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France, as one of Europe’s largest economies, is expected to continue to play a key role in the region, and globally, as a result of its projected stable GDP growth over the next four to five years and will likely become an increasingly attractive destination for FDI. The proposed policies on tax reform and labour market regulation also present an additional opportunity for France to further shape its value proposition as an attractive investment destination.

However, from a manufacturing perspective, increased globalisation has impacted the competitiveness of the sector and reduced its contribution to GVA, which as a result has led to increased unemployment since 2010. Nevertheless, a recovery for the French manufacturing sector is expected by 2020, with France growing its exports by improving their manufacturing cost competitiveness to meet rising global demand. The French manufacturing sector can also drive further growth by capitalising on existing strengths, such as its emphasis on entrepreneurship and the high level of technological readiness.

To support this manufacturing recovery, the French government has emphasised its focus on innovation and technology in recent years, with the launch of the ‘Industrie du Futur’ (IdF) initiative to support companies across sectors with adopting Industry 4.0 tools. In this report, we outline two key themes that have the potential to further strengthen France’s manufacturing sector:

A. Creating an attractive environment for the adoption of Industry 4.0 within the manufacturing sector:

‘Alliance Industrie du Futur’ must move towards supporting companies with the next phase of implementation of Industry 4.0 tools and provide a strong supporting legal and regulatory framework

B. Prepare SMEs and start-ups for growth in the global arena:

Enabling the scaling of SMEs and vibrant entrepreneurship will be crucial to driving the next phase of growth in manufacturing sector.

Focusing on enabling investments in large companies and creating the supporting ecosystem for SMEs and start-ups, will position France to better compete in the rapidly evolving global manufacturing sector. Overall, France’s manufacturing sector outlook is positive in the near term, but the longer term outlook will be determined by the efforts of French companies to scale, drive innovation and transfer technological innovation to implementation.

“France’s leadership in Europe and the world will continue to depend on its traditional strengths in food, tourism, and services, coupled with its aerospace, machinery, manufacturing and technology sectors. President Macron’s growth incentives hope to create a renaissance of sorts for the French economy. Though manufacturing’s role in the economy as well as in exports, has declined between 2000 and 2016, the Alliance Industrie du Futur’ (IdF) program can truly revive France’s manufacturing and industrial sectors, by adopting the disruptive technologies of the 4th Industrial Revolution. This, coupled with the emergence of “sustainable manufacturing, and the renewed emphasis on SMEs and digital entrepreneurship via ‘French Fab’, will be the drivers for a growing and export-oriented manufacturing sector in France by 2022. These of course will require investments in new skills and capabilities such as digitization, data analytics, 3D printing, and other innovative tools and techniques.”

Anil Khurana
GMIS Organising Committee
PwC Partner, US & ME, and Advisor

“The challenges that manufacturing in France faces stem from the increase and intensity of global competition; a pattern replicated in many countries around the world. The opportunities presented by the onset of Industry 4.0 technologies are a path to responding to these challenges, and it is here that France has the capacity to be a key player in the future of manufacturing, due to its capacity to transition to a ‘digital-first’ economy – and one with manufacturing at its core.”

Badr Al- Olama
Head of GMIS Organising Committee
France is the third largest economy in Europe and also has the second largest population in the region\textsuperscript{1}. GDP growth was at 1.8% in 2017 and is projected to marginally decline, to reach 1.6% in 2022\textsuperscript{2}. This economic growth has been driven primarily by a healthy increase in physical assets investment, supported by steady private consumption. Furthermore, the top-line unemployment rate fell to 9.4% in 2017 although real wage growth has slowed since 2015\textsuperscript{1}. Against this backdrop, the elected Macron administration launched an economic strategy in July 2017, focused on enacting tax reforms, reducing government spending and easing labour market regulations which are expected to boost economic growth, reduce unemployment, and drive business investments.

