oracle, **69% of respondents stated that Industry 4.0 was going to have a significant impact on their business**. As the report's editor, Malcolm Wheatley, rightly points out; the results could hardly be more unambiguous.

But how will that sentiment be carried forward by UK manufacturers? Will they grasp the data nettle? Will they realise the real-world potential of additive manufacturing? Will they take their customer relationships that one step further and put service at the top of their business models?

Let's hope so, because **the future of manufacturing in this country is certainly shaping up to be an exciting one.**

Callum Bentley

Editor, The Manufacturer



Section 1

Opportunity beckons



Revolutions, it's said, share a common characteristic. Seemingly impossible at the beginning, they appear inevitable after the event.

So too with **Industry 4.0, dubbed 'the fourth industrial revolution'**. To a manufacturer viewing the world through the lens of a decade or so back, the transformation heralded by Industry 4.0 appears fantastical. Almost at a stroke, the logic underpinning many traditional business models, manufacturing paradigms, and management methodologies has become obsolete.

But that logic stemmed from an era of uncertainty. What will customers order—and when? When will inventories need replenishing—and by how much? Does a particular piece of equipment require maintenance—and if so, why, and what? Exactly how much inventory do we have, and where? And where, precisely, do our yield losses, scrap and material wastage occur?

But with Industry 4.0, that era of uncertainty has come to an abrupt end. In place of forecasts and assumptions comes a highly granular level of actual knowledge, and an unprecedented level of insight. More than that, of course, comes the ability to actually act upon that knowledge and insight. Hence, of course, the reference to revolutions' inevitability. **When you have answers, why go back to ignorance?**

Yet for all its promise, Industry 4.0 is itself something of an unknown. As with the old joke about economists, any gathering of a dozen or so manufacturers will likely possess at least that many opinions about what exactly Industry 4.0 is.

In part, that's to be expected. Industry 4.0 is, after all, a relatively new term, first coined in 2011. Moreover, it's also

one that represents a fusion of a set of relatively new technologies, themselves at times poorly understood.

Big Data and advanced analytics, the Internet of Things, digital modelling, additive manufacturing, computer-integrated manufacturing—Industry 4.0 not only embraces each of these (and more), but combines them together in order to make a whole that is vastly greater than the sum of its parts.

So what might such a fusion deliver? In its entirety, it's perhaps safest to say that no one yet knows: as with the three revolutions in manufacturing practice that came prior to Industry 4.0—the era of steam and water power, electrically-powered mass production, and electronics-led automation—few could envisage at the outset how seismic would be the changes that they wrought.

But tantalisingly glimpses of what Industry 4.0 can be capable of offering can be readily seen at those companies that are taking two, three or more Industry 4.0 technologies and then applying them to transform their businesses.

Such as? Take new business models, such as 'servitization', where customers pay for equipment on a usage basis, rather than through outright capital purchase—palletisers, for example, paid for on a per-pallet-wrapped basis. And automated replenishment, for another: Internet of Things-based intelligent devices 'calling home' when consumables need topping-up or replacing, or when maintenance is required.

Science fiction? Far from it. The palletiser example is real—and just as solid as your Hewlett-Packard computer printer when it remotely orders replacement cartridges. Meanwhile, Worcester Bosch, the UK gas boiler manufacturing arm of German industrial giant Bosch, has

announced a boiler add-on, developed in conjunction with British Gas, through which consumers' boilers will automatically summon a maintenance engineer in the event of a malfunction.

Similarly, **a fusion of Big Data, the Internet of Things, and advanced analytics is providing manufacturers with unprecedented insights**—insights into manufacturing performance, customer behaviour, and new product development.

Aero-engine manufacturer Rolls-Royce, for instance, is capturing half a terabyte of manufacturing data on each individual engine fan blade that it manufactures, analysing it with its clusters of high-power supercomputers to seek improvements to quality levels and product performance.

Industry 4.0, in short, is here, and is real.

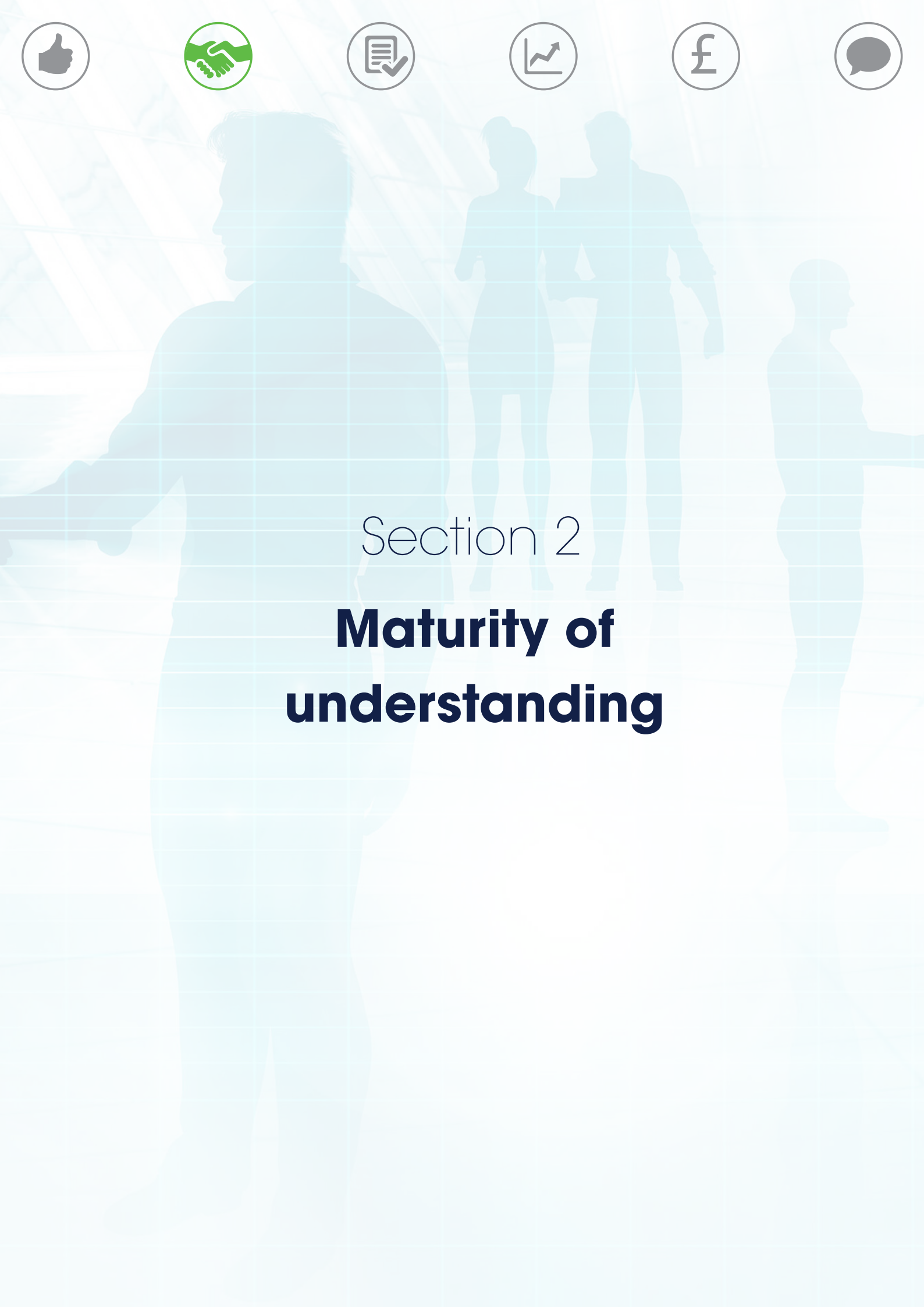
"For us, Industry 4.0 means that mass customization and the interconnectivity of our products will open new markets."

