Industry 4.0: Building the Digital Industrial Enterprise

Middle East key results

***US$16.9bn** in annual revenue gains*

***US$17.3bn** in annual cost and efficiency gains*

***US$42bn** in annual digital investment*

http://gmisummit.com/

https://www.pwc.com/gx/en/industries/industry-4.0.html

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GMIS | Global Manufacturing & Industrialisation Summit

*Taking a **Transformational** Approach*

Introduction

Dear Readers,

We are delighted to share with you the first white paper that has jointly been produced by Pricewaterhouse Coopers (PwC) and Global Manufacturing & Industrialisation Summit (GMIS). The Global Manufacturing & Industrialisation Summit (GMIS) is a joint initiative launched by the United Nations Industrial Development Organization (UNIDO) and the UAE's Ministry of Economy. As the world's first ever cross-industry forum, GMIS is designed to help transform global manufacturing and industrial activity by creating an universal consensus amongst governments, businesses and society to take a transformational approach towards shaping the future of manufacturing. GMIS aims to promote a roadmap for future development to amplify the evolution in technology, innovation, human capital, international trade and others. PwC is the knowledge partner for GMIS, and is working closely with GMIS on a number of topics such as thought leadership, pilot projects, IoT (Internet of Things) standards, best practices, industry trends, and other exciting objectives.

The Middle East, perhaps more than any other region, is at the epicentre of the various megatrends reshaping the world. *Demographic and social change* has driven both prosperity and instability in much of the Middle East, as explosive population growth has boosted economies, strained resources and raised the spectre of youth unemployment. Part of that population growth stems from the inflow of talent, responding to the *shift in global economic power* which has placed the Middle East firmly in the middle of the world's fastest-growing markets allowing Dubai and Abu Dhabi, in particular, to turn into a global hubs. *Urbanisation* is transforming nations worldwide. Our region is one of the most highly urbanised in the world and, with new cities under construction, the pace of transformation is exponential. It is a struggle to develop sufficient infrastructure to cope with both the population explosion and the pressures brought by *climate change and resource scarcity* – water consumption and energy diversification will become more pressing issues in coming years. *Technological breakthroughs* could be part of the answer, but the disruption that digitalisation is bringing to today's organisations also requires new skills that are needed in the Middle East. This first report in the GMIS Thought Leadership series explores the impact of these trends on Industrial Manufacturing.

Industrial Manufacturing plays a crucial role in the exponentially evolving world economy, accounting for an average 17% of global GDP over the past 5-10 decades. We are entering a new age – today's emerging technologies and digital strategies are rapidly changing our lives, working environments and industries. These technologies and their applications in the industrial sector are transforming how companies operate internally, with their employees and processes, as well as with their customers, suppliers and partners. This is impacting the complete industrial ecosystem that goes beyond the boundaries of a nation.

This inaugural paper in our GMIS-PwC thought leadership series explores how Middle East companies are planning to leverage technologies in comparison to their global peers. In this report, we have defined Industry 4.0 and have shared the views of technology adopters/ companies with you. We have also explored the current challenges, developments and have shared key actions that different stakeholders, such as technology adopters, technology providers and policy makers could take immediately to get started on this journey. Based on the findings and our experience of working with technology adopters, technology providers and policy makers, we've also crafted a blueprint for success to help you secure your organisation's position as a leading digital enterprise in tomorrow's complex industrial ecosystems.

We sincerely hope that this report would contribute to your organization's development. We would like to take this opportunity to invite you to attend the inaugural edition of the Global Manufacturing and Industrialisation Summit (GMIS) that will be held from March 27-30 in Abu Dhabi, the capital of the United Arab Emirates. For more information, please visit *www.gmisummit.com*

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Contents

PwC's 2016 Global Industry 4.0 Survey is the largest worldwide survey of its kind, with over 2,000 participants from 26 countries. The GMIS and PwC teamed up for the Middle East part of the survey which had 52 participants from six key industries in the region. Although the sample size is not very large in this inaugural year, the findings go to the heart of companies' perspectives on the progress of Industry 4.0.

Perspectives

The study explores the benefits of digitising your company's horizontal and vertical value chain, as well as building your digital product and service portfolio. Based on the findings and our experience of working with first movers, we've also crafted a blueprint for success to help you secure your company's position as a leading digital enterprise in tomorrow's complex industrial ecosystems. We also offer suggestions for how both user companies and solution suppliers can take action.

Industry 4.0 at a glance

In this report, the term 'Industry 4.0' stands for the fourth industrial revolution. Other related terms include the 'Industrial Internet' or the 'Digital Factory', although no single term takes a complete view. While Industry 3.0 focused on the automation of single machines and processes, Industry 4.0 focuses on the end-to-end digitisation of all physical assets and integration into digital ecosystems with value chain partners. Generating, analysing and communicating data seamlessly underpins the gains promised by Industry 4.0, which networks a wide range of new technologies to create value. While the term Industry 4.0 is becoming increasingly familiar, we use it in a specific way in this report. In our view, Industry 4.0 is driven by:

1) Digitisation and integration of vertical and horizontal value chains

Industry 4.0 digitises and integrates processes vertically across the entire organisation, from product development and purchasing, through manufacturing, logistics and service. All data about operations processes, process efficiency and quality management, as well as operations planning are available real-time, supported by augmented reality and optimised in an integrated network. Horizontal integration stretches beyond the internal operations from suppliers to customers and all key value chain partners. It includes technologies from track and trace devices to real-time integrated planning with execution.

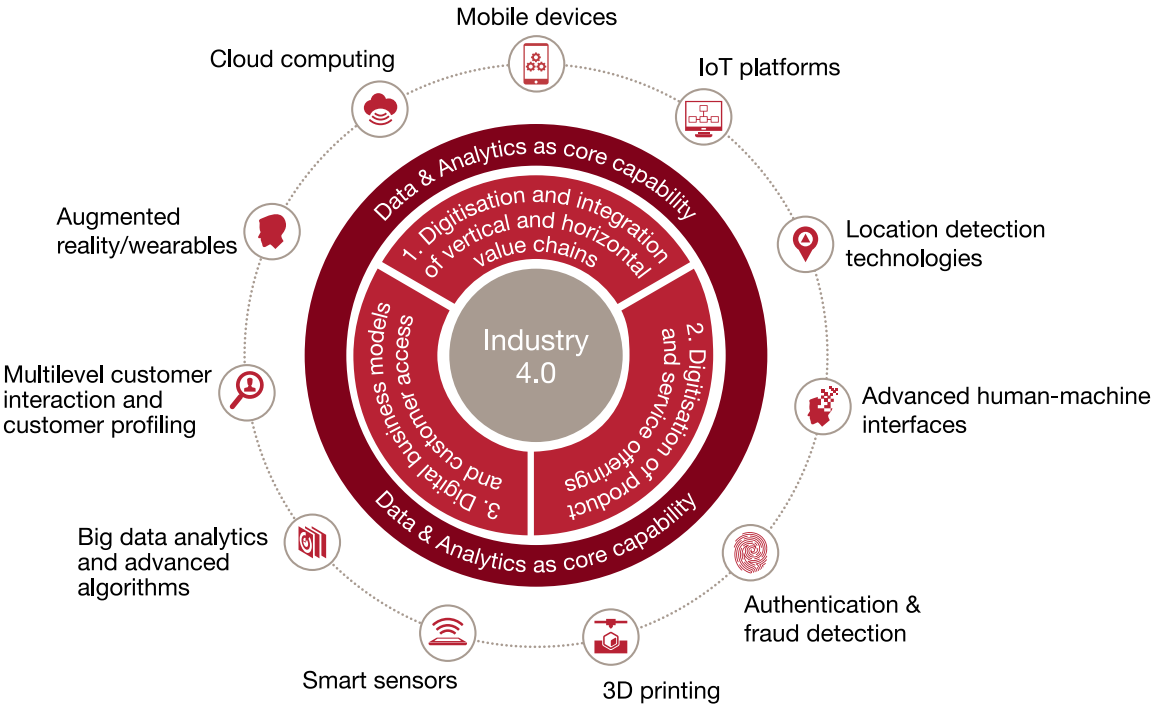
2) Digitisation of product and service offerings

Digitisation of products includes the expansion of existing products, e.g. by adding smart sensors or communication devices that can be used with data analytics tools, as well as the creation of new digitised products which focus on completely integrated solutions. By integrating new methods of data collection and analysis, companies are able to generate data on product use and refine products to meet the increasing needs of end-customers.

3) Digital business models and customer access

Leading industrial companies also expand their offering by providing disruptive digital solutions such as complete, data-driven services and integrated platform solutions. Disruptive digital business models are often focused on generating additional digital revenues and optimising customer interaction and access. Digital products and services frequently look to serve customers with complete solutions in a distinct digital ecosystem.

Industry 4.0 framework and contributing digital technologies

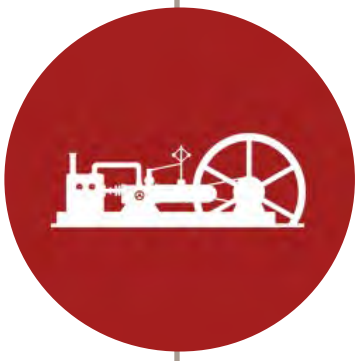


1800

End of 18th century

Industry 1.0

In the late 18th century, the invention of mechanical production powered by water and steam started the first industrial revolution.

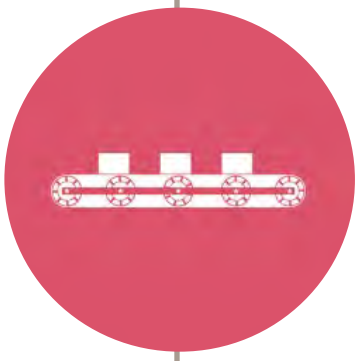


1900

Beginning of 20th century

Industry 2.0

The second industrial revolution was fueled by the start of mass production powered by electricity and combustion engines to power machines in the beginning of the 20th century. The first assembly lines were introduced, the use of new materials and chemicals became possible and communication was getting easier.



2000

1970

Industry 3.0

In the 1970s, the introduction of automation and robotics ushered a new era, the third industrial revolution. Electronics and IT such as computers, robots and the Internet constitute the beginning of the information age.

2014

2015+

Industry 4.0

At present, we find ourselves at the beginning of the fourth industrial revolution. Based on cyber-physical production systems aiming to connect the physical and digital world of production, Industry 4.0 / Digital Operations comprises the digitization and integration of value chains and products and/or services. IT, machines and humans are connected, interacting in real time thus creating a more flexible, resource-efficient, customized way of manufacturing – the Smart Factory which leverages the Internet of things (IoT). The integrated analysis of data and collaboration form key value drivers.

2020

Executive summary

Around the world, behind the scenes of the world's leading industrial and manufacturing companies, a profound digital transformation is now underway, and the Middle East is no exception. PwC's 2016 Industry 4.0 Middle East Survey covered six industries with the predominant focus on engineering and construction (37% of participants), industrial manufacturing (31%) and transportation and logistics (21%). There was also participation from chemicals and metals companies.

We found that companies are increasingly focused on 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.

What are survey participants saying?