### Developed economy, supported by private consumption

- In 2017, France was the world’s 7\textsuperscript{th} largest economy with a GDP of US$2.6 trillion\textsuperscript{1} and real GDP growth of 1.8%.
- Going forward, the country’s real GDP growth is expected to marginally decline due to the impending normalisation of monetary policy and a slowdown in external demand from the Eurozone\textsuperscript{2}.
- Private consumption growth will remain an important contributor to the economy as it accounted for 55% of France’s GDP in 2017\textsuperscript{2} and is driven by low borrowing costs for households and businesses and improving labour market conditions.
Key exports from France, 2010-16 (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
<th>Transportation</th>
<th>Machines</th>
<th>Metals</th>
<th>Chemical Products</th>
<th>Foodstuffs</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>US$508 billion</td>
<td>29%</td>
<td>20%</td>
<td>8%</td>
<td>6%</td>
<td>17%</td>
<td>6%</td>
</tr>
<tr>
<td>2016</td>
<td>US$486 billion</td>
<td>31%</td>
<td>21%</td>
<td>7%</td>
<td>6%</td>
<td>15%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Note: Others include vegetable products, precious metals, plastics and rubbers, paper goods etc. 
Source: UN Comtrade

Top 5 Export Partners (2016)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Partner</th>
<th>Export Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Germany</td>
<td>(16%)</td>
</tr>
<tr>
<td>2.</td>
<td>Spain</td>
<td>(7.5%)</td>
</tr>
<tr>
<td>3.</td>
<td>Italy</td>
<td>(7.4%)</td>
</tr>
<tr>
<td>4.</td>
<td>UK</td>
<td>(7.1%)</td>
</tr>
<tr>
<td>5.</td>
<td>Netherlands</td>
<td>(3.6%)</td>
</tr>
</tbody>
</table>

Source: UN Comtrade

Strong export focus, but potential challenges ahead

- Transportation equipment (22%), machines (19%) and chemical products (15%) are the main export categories as of 2016 and have remained so since 2010, with exports mainly going to Germany (16%), Spain (7.5%) and Italy (7.4%)
- Strong forecasted growth in emerging markets such as Africa, India, and Southeast Asian countries could create opportunities for French exporters, although the Eurozone economic growth is expected to decelerate
- France’s export competitiveness has been challenged due to rising labour costs that has grown in excess of productivity gains and have resulted in a reduced share of global exports
- Going forward, the impending exit of the UK from the European Union and protectionism in the US’s trade policies are potential risks for France’s export growth

Source: UN Comtrade
Attractive investment destination, especially for countries in the region

- France ranks 14th globally for FDI inflow according to the UNCTAD’s 2017 World Investment Report, higher than the two largest economies in Europe - Germany and UK, but lower than The Netherlands, Belgium and Italy
- EU countries are the largest FDI investors into France – Luxembourg (12% of FDI inflow in 2015), Netherlands (12% of FDI inflow in 2015) and UK (11% of FDI inflow in 2015), followed by the US and Germany
- The construction sector received the largest share of FDI (36% of total FDI stock in 2015) with the manufacturing sector owning the fifth largest FDI stock, behind financial services, real estate and trade and maintenance
- The presence of technological sophistication, a strong focus on research and development (R&D) and skilled talent especially in the chemical and aerospace industries are attractive factors for investment
- In manufacturing, companies have continued to invest in expanding production capacity in France to alleviate capacity constraints, further incentivised by low interest rates
The evolution of French manufacturing

France’s manufacturing sector is the 8th largest in the world and 3rd in Europe, with a total Manufacturing Value Added (MVA) of over US$250 billion in 2016. The manufacturing sector is an important contributor to France’s economy, representing 11.3% of the country’s GVA in 2016 and manufactured goods represented 79.8% of total exports in 2016. However, its contribution to the French economy is expected to decrease over the next five years to 9.9% of GDP in line with historical volatility in the sector, as year-on-year growth has ranged from -13% to 9% in the period between 2010 and 2016. Furthermore, a declining trend in the Manufacturing Purchasing Manager Index (PMI) during the first four months of 2018 suggests signs of a slight slowdown in Eurozone demand. However, the longer term fundamentals seem positive as France is ranked in the top quartile of countries on drivers of production such as ‘global trade and investment’, ‘demand environment’ and ‘sustainable resources’, as reported in the World Economic Forum’s Readiness for the Future of Production Report. To further support companies across sectors with adopting and reaping the benefits of Industry 4.0 tools, the French government launched the ‘Industrie du Futur’ initiative in 2015. These factors are expected to drive growth in France’s manufacturing sector going forward, with the MVA expected to increase at a CAGR of 2.1% between 2016 and 2022.

Figure 1: France’s manufacturing is expected to recover from a downward trend
Manufacturing Value Added, 2010-22 (US$ billion)

Source: BMI

Figure 2: France’s manufacturing’s share of GVA has remained steady since 2010
Contribution of Manufacturing to GVA (%)
The manufacturing sector accounted for 12.3% of French jobs in 2016 and this has remained constant since 2010. And its wages have followed a similar path, remaining stagnant over the past six years, ranking 5th in the EU at US$45.1 per hour, behind Germany’s US$46.8 per hour.