Process improvement manager, £101-500m machinery and equipment manufacturer

"The possibilities have not yet been explored in full, but already we can see how Industry 4.0 will drive business growth. Very simply, it is a fundamental change in how things are manufactured."

Marketing lead, £5bn+ global consulting business





Section 2

Maturity of understanding



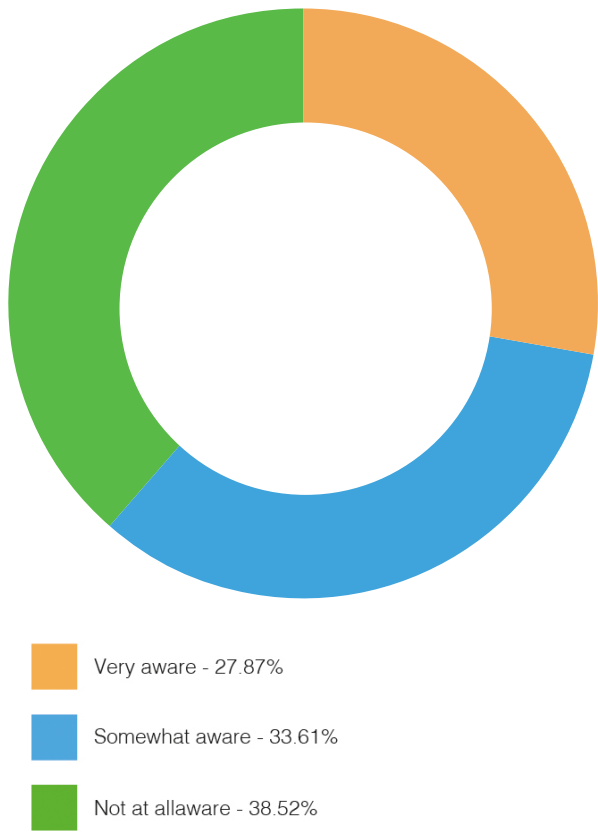
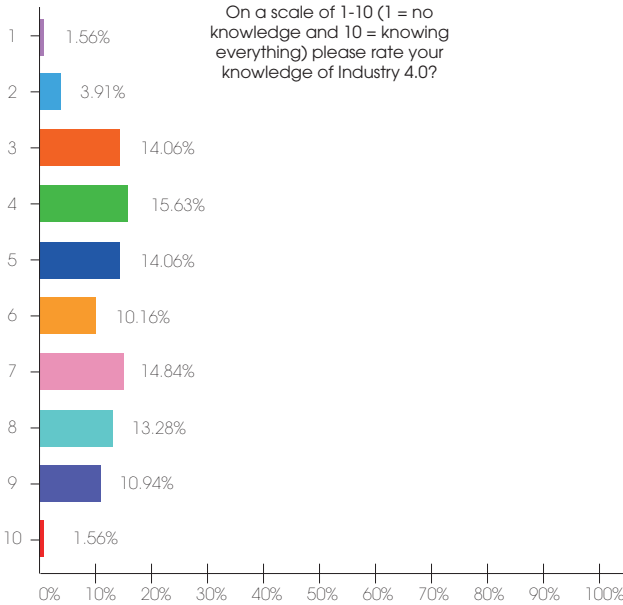
But how well aware are manufacturers of the opportunity that is offered by Industry 4.0? What benefits do they see in Industry 4.0? And how prepared are they to invest in Industry 4.0 capabilities designed to deliver those benefits? A survey, carried out by The Manufacturer, and sponsored by Oracle, sought to determine the answers to such questions.

Overall, for instance, just over a quarter of respondents—28%—declared themselves to be 'very aware' of Industry 4.0, while a further third of respondents—34%—regarded themselves as being 'somewhat aware'.

Nor did the size of respondents' businesses make a perceptible difference. Of those respondents who were at least aware of Industry 4.0, virtually identical proportions of respondents from large organisations, defined as £100 million + turnover, declared themselves to be 'very aware' of Industry 4.0 (43%) as did respondents from smaller organisations (42%).

That said, while encouraging, the overall picture across all sizes of organisation was still one of 38% of respondents—over a third—reporting that they were 'not at all aware' of Industry 4.0. Clearly, the Industry 4.0 message is not yet ubiquitous.

How aware are you of Industry 4.0?



More encouraging, though, was the precise level of knowledge possessed by respondents who declared themselves to be at least 'very aware' or 'somewhat aware' of Industry 4.0.