Middle East survey participants are anticipating that significant gains will flow from digitisation and integration over the next five years, as follows:

- Annual digital revenue increase of 3.8% on average with a significant minority that expect total increase of more than 50% over five years. Our estimates, based on extrapolation of our respondents' inputs to all the industrial segments across the Middle East and country industrial data, indicate that this can add up to US$17bn in increased annual revenues for the next five years across the industrial sectors we surveyed in the Middle East
- Cost reductions of 3.8% per annum on average is forecasted. Since digital technologies enable shorter operational lead times, higher asset utilisation and maximum product quality. We estimate this represents an average US$17.3bn, based on extrapolation, in cost savings each year for the next five years
- The Middle East companies that we spoke to are making a strong investment commitment to Industry 4.0. The vast majority (89%) are planning to invest 4% or more of their annual revenue in digital operations solutions, amounting to an investment of US$42bn over the next five years. That is a significantly higher percentage than the 52% of those in our worldwide sample planning investment at that level

Is Digital = ERP++?

A major focus of these investments will be on digital technologies such as sensors or connectivity devices, and on software and applications like manufacturing execution systems and enterprise resource planning (ERP) platforms. However, many industrial companies in the Middle East believe that the digital enterprise is the equivalent of having an enhanced ERP system; this is a possible reason for some of the anomalies in the results that we discuss in the report. In addition, companies are investing in training employees and driving the required organisational change.

Other technologies on the horizon

A range of wider technologies, including 3D printing, robotics, IoT and analytics, have direct relevance for many companies in the region and extend the scope of digitisation, along with other new technologies that will help increase integration and productivity too. For example, autonomous vehicles can provide driverless transportation of materials between sites and on-site, whereby flying robots and drones offer the prospect of greater safety and minimising human exposure to hazardous chemicals and gases. According to a recent survey, the global market for drones is expected to be worth US$127bn by 2020. In the Middle East alone, there are numerous government agencies that have started using these smart machines for functions such as inspection, surveillance, mapping, search and rescue, maintenance, distribution and many more.

Companies in the GCC have started using 4th generation industrial technologies

Companies in the region are beginning to embrace them at an increasing rate. For example, a Middle East based aerospace manufacturing company is on course to establishing a digital factory in which product/ process traceability, process automation and digital feedback will be a norm. Another, in the retail sector, is using micro-location-based technology in the form of beacons that can track consumer and product flow. The potential is there to examine dwell times of consumers in stores, identify the presence of high-value customers, keep track of staff interaction with customers, allowing the aggregation of information and generation of 'big data' that can be analysed and used to optimise product and sales.

By taking advantage of digitisation, integration and automation opportunities, companies can seek to stay relevant by taking actions as the era of digitally-connected smart infrastructure develops.

الملخص التنفيذي

يجري حالياً على مستوى العالم وخلف كواليس الشركات الصناعية العالمية الرائدة، تحوّل رقمي عميق للأعمال. لا يستثني هذا التحول منطقة الشرق الأوسط، حيث شمل استطلاع قطاعات الشرق الأوسط (Middle East Industry 4.0) لعام ٢٠١٦ الذي أجرته شركة برايس ووتر هاوس كوبرز، ستة قطاعات أبرزها قطاع الهندسة والإنشاءات بنسبة (٣٧٪ مشارك)، وقطاع الصناعات التحويلية بنسبة (٣١٪)، بالإضافة إلى قطاع النقل والخدمات اللوجستية بنسبة (٢١٪)، إلى جانب مشاركين من شركات الصناعات الكيماوية والمعادن.

وقد تبين من خلال الاستطلاع أن الشركات تركّز بشكل متزايد على التحول الرقمي لوظائفها الأساسية ضمن سلسلة القيمة الرأسية الداخلية، وكذلك حالها مع الشركاء الأفقيين على طول سلسلة التوريد. إضافة إلى ذلك، تقوم الشركات بتعزيز مجموعات منتجاتها من خلال الوسائل الرقمية وإدخال خدمات مبتكرة قائمة على البيانات.

ما هو رأي المشاركين في الاستطلاع؟

يتوقع المشاركون في استطلاع قطاعات الشرق الأوسط حصولهم على مكاسب كبيرة على مدى السنوات الخمس المقبلة نتيجةً للتحوّل الرقمي وتحقيق التكامل. تتلخص هذه المكاسب فيما يلي:

- زيادة العائدات الرقمية السنوية بمعدل ٣٫٨٪، بينما توقعت نسبة ضئيلة زيادة إجمالية تتجاوز ٥٠٪ على مدى السنوات الخمس القادمة. وتشير تقديراتنا في شركة برايس ووترهاوس كوبرز بحسب إجابات المشاركين من جميع الأقسام الصناعية في الشرق الأوسط والبيانات الصناعية الخاصة بكل دولة، بأن هذا سيؤدي إلى زيادة تصل لغاية ١٧ مليار دولار أمريكي على الإيرادات السنوية على مدى السنوات الخمس القادمة في كافة القطاعات الصناعية التي قمنا بدراستها في الشرق الأوسط
- يتوقع انخفاض التكاليف بمعدل ٣٫٨٪ سنوياً، حيث تتيح التقنيات الرقمية تقليل مدة الإنجاز التشغيلية، واستغلال الأصول بشكل أفضل، إلى جانب تقديم منتجات ذات جودة أعلى. وتشير التقديرات إلى أن هذا يمثّل ما معدله ١٧٫٣ مليار دولار أمريكي سنوياً، بحسب قراءتنا للإجابات، على شكل وفرة في التكاليف على مدى السنوات الخمس القادمة
- أظهرت شركات الشرق الأوسط التي أجري عليها الاستطلاع التزاماً قوياً بالاستثمار في الثورة الصناعية الرابعة، حيث كشفت الغالبية العظمى (٨٩٪) منها عن نيتها في استثمار ما نسبته ٤٪ أو أكثر من إيراداتها السنوية في حلول العمليات الرقمية، والذي سوف يشكّل إجمالي استثمار يصل إلى ٤٢ مليار دولار أمريكي على مدى السنوات الخمس المقبلة، حيث لوحظ بأن هذه النسبة تزيد بشكل كبير عن ٥٢٪ لعينة الاستطلاع العالمية ممن لديهم خطط للاستثمار على هذا المستوى.

هل التحول الرقمي = أنظمة تخطيط موارد المؤسسات ++؟

سيكون التركيز الرئيسي للاستثمارات على التقنيات الرقمية مثل أجهزة الاستشعار أو أجهزة الاتصال، وعلى البرمجيات والتطبيقات مثل أنظمة تنفيذ التصنيع، وأنظمة تخطيط موارد المؤسسات (ERP). ولكن، تظن العديد من الشركات في الشرق الأوسط بأن امتلاك نظام تخطيط موارد مؤسسات رقمي متطور يعني بأنها شركة رقمية، وهذا قد يكون السبب في الاختلافات في النتائج المطروحة في التقرير. إضافة إلى ما سبق، سوف تستثمر الشركات في تدريب الموظفين وقيادة التغيير المؤسسي المطلوب.

التقنيات الأخرى التي تلوح في الأفق

بالإضافة لما ورد سابقاً، يمكن إيجاد مجموعة أوسع من التقنيات مثل الطباعة ثلاثية الأبعاد، وإنترنت الأشياء، والرجل الآلي، والتكنولوجيا الدقيقة، التي تتلاءم وتساهم في توسيع نطاق التحول الرقمي لدى العديد من الشركات في المنطقة، إضافة إلى التقنيات الجديدة الأخرى التي ستساعد على زيادة التكامل والإنتاجية أيضاً. فعلى سبيل المثال، يمكن أن تنقل المركبات ذاتية القيادة المواد بين المواقع المختلفة وفي أرجاء الموقع نفسه، كما يعتبر الرجل الآلي والطائرات بدون طيار أكثر أماناً، كونها تحد من تعرض الإنسان للمواد الكيميائية والغازات الخطرة. ووفقاً لدراسة حديثة، من المتوقع أن تبلغ قيمة السوق العالمية للطائرات بدون طيار ١٢٧ مليار دولار أمريكي بحلول عام ٢٠٢٠ علماً بأن عدداً ضخماً من الجهات الحكومية في الشرق الأوسط قد بدأت باستخدام هذه الآلات الذكية للقيام بالعديد من الوظائف، مثل: التفتيش، والمراقبة، ورسم مخططات الأعمال، والبحث، والإنقاذ، والصيانة، والتوزيع، والعديد من المهام الأخرى.

بدأت الشركات في منطقة الخليج العربي باستخدام تقنيات الجيل الرابع الصناعية

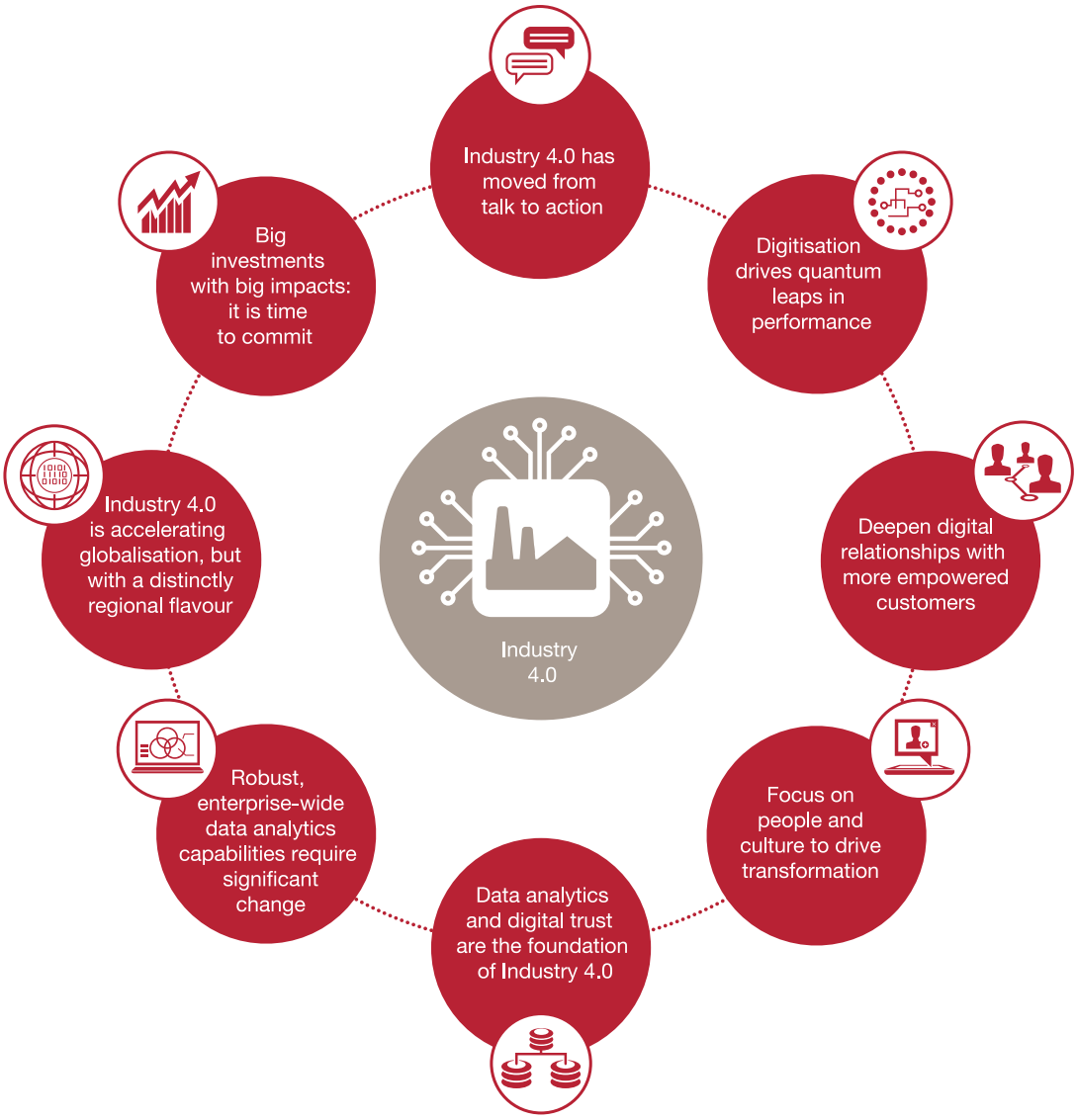
بدأت الشركات في المنطقة باعتماد هذه التقنيات الحديثة بشكل متزايد، حيث من المتوقع أن يقوم أحد عملائنا ممن يعملون في مجال الطيران بإنشاء مصنع رقمي، حيث ستصبح عمليات تتبع المنتجات/ الإجراءات، وأتمتة العمليات، والتغذية الراجعة الرقمية الأساس وطريقة العمل المعتمدة. كما يقوم عميل آخر في قطاع تجارة التجزئة، باستخدام التقنية القائمة على الإسقاط الدقيق لإحداثيات المواقع بصيغة الأنوار لتتبع مسارات المستهلكين والمنتجات، بالإضافة إلى إمكانية دراسة عدد المرات التي زار فيها المستهلكون المتاجر، وتحديد تواجد الزبائن ذوي القيم الاستهلاكية المرتفعة، وتتبع تفاعل طاقم العمل مع الزبائن، مما يتيح إمكانية جمع المعلومات وإنشاء قاعدة بيانات ضخمة يمكن تحليلها واستخدامها لتحسين المنتجات والمبيعات.