**Figure 3: France’s manufacturing remains an important source of employment**

Contribution of Manufacturing to Labour Force (%)
France’s chemical industry represented 8.6% of its manufacturing output in 2015, with a turnover of US$88 billion (€73.4 billion) and a value-added of US$19.2 billion (€16.6 billion). In 2015, the industry was represented by 2,840 companies, employing 139,000 people. Among some of the largest French chemical companies are Air Liquide, Solvay and Arkema. The chemical industry in France has attracted foreign direct investments from other major international chemicals companies such as BASF, Bayer, Dow Chemical and DuPont, with its strong focus on innovation and R&D. It is also France’s leading export industry with 65% of chemical sales exported globally, mostly to other European countries (62%), followed by Asian countries (18%), United States (7.7%) and the rest spread across Africa and South America. The industry’s main products are organic and inorganic chemicals, soaps and detergents, speciality chemicals, and fine chemicals for pharmaceuticals, which are supplied to end-industries including the agricultural sector, aerospace sector and other industrial sectors.
The aerospace industry is a major manufacturing industry in France and the world’s second-largest exporter of aeronautical equipment after the United States, with total export value reaching US$68 billion in 2016, growing strongly at a CAGR of 6.05% from 2010 to 2016. Its main exports of planes, helicopters and spacecraft accounted for 9.3% of the country’s total exports, while aircraft parts made up 1.8% in 2016. Leading the aerospace industry and headquartered in the country are world renowned players including Airbus, Matra and Safran. The country also houses a world-class aerospace cluster, Aerospace Valley, which comprises leading aerospace engineering companies, universities and research centres. It accounts for around a third of the French aerospace workforce and represents 850 companies, including more than 500 SMEs. The aerospace cluster was established in 2005 as a significant innovation under the ‘pôle de compétitivité’ programme, a French industrial policy to drive industrial competitiveness.

Source: UN Comtrade
France’s approach to sustainability in manufacturing

France has a long-standing commitment to the UN Sustainable Development Goals (SDGs) since its launch in 2015. The UN SDGs, which apply to both developed and developed nations, seek to eradicate extreme poverty, combat inequality and protect the planet. The French manufacturing sector has generally made significant efforts towards the achievement of the SDGs. Specifically on SDG 9: Industry, Innovation and Infrastructure, France has made strides in encouraging innovation and supporting investment in R&D. The country has also strengthened the environmental performance of industries, with key initiatives such as the Green Tech Verte, which promotes start-ups that leverage digital technologies to support the energy transition. The country also provides green loans of up to US$3.6 million (€3 million) for companies seeking to improve their environmental performance17. On SDG 12: Responsible Consumption and Production, France has taken a number of steps that encourage adoption of best practices in sustainability by manufacturing companies, such as implementing clear standards on environmental labelling, creating disincentives for planned obsolescence and supporting “zero waste” territories.

France is also committed to using Industry 4.0 technologies as a means to achieve the SDGs, and specifically sustainability in the manufacturing industry. Emmanuel Macron, France’s current President, has promised 1.5 billion Euros of public funding to go towards the development of artificial intelligence (AI) by 2022 in Mission Villani18. The ‘Industrie du Futur’ programme has also encouraged the use of digital technologies such as AI to improve the efficiency of industrial processes. The introduction of AI in France can help achieve increased efficiency in the manufacturing of products through optimisation of raw materials and energy in production and reducing scrap due to defects in production. AI can also support the optimisation of logistics routes within plants and for servicing customers as well as to reduce greenhouse gas emissions. Therefore, AI has the potential to increase the sustainability of French manufacturing businesses, whilst also increasing output and profit margins.

There have been significant efforts made by the French manufacturing sector to drive sustainability in manufacturing. France’s Sustainable Innovation Forum (SIF) is an annual event that works in partnership with COP, Climate Action and UNEP (the world’s foremost organisation on environmental conservation) to shape a response to the UN SDGs19. The forum establishes event platforms, which allow investors to exchange expertise in order to innovate new, sustainable solutions to address the SDGs.