On a scale of 1 to 10, with 1 representing 'no knowledge' and 10 representing 'knowing everything', just under 20% of respondents—one in five—placed themselves in the lowest three deciles. Over a quarter—26%—placed themselves in the highest three deciles, while 51% placed themselves as being in the highest five deciles.

By any measure, this is an encouraging response. For a term that just four years ago had yet to be coined, respondents are reporting levels of knowledge that are both creditably high, and fairly well spread. Put another way, among those respondents reporting a degree of awareness of Industry 4.0, the vast majority have supplemented that awareness with a level of understanding that is appreciably beyond the minimum.

That said, the size of respondents' organisation does seem to play a part: while just 19% of respondents from smaller organisations possessed levels of knowledge placed in the upper three deciles, some 29% of respondents from larger organisations did so—proportionally, over half as many again.

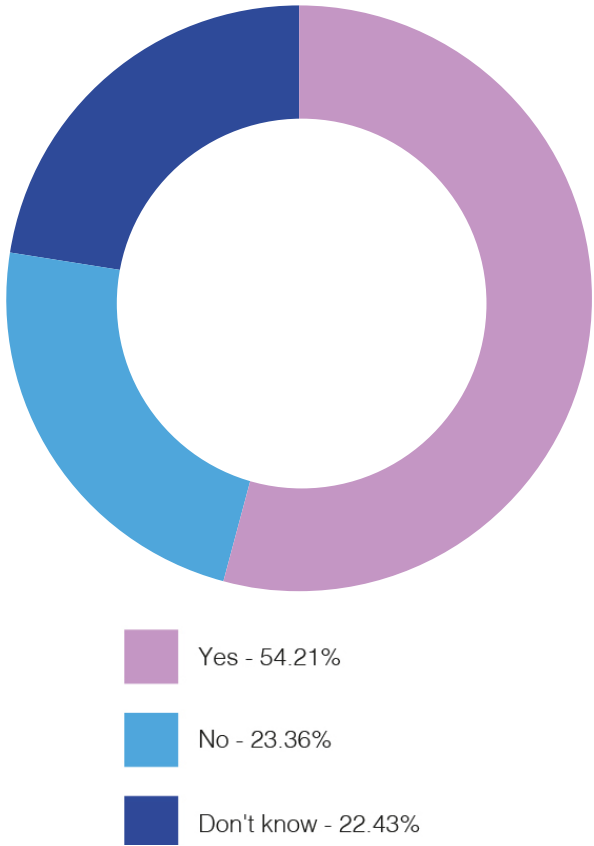
Moreover, manufacturers were also broadly cognisant of the significance of the revolution heralded by Industry 4.0.

Fully 55% of respondents, for instance, were in agreement that if steam and water power, electrically-powered mass production, and electronics-led automation represented the first three revolutionary manufacturing paradigms, then Industry 4.0 qualified as the fourth such revolutionary paradigm. Put another way, just 24%—fewer than one in four—disagreed that Industry 4.0 comprised such as revolutionary paradigm.

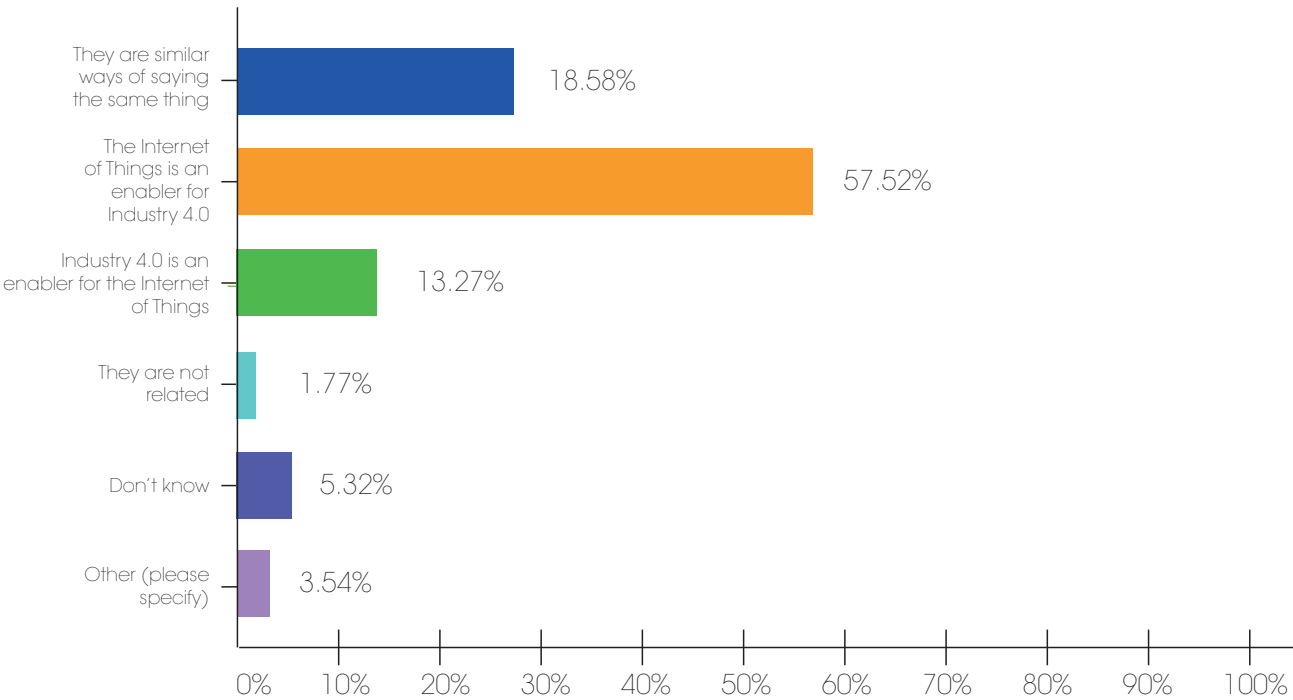
Just as tellingly, respondents' self-declared levels of knowledge regarding Industry 4.0 can be calibrated against a question designed to test that knowledge.