بناءً على ما سبق، يمكن للشركات من خلال الاستعانة بالتحول الرقمي، والتكامل، والأتمتة، أن تبقى مواكبة لهذا العصر الذي يتسم بالتطور المستمر للبنية التحتية الذكية والمتصلة رقمياً.

Key findings

1. Industry 4.0 has moved from talk to action
2. Digitisation is driving quantum leaps in performance
3. Deepen digital relationships with more empowered customers
4. Focus on people and culture to drive transformation
5. Data analytics and digital trust are the foundation of Industry 4.0
6. Robust, enterprise-wide data analytics capabilities require significant change
7. Industry 4.0 is accelerating globalisation, but with a distinctly regional flavour
8. Big investments with big impacts and rapid returns

Key findings from our survey research



1. Industry 4.0 has moved from talk to action

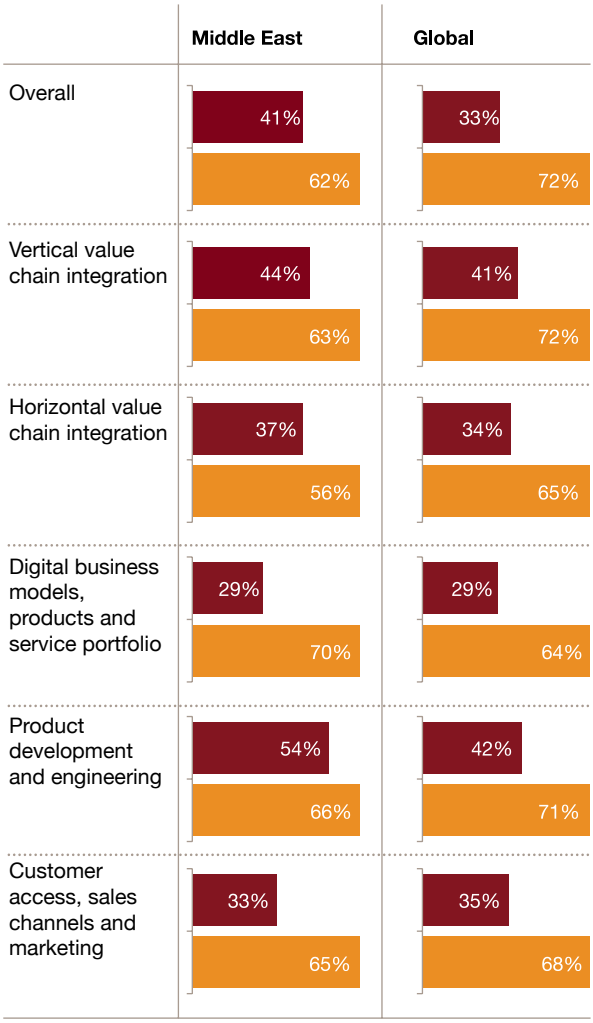
The buzz around Industry 4.0 has moved from what some had earlier seen as hype to investment and real results today. Middle Eastern companies report they are making substantial investments and this is translating into increasingly advanced levels of digitisation and integration. 41% of survey participants from the region say they have already reached an advanced level of digitisation and integration and over 62% expect to be at such a level in five years' time (figure 1).

Compared to other countries around the world, that is an unusually high level of digitisation. Respondents may have a different understanding of what truly advanced digitisation looks like. It is possible that Middle Eastern companies may be setting the bar for 'advanced' somewhat lower than companies in developed economies where Industry 4.0 has a longer history. In most of the companies, we see an increased level of process automation. However, automation at the service level is still lagging. The aim is to go beyond operational efficiency towards service excellence both internal and external, deploying the technologies to address specific client service objectives, competitive differentiation and even to integrate with client/supplier processes.

Nonetheless, there is also strong evidence that many of the industrial manufacturing and transportation and logistics companies in the region truly are leaders. For example, some regional companies in the airline sector are developing world class digital capabilities in both customer experience as well as operations.

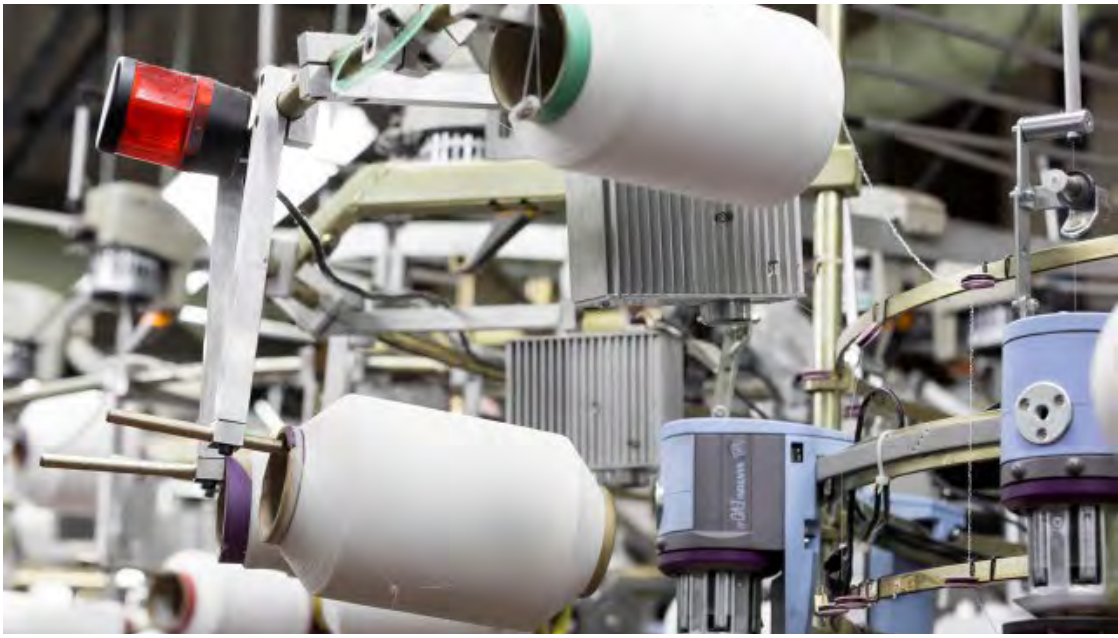
Figure 1: Middle East: Industry 4.0 is beyond the hype – it has arrived at the strategic and operational core of many companies

% of companies reporting advanced levels of digitisation and integration



Scores of 4 or 5 on a scale where 1=very low and 5=very advanced level of digitisation and integration.

Today **In five years**



Industrial manufacturers are also well on their way. For example, a leading cable manufacturing company has already achieved an advanced level of digitisation in most plants. Over the past few years the company has invested close to 10% of their annual revenues in implementing various processes and value chain optimisation measures including:

- Vertical availability and integration of all development, manufacturing and supply chain data
- Effective data management and improved data analysis in real time
- Automation of all important processes in a one-piece flow, and
- Continuous measurement and optimisation of all process steps and parameters

Looking ahead, 62% of Middle East survey respondents expect to reach an advanced digitisation level in five years' time. This lags behind the 72% reported globally. In part, this reflects the fact that sectors such as electronics and automotive that are setting much of the global pace don't have a strong manufacturing presence in the region. Nonetheless, Middle Eastern companies will want to ensure that they maintain momentum.

In common with our global survey results, 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. But, here again, the potential is immense even in sectors that are not immediately associated with the cutting edge of Industry 4.0.

In engineering and construction, for example, better availability of relevant information, rapid issue resolution, collaboration technologies with suppliers and customers, and collaborative working in the design, construction and operation of projects are among the key ways in which digitisation is improving efficiency and resource use.

The transformative potential of Industry 4.0 is reflected in the high proportion (70%) of interviewees from the region reporting that they expect the highest levels of future digitisation and integration to be in the area of digital business models and product services. The potential can be seen in one of the region's most important industries - petrochemicals. For chemicals companies, there is considerable scope to gather and leverage better knowledge about the chemical and physical properties of the product in the customers' application and use that to customise products, improve collaboration and develop shared tools and services. Additionally, some chemicals companies are already exploring the opportunities that arise from a wider digital ecosystem in their product markets. They are looking at end-market outcome data and using it not just to inform product development, but also to provide value-added services to customers.

"High levels of digitisation are reported by survey participants, but some of them may be perceiving digitisation in relatively narrow ERP system terms."

Perspective: A platform for world class excellence

Strata seeks to be a leader in advanced composite aero-structures and has partnerships with the world's leading aircraft manufacturers, Airbus and Boeing, as well as a number of tier one suppliers. Strata's CEO Badr Al Olama outlines why Strata wants to be a global Industry 4.0 leader.

"We recognised early in our evolution the importance of technology leadership to enable us to become a world class competitive business. It is key to the advanced, intelligent, and automated manufacturing systems that Strata will need to implement to be a world class partner to its OEM customers, and to reach our goal of being one of the top three composite aero-structure manufacturing companies globally.