Another sustainable initiative is the formation of ‘French Cleantech’, an association which provides advisory in areas such as the manufacturing of materials, energy, water, and transportation. They advise a variety of clients such as large corporations looking to target market opportunities or clean technology entrepreneurs looking for financing as well as shareholders seeking investment projects20.

Finally, France launched the project ‘Rev3’ in response to the SDGs. The project aims to economically restructure France’s rust belt (the Hauts de France region) into a resourceful, sustainable economy and promote concepts in sustainable manufacturing to other regions and countries. The key goals are to be carbon-free and reduce energy consumption by 60% by 205021.
Technological change, the need for increased innovation, and changing patterns of global demand are creating opportunities for the French manufacturing sector. The sector is well poised to take advantage of these trends, leveraging on the country’s strength in digital innovation. French manufacturing has weathered a turbulent period of rising global competition, underinvestment in the sector, and high input costs. The new model of manufacturing will require significant investment by companies in building their capabilities and creating the organisational structures to support these transformations. Companies must enhance their non-price competitiveness in order to provide a unique value-add in order to grow demand and identify potential new customers. The government will also be key to supporting this transition by refining the focus of the ‘Alliance Industrie du Futur’, and a supportive policy environment.

**Figure 8: France’s manufacturing industry is expected to grow with recent government support**

Key milestones for France’s manufacturing in its development

<table>
<thead>
<tr>
<th>2013</th>
<th>2017</th>
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<tbody>
<tr>
<td>- ‘La Nouvelle France Industrielle’ was a ten-year plan launched to assist French companies in upgrading and positioning themselves in the markets of the future</td>
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<tr>
<td>- The plan leads industrial support and initiatives across 34 industrial sectors such as cloud computing, factory of the future and innovative products</td>
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<tr>
<td>- Launched ‘French Fab’ a new “Made in France” initiative that aims to promote French manufacturing sector’s exports and grow market share globally</td>
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<tr>
<td>- Its focus is to drive a French industrial base that relies on medium-sized firms that export</td>
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**The future of French manufacturing will be shaped by two trends:**

A. Creating an attractive environment for adoption of Industry 4.0 within the manufacturing sector: ‘Alliance Industrie du Futur’ must move towards supporting companies with the next phase of implementation of Industry 4.0 tools and provide a supporting legal and regulatory framework

B. Prepare SMEs and start-ups for growth in the global arena: Enable scaling of SMEs and vibrant entrepreneurship will be crucial to driving the next phase of growth in manufacturing
In the last couple of decades, France’s positioning in the global manufacturing spectrum has been eroded by the emergence of global value chains, especially due to a reduced cost competitiveness against other major manufacturing locations. As a result, France’s manufacturing value-added as a percentage of GDP has declined from 17.7% in 1990 to 11.3% in 2016.

In an effort to revitalise and turn around the French manufacturing sector, the government introduced the Nouvelle France Industrielle (NFI), otherwise known as the ‘New Industrial France’ initiative in 2013. While the strategy has a firm vision on modernising the manufacturing sector to drive innovation and technological adoption, it was considered as broad and perhaps too all-encompassing as it covers 34 industrial sectors.

Realising that a sharper focus was required to effect change, a second phase of the NFI programme, called the ‘Industrie du Futur’ (IdF) or ‘Industry of the Future’, was launched in 2015. This new plan focused on a number of technologies and industries and set out specifically to modernise methods of production and reshape organisational structures. It was also equipped with a budget of US$5.99 billion (€5 billion), much more than what most European countries have set out for similar industrial revitalisation plans. Attached to the generous budget are also high expectations that each Euro of funding will generate five times worth of additional investments from the private sector.

Despite the refined agenda, the IdF plan continues to feature an extremely broad mandate that sets out to reshape nine priority market segments of which those that are relevant to manufacturing includes data economy, smart objects and digital trust. The IdF also outlines a specific plan for the adoption of Industry 4.0, which it calls the ‘Usine du Futur’ or ‘Factory of the Future’ plan. It is specifically focused on creating solutions to meet economic, technological, organisational, environmental and societal challenges faced by manufacturing companies. Similarly, it bears a broad agenda to address a large number of industries and technologies and lacks specific plans for implementation and funding necessary to support its objectives.

While much has been invested and achieved from the IdF plan - loans provided to over 800 companies, 3400 companies provided a diagnosis for modernising production, 400 testbeds established, over 300 experts identified, and an overall involvement of stakeholders across 18 regions - however, actionable steps for the implementation of Industry 4.0 have not been fully embedded in the operations of companies.