What is the precise relationship between Industry 4.0 and the Internet of Things? Fewer than 2% of respondents responded—incorrectly—that the two were not related. 58%, meanwhile, responded—correctly—that the Internet of Things was an enabler for Industry 4.0, with a further 19% responding that the two were similar ways of saying the same thing, a view that while not entirely correct is at least understandable.

Industry 4.0 has been described as the 4th manufacturing paradigm (the first three being steam/water, the mass production line, and electronics). Do you agree?



Please pick the most relevant phrase on how you view the Internet of Things in relation to Industry 4.0?





Section 3

Assessing the impact



It is one thing for manufacturers to report knowledge and awareness of Industry 4.0, however, and quite another for those same manufacturers to be prepared to translate that knowledge and aware into concrete investments and real projects.

For that to happen, manufacturers need to be convinced that Industry 4.0 will make a significant difference to their businesses, and deliver a return on any investment.

Accordingly, respondents were asked to gauge the influence that Industry 4.0 might have on their business, placing that influence on a scale of 1 to 10, with 1 representing 'not at all influential' and 10 representing 'very influential'.

The result could hardly be more unambiguous. 69% of respondents—just over two-thirds—placed the influence that Industry 4.0 would have on their businesses in the highest five deciles, with fewer than a third of respondents placing it in the lower five deciles.

Moreover, the business impact of Industry 4.0 was highly polarised around the extremes, with just 4% of respondents placing Industry 4.0 in the lowest two deciles of influence, while 28% of respondents—

seven times as many—characterised the impact of Industry 4.0 on their businesses as falling into the highest two deciles.

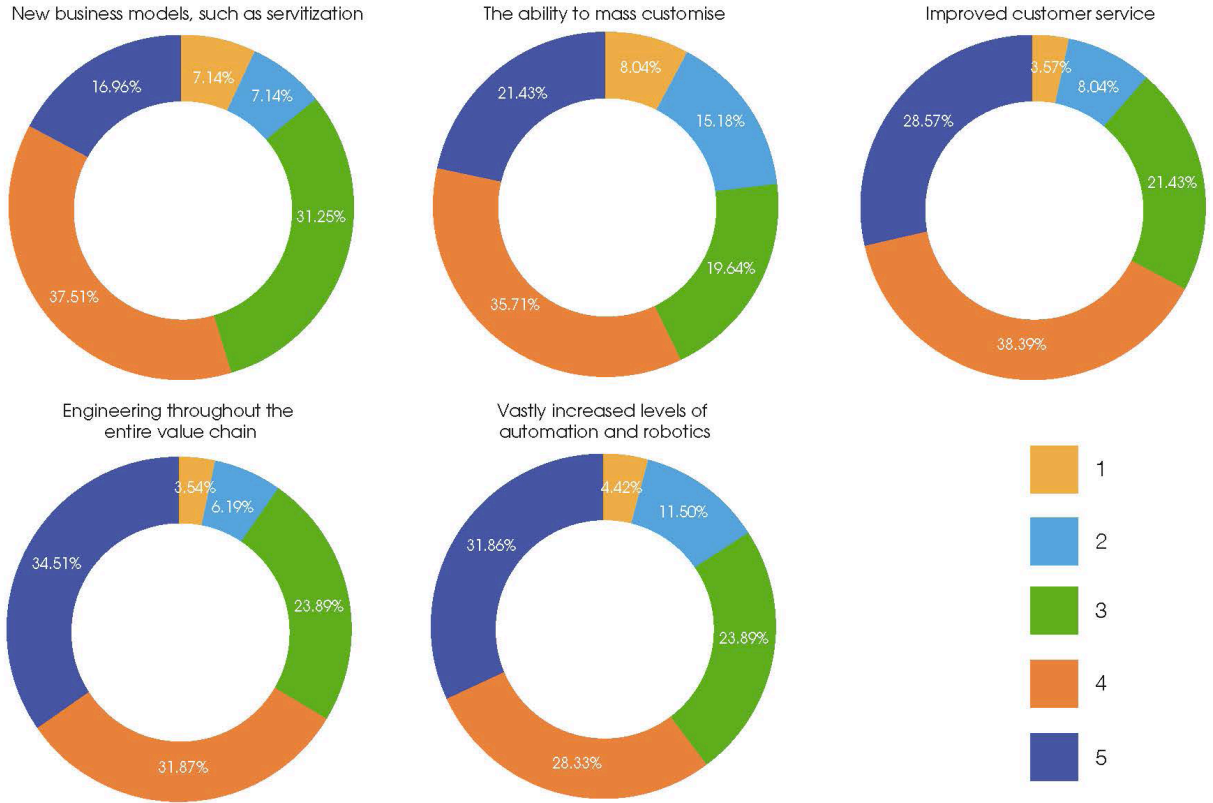
Yet again, a difference can be seen in the degree of influence perceived by larger organisations as opposed to smaller ones. Some 29% of respondents from larger organisations characterised the impact of Industry 4.0 on their businesses as falling into the highest two deciles; just 22% of respondents from smaller organisations did so.

But where within manufacturers' businesses will that influence be felt? And how will the impact of Industry 4.0 manifest itself?

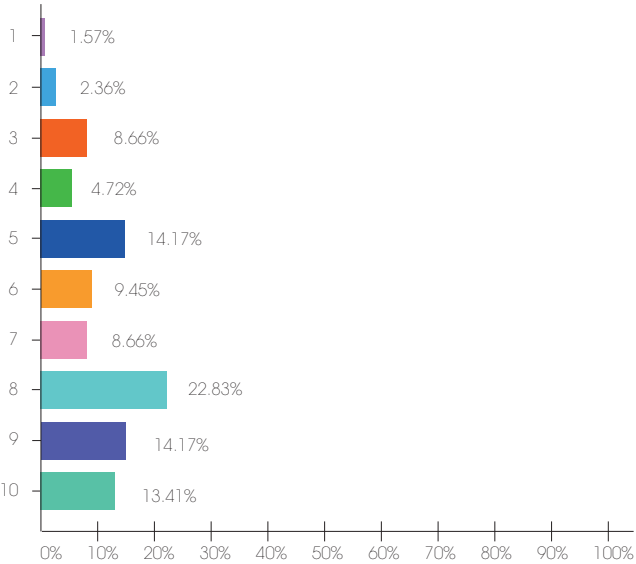
Once again, respondents were asked to assess the impact of Industry 4.0, this time gauging its impact on specific aspects of the business, and weighting those impacts on a scale of 1 to 5, with 1 representing 'low impact' and 5 representing 'high impact'.