Strata is currently advancing along its roadmap to establish a digital factory. The roadmap, started in 2013, covers all elements of digital product data creation, management and manufacturing execution, and addresses the complexity of our new large manufacturing programmes. Strata is aiming to integrate Industry 4.0 elements into our business according to our needs and maturity, and to enable smart automation capabilities.

The various elements of Industry 4.0 will impact our business in many ways. The main areas of impact in the next five years will be in our manufacturing operations and end-to-end supply chain. Agility, quality and speed of delivery will be strong drivers. Optimisation of lean manufacturing operations with high levels of quality, along with the agility to handle changes in demand or product definition, will also have a strong focus. Adopting Industry 4.0 to empower these key areas will be critical for our success".

2. 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, in our global survey, survey participants expect Industry 4.0 will translate into cost reduction of 3.6% per annum over the next five years. Those in the Middle East are even more optimistic with an annual cost reduction forecast of 3.8% (figure 2).

Survey participants also expect additional significant revenue growth to flow from their digitisation and integration initiatives. And here the outlook of companies in the Middle East is even further ahead of global expectations. Middle East survey participants anticipate a revenue gain of 3.8% per annum compared to 2.9% in the survey as a whole. When you consider both increased revenues and decreased costs, the impact is substantial.

This is due to the fact that Middle East is behind in digitalization as compared to developed economies thereby having a higher impact on revenue and cost for companies based here. We estimate they add up to a potential revenue gain of US$16.9bn[1] and cost savings of US$17.3bn[1] if the projections of our survey companies are extrapolated to all companies in the industry sectors covered in the region.

Gains of the magnitude uncovered by our survey 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. Saudi Arabia's current thrust on rapid industrial diversification can further magnify the impact. If even half of the expectations outlined above are realised, some companies may find it difficult to compete. In an increasingly cost competitive market, no company can afford to lose out in operational efficiency against their market peers.

The next two to three years will be crucial for those looking to catch up. Some of these cost savings can be achieved by implementing smart manufacturing initiatives. For example, companies are moving towards integrated planning and scheduling for manufacturing. Such systems combine data from within the enterprise – from sensors all the way through to ERP systems – with information from horizontal value chain partners, like inventory levels or changes in customer demand. Integrated shop floor planning improves asset utilisation and product throughput time. Another example is predictive maintenance of key assets, which uses predictive algorithms to optimise repair and maintenance schedules and improve asset uptime.

Middle East companies have also started using digitalisation to increase their revenues. For example, a Middle East based company has integrated its supply chain to have visibility of stocks being maintained by its distributors. This has helped the company to optimize inventory and prevent loss of revenue due to stockouts.

> ***"In an increasingly cost competitive market, there is the potential for approximately US$17.3bn[1] per annum in cost savings and another US$16.9bn[1] per annum in additional revenues from greater digitisation and integration."***

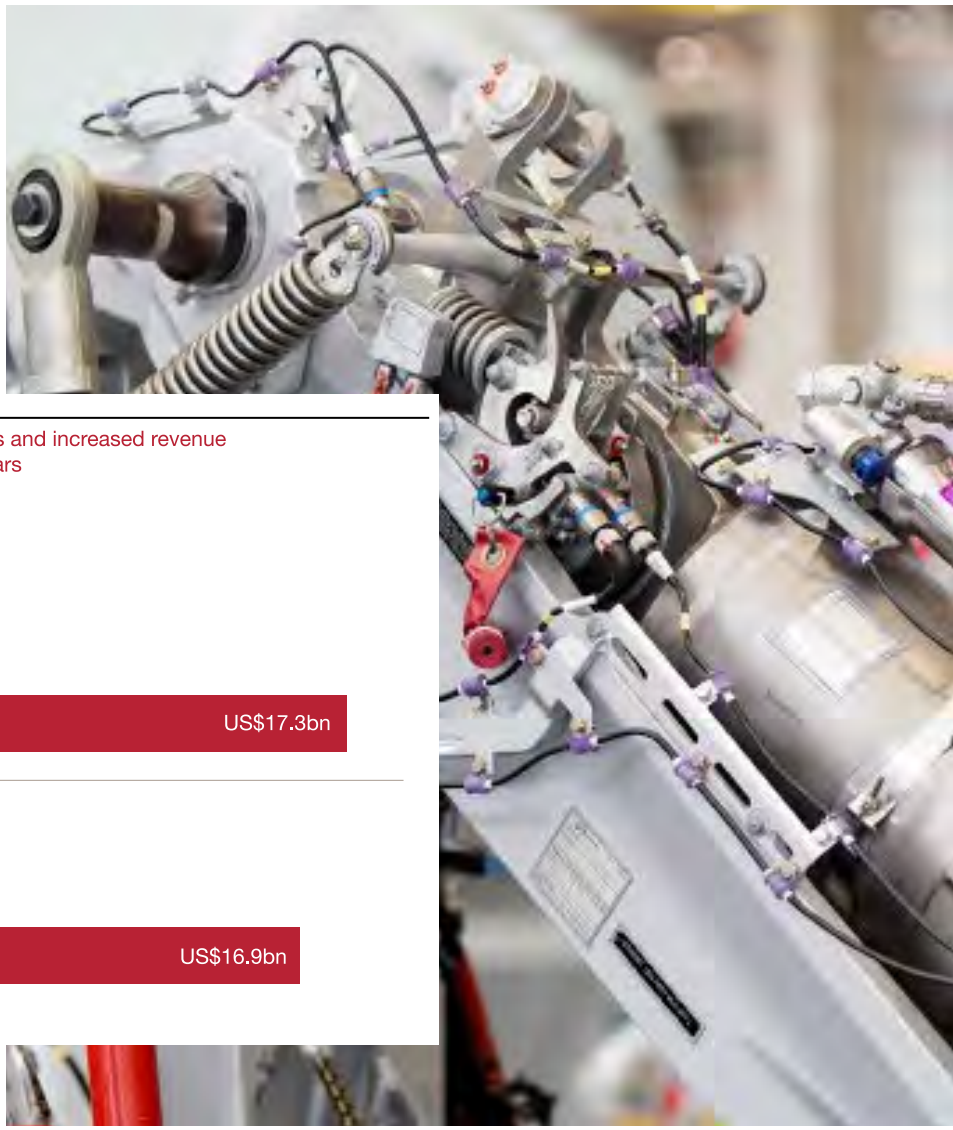
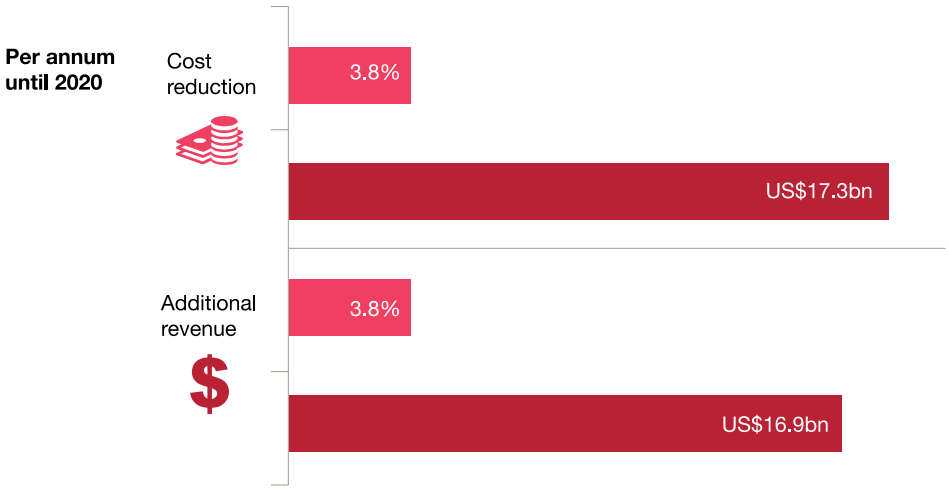


Figure 2: Middle East: High expectations of cost savings and increased revenue
Expected benefits from digitisation over the next five years



[1] Based on weighted GDP contribution (current and forecasted), industry footprint, Middle East market size, industry growth rate and insights from industry experts and market leaders; Sources: PwC Analysis, Oxford Economics, World Bank Data and Statista

How Industry 4.0 would deliver the revenue, cost and efficiency gains mentioned previously:

Additional revenue from:	Lower cost and greater efficiency from:
Digitising products and services within the existing portfolio	Real-time inline quality control based on Big Data Analytics
Creating new business models	Modular, flexible and customer-tailored production concepts
New digital products, services and solutions	Real-time visibility into process and product variance, augmented reality and optimisation by data analytics
Offering big data and analytics as a service	Predictive maintenance on key assets using predictive algorithms to optimise repair and maintenance schedules and improve asset uptime
Personalised products and mass customisation	Vertical integration from sensors through MES to real-time production planning for better machine utilisation and faster throughput times
Capturing high-margin business through improved customer insight from data analytics	Horizontal integration, as well as track-and-trace of products for better inventory performance and reduced logistics
Increasing market share of core products	Digitisation and automation of processes for a smarter use of human resources and higher operations speed
	System based, real-time end-to-end planning and horizontal collaboration using cloud based planning platforms for execution optimisation
	Increased scale from increased market share of core products

Perspective: Digitisation momentum is growing

Ducab has grown to become one of the leading manufacturers of energy cables in the Middle East and strives to be the lowest cost, highest quality cable manufacturer in the world. Andrew Shaw, Ducab's Managing Director, describes how digitisation is reaching outward from internal ERP and business processes to embrace the whole supply chain.

"There's a temptation to see digitisation as being most significant in consumer-facing markets, but it's equally relevant for manufacturers like us in a B2B environment. The momentum of change is gathering pace, through initiatives with suppliers and customers and the opportunity for cost savings.

Over the next five years, I envisage Industry 4.0 changing the whole supply chain. We will start to collect and use the machine data already available on each process line. Integration with suppliers will reduce transaction costs and streamline inventories and logistics. Better use of sensors will track and trace inventory whilst on site and in transit to customers. There will also be closer integration with customers' supply chain organisations. We're already identifying opportunities to take cost out of the combined supply chain with some large customers, and there is the chance to gain some competitive advantage for first movers.

Another big opportunity is to develop much better interfaces with customers, with more live data allowing on the spot decisions about price and availability. We also expect to develop better sales tools for our staff and visibility for customers into our stocks and invoicing. At the moment we are making relatively small steps along this journey with our customers but, once started, we expect a quick conversion and a demand for better services."

> ***"Companies will not only be able to greatly increase their ability to respond flexibly and more rapidly to customer demands but also to anticipate their demands in a range of predictive ways."***

3. Deepen digital relationships with more empowered customers

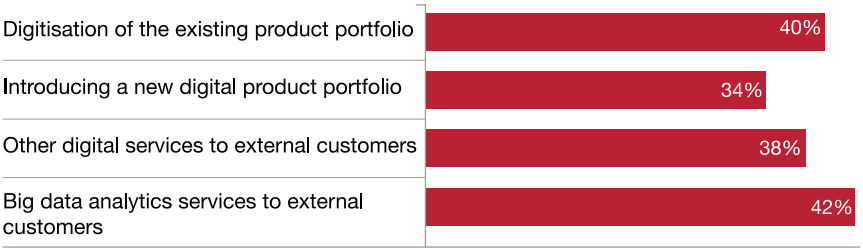
As Industry 4.0 develops, it will greatly enrich the opportunities to retain and grow the client relationship. It will also make the fight for the customer more intense. Clients and customers will be at the centre of the changes to value chains, products and services. They will be increasingly customised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

Many companies we spoke to are expecting to strengthen their digital offering to customers, either by digitising existing products or by developing new digital products. The opportunity is there not only to greatly increase the ability to respond flexibly and more rapidly to customer demands, but also to anticipate their demands. Thus, helping both the company and the customer to see ahead in a range of predictive ways.