In terms of those aspects of the business where Industry 4.0 was anticipated to have a low impact, two aspects stood out: Industry 4.0's ability to engender **new business models**, and Industry 4.0's potential for assisting in **mass customisation** initiatives. In each case, more respondents characterised the impact of Industry 4.0 as being low, compared to their assessment of its impact on other aspects of business.

On a scale of 1 - 5 (where 1 is low impact and 5 high) rate each area according to how you feel Industry 4.0 could impact your business?



On a scale of 1-10 (1 = not influential and 10 = very influential) how influential do you foresee Industry 4.0 being to your business?



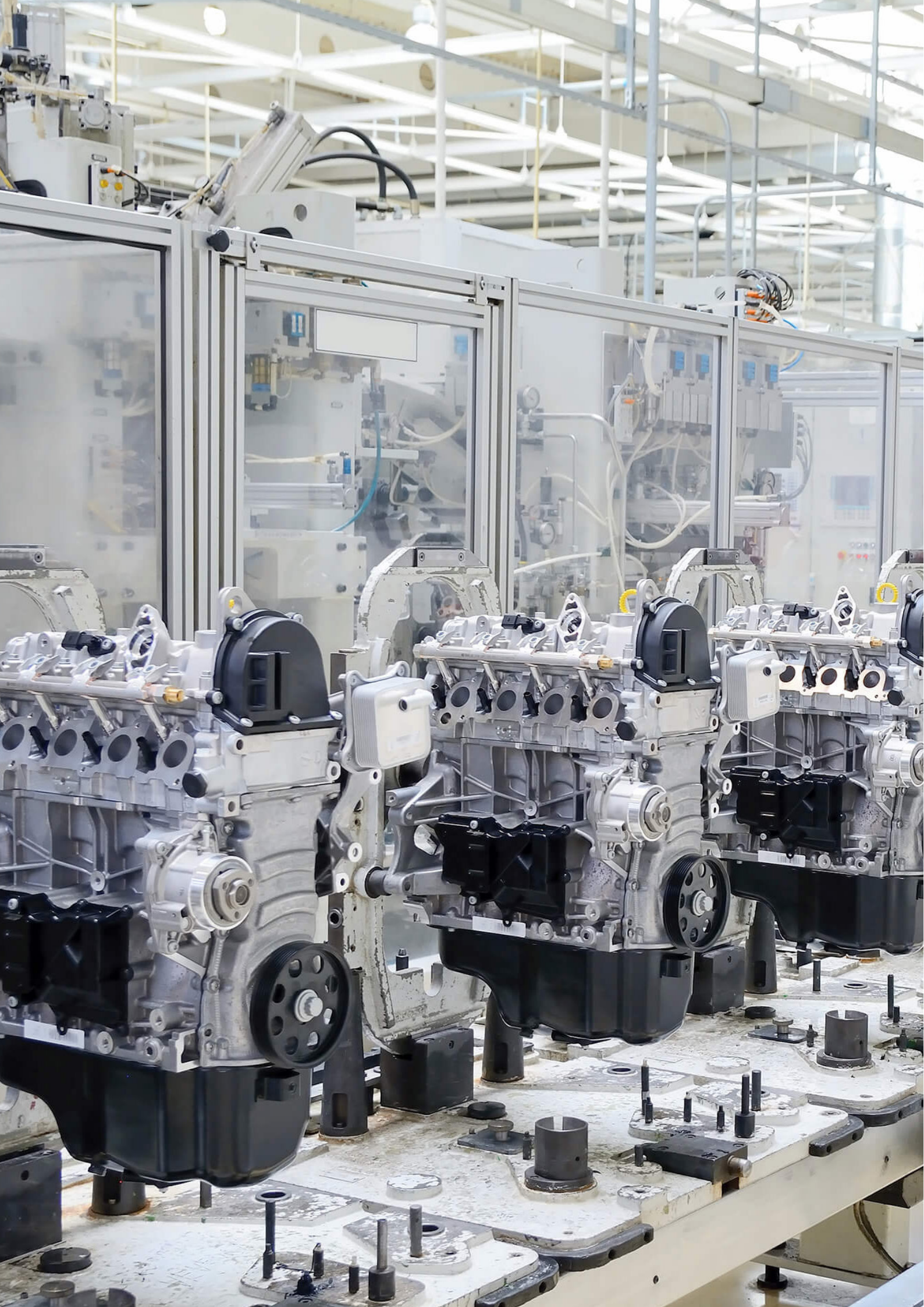
"We are already actively adapting our machines' mechanical designs and electrical controls in order to make them Industry 4.0 capable."

R&D director, £11-£50m machinery and equipment manufacturer

Conversely, Industry 4.0 was seen as having a high impact on three aspects of business: **improved customer service, end-to-end value chain engineering**, and vastly increased levels of **automation and robotics**. In each case, roughly a third of respondents saw Industry 4.0 as having a high impact.

"As a tooling manufacturer, we have to embrace Industry 4.0 and be part of it, otherwise we will no longer be a leader in our industry."

Managing director, sub-£10 million engineering company



Section 4

Building the business case



So how, then, will Industry 4.0 first manifest itself within manufacturing businesses? Where will the returns on an investment in Industry 4.0 be first experienced? And what are the biggest issues to be targeted by an Industry 4.0 investment?

To establish this, respondents were first asked to hypothesise an Industry 4.0 investment over the next one to three years, and asked to nominate an area of business activity into which that investment should be prioritised.

Should the focus be on **smart manufacturing**—defined as comprising such things as increased production output, quality, safety, and yield—for instance? Or **'connected products'**, defined as applying to Industry 4.0 to vehicles and industrial machinery in order to facilitate remote diagnostics, remote maintenance, and remote data capture, up to and including servitization? Or the **'connected supply chain'**, defined as applying Industry 4.0 to supply chains in order to increase their visibility and coordination, both inbound and outbound?

A significant majority of respondents were clear in their view that an Industry 4.0 investment in smart

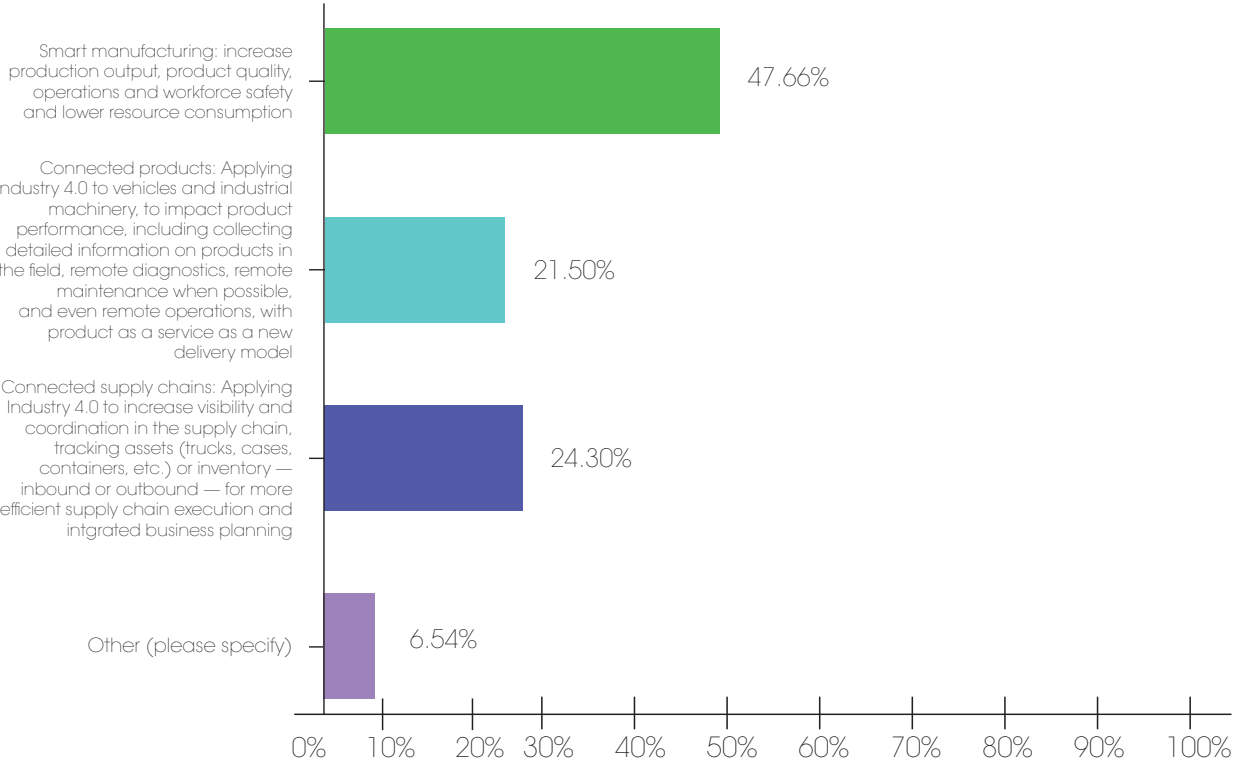
manufacturing was the priority—48% of respondents, a number that was twice the proportion electing for the next most pressing priority, the connected supply chain.

That said, a subtly different picture emerges from respondents' views as to how the main business functions—finance, R&D, logistics, production, maintenance and sales—would benefit from Industry 4.0.

Again using a scale of 1 to 5, where 1 represents 'low level of benefit' and 5 represents 'high level of benefit', respondents were asked to assess the function-by-function benefits of Industry 4.0.

Perhaps predictably, respondents designated the production function as receiving a significant benefit from Industry 4.0, with just over a third of respondents (36%) placing the production function's benefit from Industry 4.0 in each of the highest two quintiles. Interestingly, no other function was seen as receiving a higher—or even comparable—level of benefit from Industry 4.0, a view entirely consistent with the priority attached to smart manufacturing.

What is the single biggest issue facing your business which you feel could be resolved by an Industry 4.0 solution in the next 1-3 years?



On a scale of 1 - 5 (where 1 is low and 5 high) rate how much you feel each area of your business will benefit from Industry 4.0?



Yet look closely, and three other functions are also seen as benefiting, albeit not quite to the same extent. In the case of R&D, respondents electing for the highest two quintiles totalled 41% and 23% respectively; in the case of the logistics function, 29% and 27% respectively; and in the case of maintenance, 34% and 28% respectively. Maintenance, of course, is strongly allied to production, and—in terms of the definition used—again consistent with the smart manufacturing imperative.

There are two interpretations to put upon this. One is that in terms of prioritisation, smart manufacturing and the production function are clear favourites, but the imposition of a 'first past the post/ pick only one option' question format amplifies the distance between smart manufacturing and connected products and the connected supply chain.

The other—subtly different—interpretation is that the benefits of connected products and the connected

supply chain are longer term in nature: smart manufacturing is where benefits are to be seen soonest (and possibly to a greater extent), with connected products and the connected supply chain still offering distinct benefits, but benefits that take longer to come to fruition.

Either way, the message for manufacturers is clear: while Industry 4.0 is seen as offering value in the form of smart manufacturing, smart manufacturing certainly isn't the only game in town. The benefits of connected products and the connected supply chain may not be quite as prominent or imminent, but they are nonetheless real.

Either way, the message for manufacturers is clear: while Industry 4.0 is seen as offering value in the form of smart manufacturing, smart manufacturing certainly isn't the only game in town. The benefits of connected products and the connected supply chain may not be quite as prominent or imminent, but they are nonetheless real.



Section 5

Making the investment



So given the evident potential of Industry 4.0, how prepared are manufacturers to invest in it? The answer: very.

Some 56% of respondents, for instance, reported a firm intent to invest; a sharp contrast to the 10% of respondents responding in the negative. Endorsements hardly come much clearer: by a margin of almost six to one, businesses are prepared to back Industry 4.0 with cold hard cash.