Middle East companies plan to expand their digital portfolio, starting with the digitisation of their existing offering and expanding into new products and data services (figure 3). Four in ten survey participants (40%) say that the digitisation of their existing portfolio will be critical for their future revenue growth over the next five years. Slightly fewer expect to introduce new digital services or to utilise big data analytics in their services to customers.

Figure 3: Middle East: Revenues from digitising the product and service portfolio will grow significantly in the future

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?



The aviation industry is one of the major sectors in the Middle East where the digitisation of customer experience is enabling passengers to have greater control and customisation of the service they receive. Moreover, airlines are adding new services to enhance the customer experience and provide greater personalisation of the customer journey.

In the engineering and construction sector, another important part of Middle Eastern economies, building information monitoring (BIM) offers considerable potential to minimise costly project overruns, through earlier engagement in design by customers and all parties involved in a contract. Improved 3D modelling of housing developments also allows companies to demonstrate design features more clearly to planners, residents and investors.

Perspective: Integrating with the consumer experience

Gulf Marketing Group is one of the Middle East's leading family-owned companies, with a diverse portfolio of retail outlets, brands and consumer and B2B services across key sectors such as healthcare and pharmaceuticals, sports and fitness, real estate, education and technology. Amin Nasser, CEO of Gulf Marketing Group offers a retailing perspective on the consumer reach of Industry 4.0.

"We believe that the changes from the manufacturers – including the likes of Nike, Adidas and Under Armor - will be significant. For us, as retailers, it will be linked to how the retail space interacts with the consumer to create a satisfactory and holistic experience.

The times of buying and selling goods are rapidly ending. Everyone can do this, but what consumers seek today are value added experiences. This is where the industry is moving; we need to understand the complete chain and integration of products and matching activities in order to progress as retailers. for example, health benefits recommended by physicians.

Digitisation is transforming the possibilities in front of us, whether it is applications that link sports to health, tools such as beacons that allow us to track consumer and product flow, or in-store analytics platforms. The use of big data, in terms of advanced retail analytics, or with 'connected environments', such as the gamification and experience zone activities in our stores, is already very extensive. New product creation possibilities are on the horizon; for example the plans that companies such as Adidas and Nike have for custom 3D-printed sports shoes."

Digital solutions in the construction sector are also reaching further into the built environment with the advent of built-in sensors and automation enabling engineering and construction companies to develop products and services that cover the lifecycle of buildings and infrastructure assets, integrating with energy management, repair and maintenance and wider smart building and smart city applications. This is an area in which the Middle East has some exemplary projects. Take Dubai's smart transportation and infrastructure initiatives for example as well as the recently announced Smart Dubai Platform which seeks to unite city services, IoT, cloud services, big data and digital identity across all aspects of the city.

Dubai has also recently launched a vision of making 25% of its buildings 3D printed by 2030 and become a global hub for 3D printing. The 3D strategy will be implemented by many government partners, including Dubai Municipality, Dubai Health Authority, Dubai Holding and the Dubai Future foundation. Dubai's vision chimes with developments in a host of sectors worldwide and reaches beyond the 'hard' materials usually associated with 3D printing. In the clothing and footwear sector, for example, 3D production can be used to produce customised apparel 'made for perfect fit' for consumers at the point of sale, eliminating costly global supply chains.

Furthermore, 3D printing is making headways into the construction sector by reducing labour and waste generation. Utilised for home offices, such 3D printed structures could be erected and dismantled very quickly.

The Saudi market has the highest potential for this method of construction due to the size of its developments, as well as the country's landscape. Saudi Arabia is studying a proposal to employ 3D printing techniques in the construction of 1.5 million housing units through a collaboration with a Chinese company in next five years.

4. 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. From our interviews with companies in the Middle East, the biggest challenges centre on internal issues such as culture, organisation, leadership and skills.

The absence of a digital culture and the right training was identified as the single biggest challenge by Middle East survey participants. Over half (54%) put it in their top three challenges. In this respect, they are in good company as changing the culture was the leading issue across all the sectors we surveyed worldwide with 50% of those in our global survey ranking it in their top three challenges.

The extent of the internal culture challenge is highlighted by the fact that it ranks above external issues, such as whether the right standards, infrastructure and intellectual property protection are in place. While also important, they are not ranked by the companies in our survey at the top of their list of challenges.

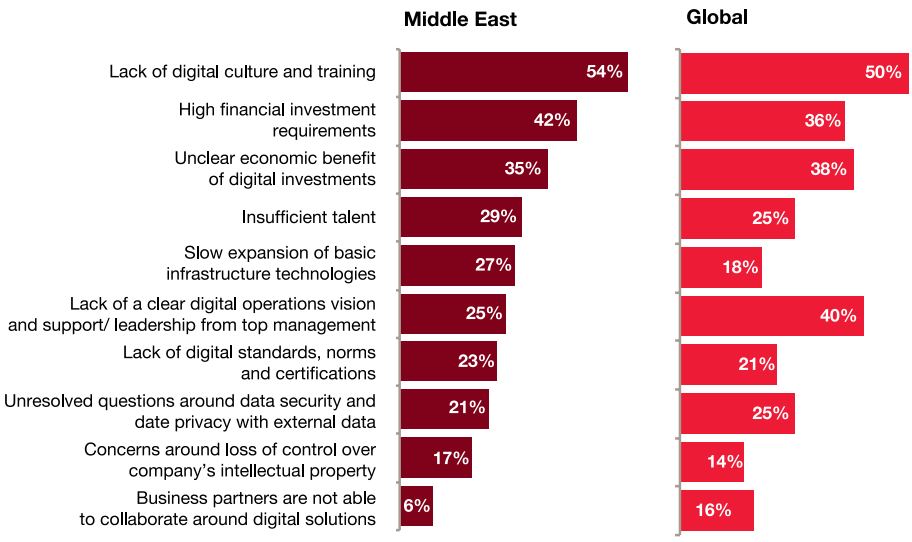
For many companies, culture is linked closely with the need to have clear vision and leadership from top management about the direction of digital operations. This was an important issue globally but is less of a concern at this stage for our Middle East survey participants who appear to be more confident that their company does have a digital vision. In our global survey 40% put top management digital leadership and vision as a leading concern but only a quarter (25%) of Middle East participants had similar concerns.

Instead, in the Middle East, worries about leadership were pushed aside by concerns about the high financial investment requirements of digital operations capabilities. This was identified as a leading challenge by 42% of Middle East participants compared to 36% in the global survey. All these factors go hand in hand. It will be important for top management to identify clearly the benefits that they see ahead and to ensure they are communicated well to external and internal stakeholders.

"The top challenges identified by the surveyed companies are a lack of digital culture, the high financial investment requirement and unclear economic benefits of digital investments."

Figure 4: Middle East: Lack of digital culture and training is the biggest challenge facing companies

Challenges facing the successful implementation of Industry 4.0
Selection of the top 3 challenges (percentages)



5. Data analytics and digital trust are the foundation of Industry 4.0

Data lies at the heart of the fourth industrial revolution, but the value of a massively growing information flow is limited without the right analytics techniques and the wider infrastructure to support it. Connected networks and capacity need to be in place for the full potential of big data to be realised. In this context, the region needs to make further investment if it is to become a leader in digitisation. No Middle East countries, for example, make it to the top twenty in the latest Network Readiness Index from the World Economic Forum. The growth and development of Industry 4.0 needs to be supported by network infrastructure enhancement.

Some of the ME government entities have already started implementing open data initiatives. For example, Dubai recently issued Dubai Open Data Law, which allows sharing of non-confidential data between government entities and other stakeholders.

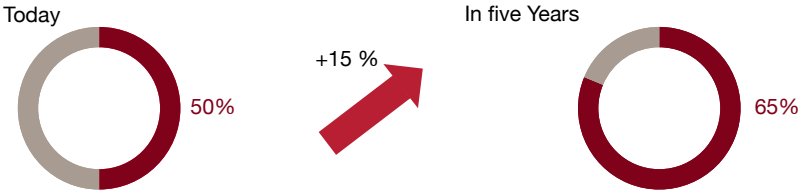
Inside company operations and processes, the rapidly growing number of sensors, embedded systems and connected devices, as well as the increasing horizontal and vertical networking of value chains is already resulting in a huge continuous data flow.

Data comes 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. With so many points of entry, companies need to take a rigorous, pro-active approach to data security and related issues and work to build digital trust.

Our survey data shows that many Middle Eastern companies already understand the vital importance of data analytics. Half of our survey participants in the region view it as important or very important to their companies today, and this rises to 65% when they are asked to look five years ahead (see figure 5). The current emphasis in the region on the use of data analytics for decision-making is exactly in line with the response in our global survey but the 65% emphasising it in five years' time falls short of the 83% result in our global survey. Some companies in the Middle East may need to reappraise their view of the future benefits of data analytics. Whether in the Middle East or globally, there's still a long way to go before companies reach the level of data analytics sophistication needed to really drive Industry 4.0 applications.

Figure 5: Middle East: In five years from now a significant importance will be placed on data analytics

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



Only 18% of participants from the Middle East rate the maturity of their data analytics capabilities as advanced – exactly in line with the global result.

A key challenge is skills. One in three (29%) survey respondents in the Middle East ranked 'insufficient talent' as a leading challenge versus 25% of companies in the global survey as a whole. More specifically, over half (52%) of our Middle East survey respondents identify lack of data analytics skills in their own workforce as a data analytics challenge compared with 53% globally. And, 71% cite increasing in-house data analytics technology and skill levels as the single biggest improvement route to boost their data analytics capabilities versus 69% in the global survey as a whole.

6. Robust, enterprise-wide data analytics capabilities require significant change

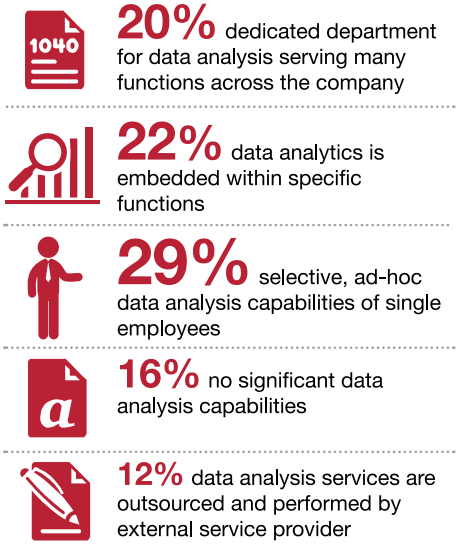
Another challenge lying in the way of companies establishing strong data analytics capabilities is getting robust organisation and governance frameworks in place. We found that many companies still have 'ad hoc' approaches to data analytics.