Granted, a third of respondents (33%) have yet to make up their mind. But assuming for the sake of argument that they too eventually decide along roughly the same six-to-one lines, then the overall proportion of businesses electing to invest in Industry 4.0 is over 80%.

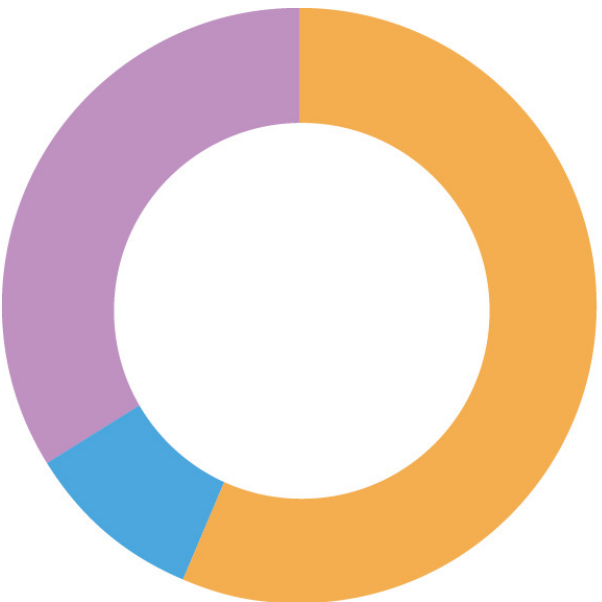
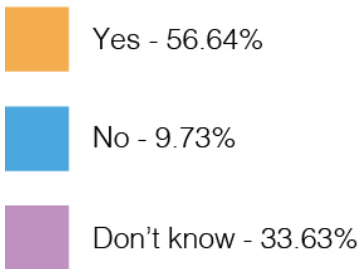
And how quickly might these investments be made? Again, the picture is compelling, with 64% of respondents—almost two-thirds—saying that they plan to invest in the next twelve months.

Add in the further 24% of respondents—almost a quarter—planning to invest in the next two to three years, and the level of conviction is clear. Industry 4.0 is not only investable, it is compellingly investable, with plans and intentions at an advanced stage.

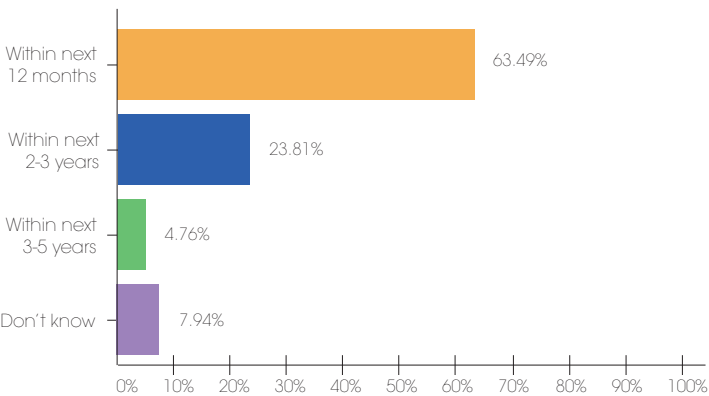
And finally, where exactly do respondents envisage making these investments, in terms of the individual business functions involved?

Given respondents' views as to where the benefits of Industry 4.0 are to be found within their businesses, there are few if any surprises.

Do you plan to invest in Industry 4.0 within your business?



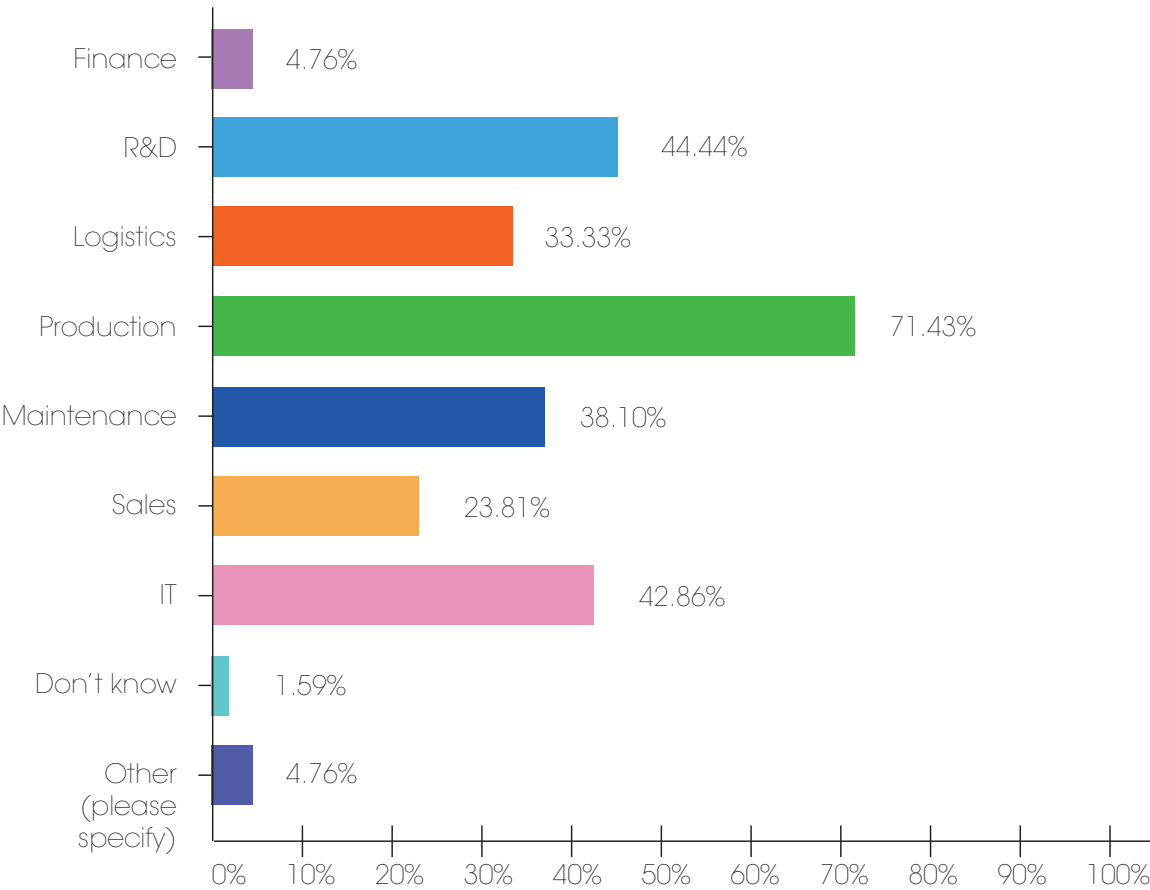
If yes, when?