Almost half (45%) of the Middle East survey participants said their companies lack a structured approach to data analytics organisation and governance, either relying on the selective, ad-hoc data analytics capabilities of individual employees (29%) or having no significant data analytics capabilities at all (16%). Another 12% outsource data analytics services to external service providers, giving a total of 57% with no significant data analytics functions within their companies.

In contrast, just over a fifth (22%) have embedded data analytics into specific functions, giving themselves the flexibility and proximity to business knowledge to fully utilise the potential of data analytics. Another 20% of companies have a dedicated department for data analytics serving many functions across the company.

> ***"There is much to do in building data analytics capabilities - 57% of Middle East survey participants say their companies have no significant data analytics functions embedded within the company."***

Figure 6: Middle East: Organisation of data analytics capabilities within companies



There is a danger that Middle East companies are not placing sufficient emphasis on data analytics capabilities. Out of the companies surveyed, 60% believe that standard enterprise resource planning (ERP) solutions are the most suitable data analytics platform.

While ERP-based solutions can be good for data collection, companies need to fine tune their data analytics capabilities to meet their specific needs and demands. Crucially, the focus needs to be on business intelligence to guide strategy and not just on the process data that has been the traditional ERP system focus.

Companies in the global survey who consider they have advanced data analytics capabilities are much more likely to be taking a structured approach – 43% have embedded their data analytics in specific functions and 24% have a dedicated department, adding up to 67% altogether. This is far more than the 49% in the global survey as a whole and only 42% of Middle East participants. Moreover, 16% of Middle East participants believe that their companies have no significant data analytics capabilities as compared to 9% of the participants in global survey.

7. Industry 4.0 is accelerating globalisation, but with a distinctly regional flavour

Companies are actively looking to expand their local markets. Although the global goods trade has flattened and cross-border capital flows have declined sharply since 2008, globalisation is being redefined by soaring flows of data and information. Developed countries took nearly four years to move from the emerging to transitional stage; whereas some Middle East countries such as the United Arab Emirates and Kuwait have made the same move in less than two years.

Many industrial leaders operate worldwide facilities, so successful Industry 4.0 implementation is not limited to specific countries or regions. At the same time, many applications will link closely to local companies as customised products often require regional manufacturing capabilities.

Our survey results show similarities between leading companies around the world, but they also differ considerably by region. Conventional wisdom suggests that developed economies could be the winners, in the short term at least from Industry 4.0, as they are driving digital operations improvements to secure significant efficiency gains. The survey results further indicate that emerging nations have the most to gain as Industry 4.0 takes hold around the globe. They can leverage digitisation to gain efficiency in their horizontal value chain, efficiently working within a global manufacturing network to supply key components, products and systems. In addition, rising personnel costs and the high potential to digitise processes will lead to above-average efficiency gains in emerging economies.

Industrial product companies in all regions are pressing hard on the Industry 4.0 accelerator and expect to secure significant benefits. Looking five years ahead, the companies expect to have advanced digitisation and integration capabilities, with Japan and Germany reaching digitisation levels above 80% while the companies based in the Middle East aim to be at 72%. We believe that this pessimistic perception is primarily driven by the impact low oil prices are having on the region. Most of the company executives do believe that this may not be a good time for significant investment and prefer to take a slow approach towards any investments.

> ***"Five years ahead, companies expect to have advanced digitisation and integration capabilities, with Japan and Germany reaching digitisation levels above 80% while the companies based in the Middle East aim to be at 72%. Low oil prices may be slowing the investments in this area in Middle East."***

8. 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. Taking the results from our survey and extrapolating them across the industries that the survey covered, we estimate that Middle East companies plan to invest US$42bn per annum in Industry 4.0 applications over the next five years. It is a very substantial sum, but the benefits are impressive. Survey respondents anticipate that those investments will lead to US$16.9bn in additional revenues annually, in addition to strong gains in efficiency and a US$17.3bn reduction in cost.

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 across a wider range of activities and from partners, suppliers, collaborators, end-users and end-customers in ways that enable faster and 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 services to develop new kinds of offerings to address their markets.

The pace at which companies in the Middle East expect to accrue benefits from Industry 4.0 investment leads half of them (51%) to estimate a return on investment (ROI) timescale of two years or less (figure 7). Just over a third (37%) anticipate a longer timescale of two to five years but relatively few (10%) think that it will take any longer than five years for Industry 4.0 investments to pay for themselves.

> ***"Companies expect not only to have significant revenue gains, but also simultaneously reduce costs. Moreover, 51% of the surveyed Middle East companies expect an ROI within two years."***

Figure 7: Middle East: Most companies expect 4.0 Industry investments to pay back within two years

What return on investment period (ROI) do you expect from your digital investments?

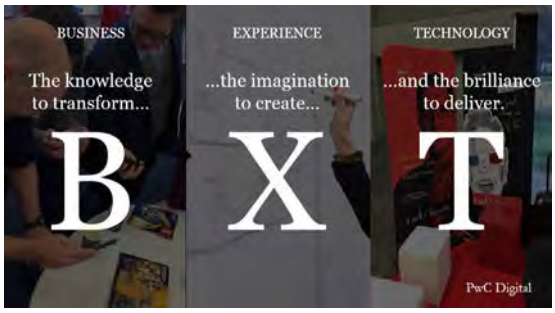
Catching up is getting increasingly difficult

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 but that could be short-sighted. As we've already shown, the biggest challenge companies face is not buying the right technology, it is rather the organizational culture and people change and transformation, which requires long-term change programmes.

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

Blueprint for success

To move forward with Industry 4.0, acquiring and rolling out digital capabilities across your company are all-important. This process takes time, so in order to gain or retain first-mover advantage over your competitors, you will need top management commitment and significant implementation investments. You need to look at it comprehensively from business, as user experience and technology perspective (BXT). Any use of technology needs to be driven by business needs and logic. This needs to be supported by an user interface experience that makes it easy to use even for industrial applications and B2B.



Based on dozens of projects with leading industrial companies, we have defined six practical steps your company needs to take to lead tomorrow's competitive digital landscape.

Blueprint for digital success

Map out your Industry 4.0 strategy

Your Industry 4.0 strategy will shape every step you take on the path towards becoming a fully digital enterprise, so it is important to take the time to clearly define your vision.

Evaluate your own digital maturity now and set clear targets for the next five years

Many industrial companies have already begun digitising their business. However, the process started in organisational silos, rather than through a holistic approach. Therefore, take the time to evaluate your maturity level in all areas of Industry 4.0 so that you understand what strengths you can already build on, and which systems/processes you may need to integrate into future solutions. It is important to network with other companies with similar mindsets and challenges. This, supported by a benchmarking exercise will help you to get market and industry views in your evaluation.

Our "maturity model" is one tool that can help speed up this process (see PwC maturity model on next page), in addition to our Digital IQ Benchmark tool that you can use. As you start to think about where you want to go in the future, take the time to consider what you could gain by collaborating with customers, suppliers, technology partners and even competitors, without limiting your vision based on current constraints. Move your focus beyond technical details and consider what impact new applications could have on your value chain and your relationships with, and access to, your customers. It is important to prepare a business case and roadmap to get stakeholder buy-in. Your roadmap will need to consider future changes in customer behaviour and how your relationship with them will change.

Moving from the current to the desired future state will need precise steps and a clear prioritisation. Companies that become a digital champion embark on a journey that starts small but ends ultimately in a transformation of the core business.

Questions to ask as you develop your digital strategy:

How mature are my current capabilities?

What synergies could I gain by better collaboration within my company?

What could I gain by better collaboration with customers, suppliers, technology partners and even competitors?

How is customer behaviour changing and how does my relationship to customers need to change in response?

Make sure you engage champions throughout your business

Building up capabilities, adapting processes and IT and driving the cultural shift needed will take years. It is critical to provide clear leadership from your top management, but equally important is convincing the top stakeholders who will need to roll up their sleeves and implement the desired changes. One way to line up champions throughout the organisation is to educate stakeholders from the outset, for example through technology roadshows and visits to innovation hubs.

Create initial pilot projects

With so much riding on the outcome of Industry 4.0 projects, companies will need to work hard to overcome initial challenges. It can be difficult to secure funding and stakeholder buy-in, as the economic benefit case of digitisation is not always easy to calculate, while teams will initially only be able to provide very limited proof of concept and demonstration of technologies.

Pilots can help address these issues, noting that not every project will succeed, but they will all help you learn the approach that works for your company. With evidence from early successes, you can also gain buy-in from the organisation, and secure funding for a larger rollout.

It is important to pick the right projects. We recommend targeting a confined scope, but highlighting the end-to-end concept of Industry 4.0. Possible options include vertical integration within one or two manufacturing sites including digital engineering and real-time data integrated manufacturing planning.

PwC maturity model - Industry 4.0 capabilities develop across seven dimensions and four stages

	1 *Digital novice*	2 *Vertical integrator*	3 *Horizontal collaborator*	4 *Digital champion*
Digital business models and customer access	First digital solutions and isolated applications	Digital product and service portfolio with software, network (M2M) and data as key differentiator	Integrated customer solutions across supply chain boundaries, collaboration with external partners	Development of new disruptive business models with innovative product and service portfolio, lot size 1
Digitisation of product and service offerings	Online presence is separated from offline channels, product focus instead of customer focus	Multi-channel distribution with integrated use of online and offline channels; data analytics deployed, e.g. for personalisation	Individualised customer approach and interaction together with value-chain partners. Shared, integrated interfaces	Integrated Customer Journey Management across all digital marketing and sales channels with customer empathy and CRM
Digitisation and integration of vertical and horizontal value chains	Digitised and automated sub processes. Partial integration including production or with internal and external partners, standard processes for collaboration partly in place	Vertical digitisation and standardised and harmonised internal processes and data flows within the company; limited integration with external partners	Horizontal integration of processes and data flows with customers and external partners, intensive data use through full integration across the network	Fully digitised, integrated partner ecosystem with self-optimised, virtualised processes, focus on core competency; decentralised autonomy, near real-time access to extended set of operative information
Data and Analytics as core capability	Analytical capabilities mainly based on semi-manual data extracts; selected monitoring and data processing, with no event management	Analytical capabilities supported by central business intelligence (BI) system, Isolated, not standardised decision support systems	Central BI system consolidating all relevant internal and external information sources, some predictive analytics, specific decision support and event management systems	Central use of predictive analytics for real-time optimisation and automated event handling with intelligent database and self-learning algorithm, enabling impact analysis and decision support
Agile IT architecture	Fragmented IT architecture in-house	Homogeneous IT architecture in-house. Connection between different data cubes developing	Common IT architectures in partner network. Interconnected single data lake with high-performance architecture	Single data lake with external data integration functionalities and flexible organisation. Partner service bus, secure data exchange
Compliance, security, legal and tax	Traditional structures, digitisation not in focus	Digital challenges recognised but not comprehensively addressed	Legal risk consistently addressed with collaboration partners	Optimising the value-chain network for compliance, security, legal and tax
Organisation, employees and digital culture	Functional focus in “silos”	Cross-functional collaboration but not structured and consistently performed	Collaboration across company boundaries, culture and encouragement of sharing	Collaboration as a key value driver

Horizontal integration with selected key suppliers is another option. For example, installation of track-and-trace devices on your shipments would help to create end-to-end visibility in your supply chain. You could also consider installing sensors and actuators on critical manufacturing equipment and use data analytics to explore predictive maintenance solutions. The diagram below provides an overview of possible areas for pilots.