"We're excited by Industry 4.0, and see in it a way to provide 'foundation thinking' as to how best approach our future business direction."

Transformation manager,
£51-100m industrial electronics
manufacturer

What area do you plan on investing in?
(tick all that apply)



Predictably, Industry 4.0 investment in production-related areas is seen as a priority, with 71% of respondents declaring an intention to do this. R&D and IT also feature strongly, at 44% and 43% respectively—with investment in IT, perhaps, being seen as an enabler, rather than as a direct source of ROI.

Respondents also indicated their intentions to invest in their businesses' logistics and maintenance functions, with 33% and 38% of respondents expressing this view. Just 5% of respondents said that their businesses planned on making an Industry 4.0 investment in their finance functions.

"Industry 4.0 is the future of our business: we have a good understanding of where we are going, but implementation will be difficult, and we know we have a long way to go."

Chairman, sub-£10 million engineering company



Section 6

Partner comments



So what to make of it all? Here at Oracle, we are in no doubt. Industry 4.0 is real, it is happening, and hard cash is being invested in it—with firm expectations of tangible returns. Companies have already realised tangible benefits, for example a gas producer achieved the following -

- Forecast accuracy improvement of 7-28%
- Order accuracy improvement of 5-12%
- Shipment accuracy improvement 3-10%
- Reduction in freight spend 5-25%

What's more, as this survey highlights, the timescales involved are aggressive. Manufacturers aren't waiting for others to lead the way: significant numbers of businesses appear to have firmly-identified projects in mind, with equally firm plans to fund those projects over the next year to eighteen months.

Our position as one the world's very largest enterprise applications and technology companies gives us unparalleled insight into the use-cases that businesses are seeing in Industry 4.0.

Use-cases such as Big Data, for instance, enabling high service levels alongside faster and leaner supply chains. Increasing lifetime customer value, through identifying spend desire. Remote monitoring of customers' bulk chemical usage and inventory levels by VMI suppliers within the process industry. End-to-end visibility within logistics processes, plus optimum transportation planning. Smart manufacturing. The possibilities are—almost literally—endless.

Nor are they academic, theoretical possibilities. Look closely, and you'll find Oracle customers doing all these things. A toy producer, for instance. A chemical manufacturer. An architectural masonry manufacturer. A healthcare firm. An end-to-end integrated coffee chain. And many more. Real businesses, in short, embracing Industry 4.0 to deliver real bottom line benefits.

How best to categorise these opportunities? In our view—a view echoed by this survey—the key underpinning concept is 'connection', and the connectivity possibilities that Industry 4.0 unlocks.

Specifically, for instance, we see Industry 4.0 opening up possibilities in the areas of:

* Connected Products, leveraging Industry 4.0 to operationalise innovation, and ensure that the product portfolio evolves ahead of the competition, in order to deliver top line growth. The toy manufacturer referred to above is a great example of this, increasing customer lifetime value by identifying products' most used features, split by geography and customer segment.

* Connected Demand, using Industry 4.0 to improve the customer experience, reduce cost and potentially

develop new value-adding business models. One Oracle customer, an industrial gas producer, not only delivers great service through timely replenishment based on real-time usage data, but also goes the extra mile by alerting the customer if the gas usage is abnormal.

* Connected Logistics, utilising Industry 4.0 to dramatically improve visibility and increase responsiveness. Here, we're thinking of an industrial company which has not only achieved complete order control by tracking outbound product movement, but is also able to determine the best mix of private and common fleet based on detailed data.

* Connected Manufacturing, exploiting Industry 4.0 to dramatically improve plant efficiency and improve product quality. One Oracle customer (global high-tech manufacturer of semiconductor and display products) enhanced total yield by solving chronic failure problems on the equipment using data from over 500 thousand sensors and 3.5 billion data points. They were not able to solve the problem through conventional statistical analysis.

* Connected Service, using Industry 4.0 to take maintenance to the next level. A leading manufacturer of valves, automation components and other products for high-tech process industry was able to pro-actively and timely replace parts and avoid production downtime. They used real-time filtering and processing of events from equipment deployed world-wide and integrated this information with service field CRM system.

* Connected Value Chain, using Industry 4.0 to take mass customisation to the next level. Rather than facing the market with a 'one size fits all' approach, companies can instead deliver specialist products at a more granular customer segment level, while simultaneously increasing profitability. A technology consulting and services provider specialising in IoT and Connected Car solutions helped OEMs reduce the warranty cost of their fleet. This company built a platform to offer prognostics and provide fleet owners with the ability to predict events based on data mined from across the fleet. They also built customised dashboards to track fleet vehicles in real-time, monitor their health, and predict service needs.

In short, Industry 4.0 opens the door to a world of enhanced connectivity, with technologies such as the Internet of Things enabling real-time control at unprecedented levels of granularity, while also delivering information—and information in Big Data volumes—for advanced analytics to then mine for insights, performance data, enhanced customer service, and new business models.

Put another way, it's time—if you haven't already started—to consider making your own Industry 4.0 journey.

"Industry 4.0? It's the future of UK manufacturing."

Managing director, sub-£10 million engineering company

"It can be difficult when in the middle of something to recognize it for what it is. But I believe that when people look back, they will see the massive change that is going on within industry as being a genuine paradigm shift, and one offering significant opportunities to develop and increase revenue streams, improve our customer experience, and deliver better and more informed support of machinery and production lines."

Machinery value stream leader, £11-£50m machinery and equipment manufacturer

"Already, it looks like the tipping point has been reached, and Industry 4.0 technology is now mature enough to really add value, through the use of networked machinery and equipment integrated with appropriate software."

Manufacturing Development Manager, £101-500m machinery and equipment manufacturer



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