Setting up cross-functional teams has proven to be a solid strategy. These teams should be fully dedicated to the project with the freedom to think outside existing company boundaries and point the company in new strategic directions regarding technology, way of working and ecosystems. Enablers like IT and human resources play a major role and should be embedded in the cross-functional pilot teams.

Data analytics is often done as part of a pilot or as a standalone pilot for companies looking to identify and prioritise data analytics use cases.

Often pilot teams will need to design pragmatically to compensate for standards or infrastructure that don't yet exist. While pilots may already bring business benefits, their most important purpose is to generate insight into how your company can work across functions or ecosystems and what changes you may need to make in IT, security, tools, and process and people capabilities.

You may want to consider collaborating with digital leaders outside your organisation, by working with start-ups, universities, or industry organisations to accelerate your digital innovation.

Questions to ask while selecting pilot projects:

Do selected pilot project align with my company's strategic objectives?

Do I have required stakeholder buy-in and strong management sponsorship?

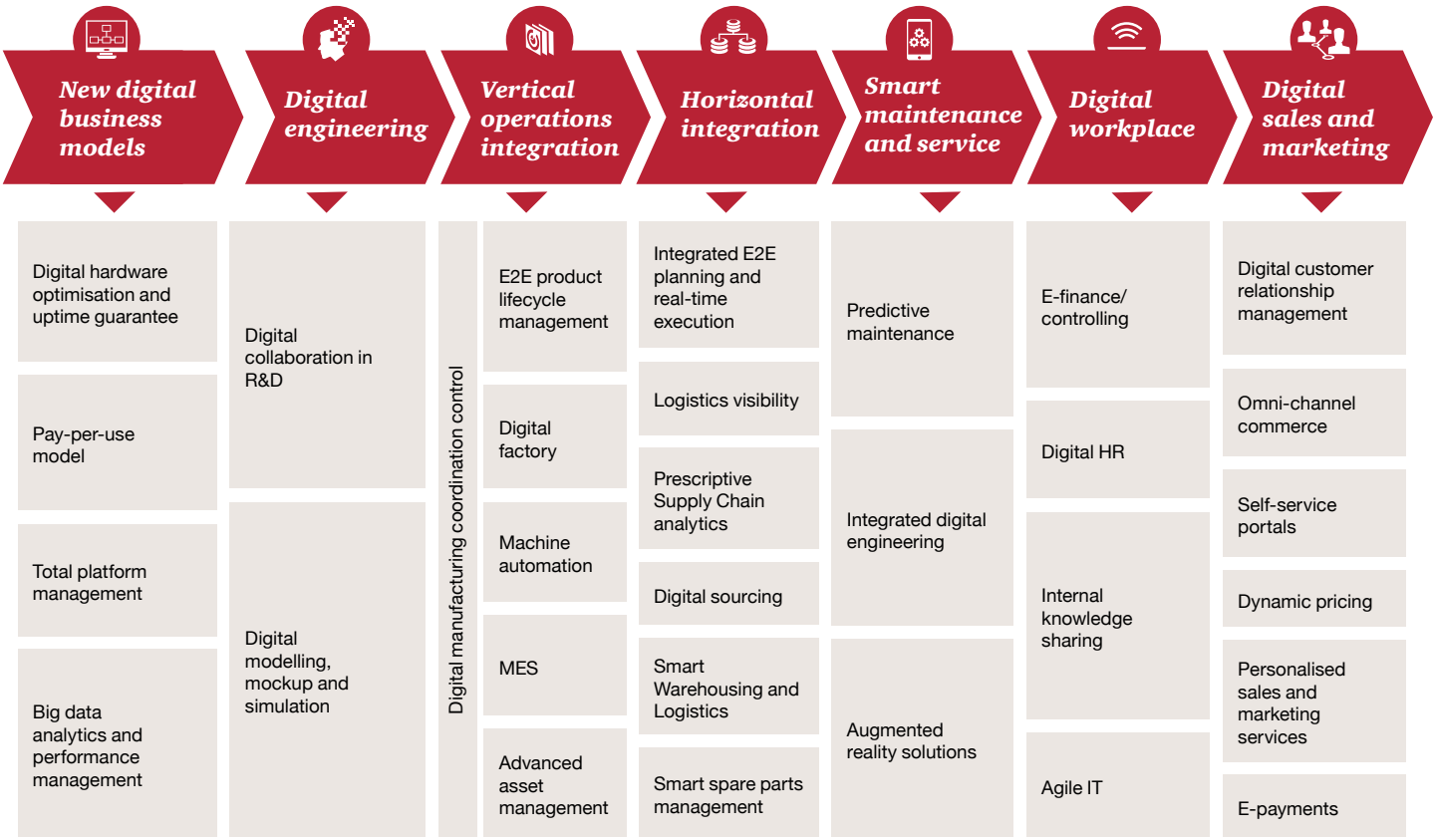
Will a successful outcome of the pilot project have an material impact on my customers (internal and external) and my operations?

Will this pilot enable the scale-up business case?

Have I clearly defined and agreed on pilot project scope, resource requirements (such as investments, team efforts) and timelines with management?

What change management support will I need based on my organisation's culture and current capabilities?

Industry 4.0 pilot opportunities exist along the full vertical and horizontal operational value chains



Define the capabilities you need

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

The most successful approaches look at which capabilities are needed to enable new digital business models or internal digitisation. To implement a new capability, you will need to consider four strategic dimensions: organisation, people, process and technology.

Fine-tuning your organisation

New organisational structures could include:

- Incubators to protect and grow a new business idea, which will not be influenced by the legacy organisation
- Pods or Centres of Excellence to enable temporarily self-organised teams without any formal hierarchy to solve problems or develop ideas in an interdisciplinary team setup
- Ideation Labs to provide an inspiring, creative, and hierarchy-free working atmosphere where a trial-and-error culture is feasible

Focusing on people

Develop strategies for attracting people with the right digital skills. Your success with Industry 4.0 will depend on skills and knowledge. Your biggest constraints may well be your ability to recruit new employees or train existing ones who can put digitisation into place. You need to introduce new roles in your company, like data scientists, user interface designers, or digital innovation managers, you will probably need to need to update existing job profiles to take into account new digital skills.

Improving processes

One of the most important changes is to focus on an end-to-end process perspective, which will foster new collaboration models. Strong user interfaces are very important to meet growing expectations and enable consistent user experiences across different channels.

There are also a number of changes needed to build digital trust. These include processes to prepare data security approaches, access rights control and setup standards in managing sensitive customer data and compliance processes. You will need to establish information assurance compliance to oversee and evaluate security requirements. Your goal should be to ensure information security and trust in a collaborative environment by providing end-to-end management of risks, threats and security issues.

Implementing new technologies

Not surprisingly, new technologies will be core to Industry 4.0 pilots. One of the most important will be to develop an agile IT function that can respond flexibly to business demand. By focusing on creating working solutions and responding to new requirements in an agile approach, an agile IT function will help you to continuously improve services.

The other core technology capability is likely to be internet of things (IoT), from management to monitoring, in addition to controlling and orchestrating large amounts of diverse devices and providing central IoT services. This includes providing functionalities (via software upgrades), communication standards and connectivity to ensure an appropriate level of security.

> ***"Make sure to keep a strong focus on building digital trust. Your goal should be to ensure information security and trust in a collaborative environment by providing end-to-end management of risks, threats and security issues."***

Questions to ask while defining the capabilities required by your company:

What new capabilities and enablers are required to enable digitalisation?

What changes are required in current organisation structure to ensure successful implementation?

What are the current gaps in skills and capabilities of existing employees and how can these be bridged?

Are new policies and processes required to foster collaborative environment and build digital trust based on my company's current capabilities and culture?

How can I leverage technology to acheive the set strategic objectives?

Become a data virtuoso

Identifying and gathering the right data, deploying it for the right purposes and effectively analysing it will be critical to make the right Industry 4.0 decisions.

Defining and developing an effective data analytics strategy will require a focus on:

- Predictive analytics and forecasting
- Prescriptive analytics
- Business-driven decision-making
- Automated feedback to the organisation and connectivity to employees

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

Companies will need to improve master data management - defining, cleaning up and maintaining data. A first step should be the identification of 'functional use cases' for early deployment. You will need to build your own data pool, based on real-time cross-functional and externally connected data, as well as develop a suite of analytics tools, connected to existing and new data sources. To get value out of that data, you will also need to build direct links to decision-making and intelligent systems design.

A key decision facing companies is the choice of data analytics platform, with the ideal being one single integrated solution. Existing ERP systems do not have full capabilities to handle the more sophisticated data trends, analytic methods and algorithms that need to be used to provide the more advanced business intelligence and foresight that will be needed in the Industry 4.0 era. A more sophisticated approach would be to invest in a data integration layer that is linked to the ERP systems and the use of tailored analytics tools by use case.

Transform into a digital enterprise

Lack of digital skills and transformation culture top the list of the challenges identified by survey respondents. We have already highlighted how important strong data analytics capabilities are, but Industry 4.0 calls for other technical skills as well.

Many industrial companies will need to develop digital skill sets around creative digital strategy design, technology architecture and design, user experience design, or rapid prototyping capabilities.

Without the right digital culture, the best talent will not want to stay. But what does a true digital mindset look like? Crossing company boundaries and outward to partners and customers is highly collaborative. Companies that remain constrained by functional silos are unlikely to achieve the integration that is so central to Industry 4.0.

Cultivating a digital environment can only happen with committed leadership. Some organisations task the CIO with leading the digital transformation, while others appoint a CDO (Chief Digital Officer) or other executive to lead the effort. Other companies establish a digital council that actively manages the development of digital enhancements, products, and services from the idea stage through to the rollout in operating units. A digital council can support cross-functional teams in proactively managing a digital pipeline.

Digital transformation will only happen if top management places Industry 4.0 squarely at the centre of the C-suite agenda and makes it a top priority.

Questions to ask:

What are our current and future data analytics requirements?

How well do we manage data today?

How can we ensure that data is accurate?

Do we have correct data management strategy and data analytics strategy to support us in acheiving set strategic objectives?

How can I prepare a business case for this investment?

Actively plan an ecosystem approach

Industry 4.0 needs to extend far wider than horizontal and vertical integration within your own organisation. First movers achieve breakthrough performance by going a step further to understand consumer needs and use digital technologies to create and deliver value to the customer in an integrated, innovative solution.

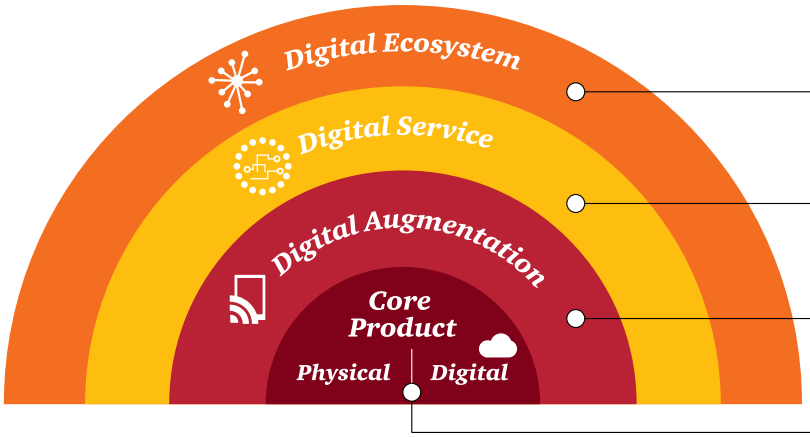
Fundamentally, this is about developing complete product and services solutions for your customers. Companies can evolve their market offering across four layers moving from a traditional, physical core product to a comprehensive digital ecosystem play. In the earlier stages, use partnerships or align with platforms if you cannot develop a complete offering internally.

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.

As the value of an ecosystem is driven by the number of involved partners and the intensity of their relationships, the biggest challenge is to set the right incentives and find suitable benefit sharing models that compensate everyone fairly for their contribution. The most basic business model in an ecosystem is a marketplace, which brings together multiple sellers and buyers capturing value from on the transaction value. Of course, this basic model has progressed significantly.

You may find it difficult to share knowledge with other companies, and you may prefer acquisitions. However, look for ways to bridge this gap so that you can profit from being part of digital ecosystems, even if you don't fully control the entire value chain.

Moving from a product-oriented to a platform-focused approach



Digital Ecosystem: With interfaces to suppliers, partners and customers the product is embedded in an ecosystem for co-creation and additional/ new value capture

Digital Service: Digitally enabled services which, in combination with a physical product, can provide an end-to-end solution to a broader customer need

Digital Augmentation: Digital customer interfaces, visualisation, touchpoints and channels augment the experience and allow a variety of interaction models

Core Product: Two possible options at the core

- **Digital:** Data and IT define the product's value proposition and generate standalone revenues
- **Physical:** Traditional base offering, which can be 'digitised' by adding digital layers around it

Taking action

The fourth industrial revolution offers attractive opportunities for the complete industrial ecosystem, including industrial companies, consulting firms, technology providers, and policy makers. Key questions that you should ask yourself today are: What role do I/ my company play in this ecosystem today? How do I understand ROI? How do I envision it changing tomorrow? What can I do today to get started?

Answers to these questions depend on which part of the value chain your company operates in today, your company's strategic objectives, current digital maturity, capabilities, management buy-in and culture.

Based on our experience and numerous discussions with industrial manufacturing organizations and technology adopters, we propose:

Educate yourself and build your network: Information and awareness are the key to taking right decisions. We suggest that you attend relevant conferences, talk to different technology vendors, and discuss with like-minded companies to understand global and regional trends and developments in the area of Industry 4.0. We at PwC conduct frequent round table discussions on Industry 4.0 and would be happy to support you in this initiatives.

Conduct a self-assessment: It is important to understand the current state of your organisation in relation to Industry 4.0. This will help you understand your need for action and will help you to benchmark your company against others. PwC offers a free online self-assessment that you can use to conduct this assessment (see the below mentioned link). Also, please check-out some of our industry publications listed at the end of this publication, and feel free to contact us if you have any questions or are facing any issues in using this tool.

https://i40-self-assessment.pwc.de/i40/landing/

Plan your journey: Based on the insights from self-assessment, you can either reach out to us or take actions in-house. If you plan to do it in-house, we suggest that you prepare a preliminary digital roadmap for your organisation for the next 6-12 months, and conduct a few pilots to support you in preparing a business case and getting management buy-in.

Technology providers play a key role in supporting and enabling industrial manufacturing companies/ technology adopters in leaping from a product-oriented approach to a platform focused approach. Technology providers typically focus on sharing new technology platforms to showcase technology features and interoperability considerations; they should also share best practices to address industry concerns such data accuracy, data security, standards, forward compatibility, skills requirements, and others. They should work closely with technology adopters and provide support for the pilot projects.

Goverments and policy makers play an important role in establishing business and regulatory environment required for the success of Industry 4.0. In addition to investing in digital infrastructure (such as broadband connectivity), they establish legal frameworks, laws, guidelines, policies and industry standards related to liability, data ownership, sharing and selling for commercial use. This will require collaboration with other countries and industry to harmonize compliance requirements related to data and liability laws.

About the survey

The PwC Global Industry 4.0 survey is based on research conducted between November 2015 and April 2016 with over 2,000 senior executives from industrial products companies in 26 countries across Europe, the Americas, Asia Pacific, Middle East and Africa. In the Middle East, the survey was extended to June 2016 and included 52 leading companies. Though the Middle East sample size is not large but it is proportional to the global sample size based on industry footprint and GDP contribution. Further, the industry distribution for the sample is generally consistent with the population.

The majority of participants were CXOs, COOs or Senior Operations and IT managers with senior executive responsibility in their company for Industry 4.0 strategy and activity.

Figure 9: Middle East: Size of surveyed companies

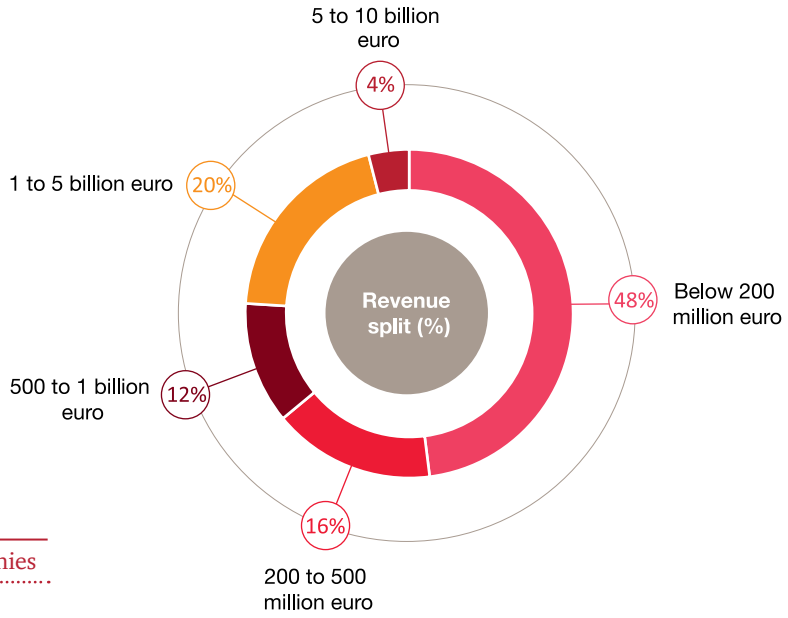


Figure 8: Middle East: Industry split of surveyed companies

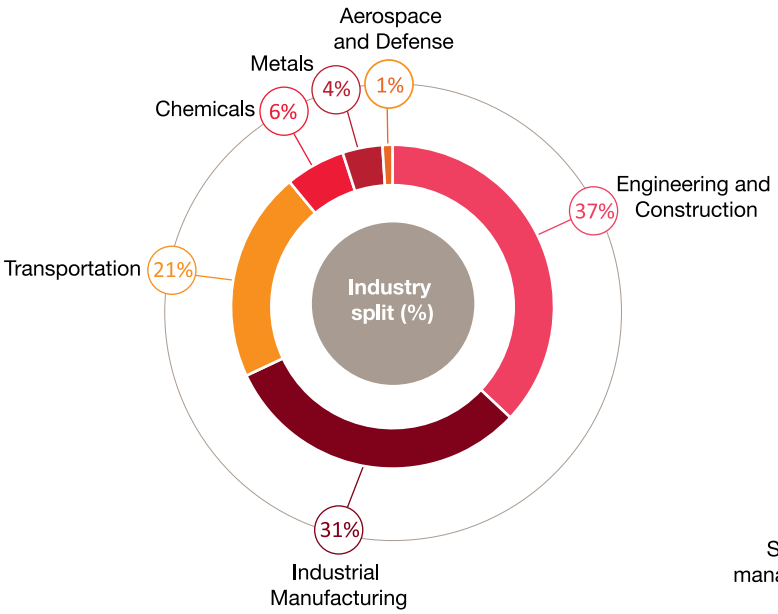
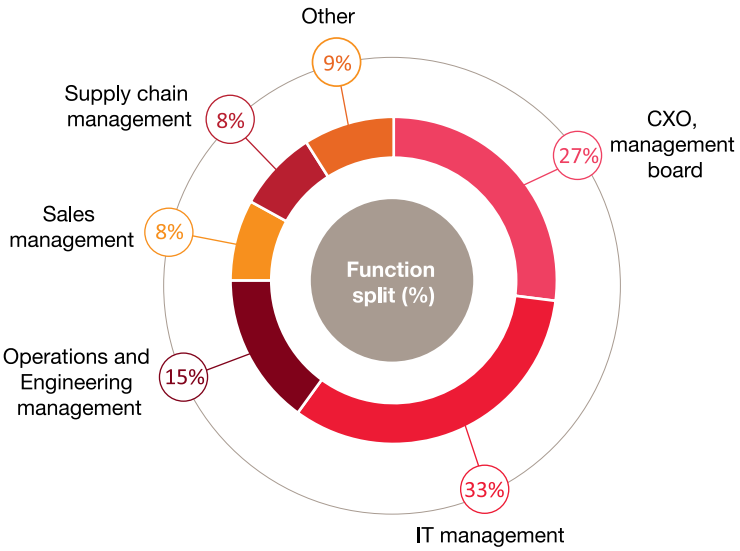


Figure 10: Middle East: Functional roles



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About the Global Manufacturing & Industrialisation Summit (GMIS)

Global Manufacturing & Industrialisation Summit (GMIS) is a joint initiative launched by the United Nations Industrial Development Organization and the UAE's Ministry of Economy in collaboration with the Global Agenda Council on the Future of Manufacturing of the World Economic Forum (WEF). GMIS aims to promote and advance inclusive and sustainable industrial development. It plans to evolve from a summit to a global conference and forum, and then into an international platform that will drive three main goals: make manufacturing aspirational; converge the diverging forces of policy makers, enterprises and civil society; and set the manufacturing agenda for the world.

The Global Manufacturing & Industrialisation Summit (GMIS) will be hosted in Abu Dhabi. The inaugural summit offers a voice and a venue for leaders with vision a to shape the future of manufacturing with a hand-selected audience of over 1,200 delegates expected to attend, including Heads of State, Government Leaders, Ministers, Policy Makers and C-Suite Executives from Global 2000 Companies.

You can find more about GMIS at:

http://gmisummit.com/
https://www.youtube.com/watch?v=wMLL7NncfLM

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Industry 4.0 sector reports on pwc.com

Aerospace, Defence & Security and industry 4.0 report
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Transportation & Logistics industry 4.0 report
http://www.pwc.com/gx/en/industries/transportation-logistics/transportation-logistics-key-findings.html

Industry 4.0 regional findings on pwc.com

EMEA

Finland
http://www.pwc.fi/fi/julkaisut/industry40.html
Germany
http://www.pwc.de/de/digitale-transformation/industrie_4_0.html

Asia / Asia pacific

India
http://www.pwc.de/de/digitale-transformation/industrie_4_0.html
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Americas

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