There is still much to be done by France for the country to maximise its full potential in the new era of Industry 4.0 revolution. With an existing strong ecosystem of technology companies and large industrial companies, France’s manufacturing sector offers large headroom for development and growth as the potential of Industry 4.0 becomes fully realised.
Figure 9: Few French companies have moved into the implementation stage for Industry 4.0
Use of Industry 4.0 concepts to manage assets by French companies (%)

Source: Infosys, Industry 4.0: The state of the nations
Focus Area 1

Convert technological readiness into production capability

France is well positioned to leverage Industry 4.0 to drive growth in the manufacturing sector. First of all, there is already a strong presence of technologically-advanced companies and start-ups in France and this also indicates a good level of technological readiness in the country, giving it an edge in implementing Industry 4.0.

For example, Airbus, an established and internationally renowned aeronautical company, and Peugeot, an automotive manufacturer, are companies that have been pushing the boundaries of new technology adoption and utilising innovative manufacturing systems. France also has specialised technology companies such as 3D design software company Dassault Systemes, and technology start-ups in areas such as the Internet of Things (IoT) and virtualisation. Many of these companies are already actively investing in advanced manufacturing. In fact, technology start-ups in France are considered among the world’s most advanced and have pioneered technologies in a number of fields. At one of the world’s largest showcase events of emerging technologies, the International Consumer Electronics Show (CES) in 2018, a total of 280 French start-ups were showcased in almost every major technology and industrial application.

Second, France can expedite the rebuilding of its industrial base by working on reshoring and re-localising its companies from overseas by implementing Industry 4.0 technologies. New technologies can help enhance the value proposition of France as a manufacturing destination, and enable innovative French manufacturing companies that have moved overseas due to high labour costs and tax burdens to relocate their production bases back home. French companies are well-positioned to realise this vision as they have access to highly-skilled talent in critical areas such as cognitive manufacturing and network supervision.

However, a large amount of capital is required in order to materialise the opportunities presented to the French manufacturing sector in adopting Industry 4.0 technologies. For example, companies will need to upgrade production tools and equipment to enable them to be connected and programmable. Yet, existing capital investments by French manufacturing is low, as compared to other industrialised countries. Furthermore, French companies have previously underinvested in machinery. According to a government report in 2015, only 27% of manufacturing investments in France were directed to machinery and equipment as compared to 45% in Germany and 67% in Italy. The majority (64%) of French investments were directed to R&D, software and databases.

Even more investments are needed in the case of France. In 2014, the French manufacturing industry faced a shortfall of US$47.9 billion (€40 billion) in investments and was unable to cope with fast-growing depreciation resulting in an overall reduced capital-intensiveness. The country’s machine use rate fell from 85% to 81% between 2000 and 2014, while the Return on Capital Employed (ROCE) dropped from 20% in 2000 to around 8% in 2014. The stock of industrial machinery in France is estimated to be, on average, ten years older than in Germany.

In order to address the above-mentioned challenges, there is a need to first refine the focus of the existing Industry 4.0 initiatives for the manufacturing sector. The lack of focus on the French manufacturing sector in the IdF plan dilutes the impact of the initiative as it focuses on specific technologies, products and services, rather than taking an ecosystem and/or value-chain approach to the digitisation of manufacturing. There is also a need to ensure that manufacturing companies and not only technology companies have access to the funding opportunities and training initiatives provided.
The ‘Factory of the Future’ plan will also need to deepen its focus on technology and on operationalising the vision of Industry 4.0. There is a need to engage individual company stakeholders to answer specific questions pertaining to the next level of detail on bringing together individual components of their organisation, to create a new vision for manufacturing.

Next, creating all-rounded support in the business environment can better enable French companies to be early movers. Establishing an early mover advantage is important to allow companies time required to align their organisation and culture to be an Industry 4.0 organisation. Investments should not only focus on upgrading to machinery and technology but also to be invested in creating the supporting environment such as training employees, hiring specialists and driving organisational change.

At the same time, French companies will also need to evaluate the effectiveness of their investment priorities in light of emerging technological trends. As production output and quality is increasingly determined by the use of technological tools, French manufacturers will have to reallocate their investments accordingly. To reduce upfront capital requirements for each company, the Factory of the Future initiative can look into encouraging ongoing collaborations between technology providers and manufacturing companies to enable cost-sharing. Also, it will be important for French companies that are seeking to make investments in Industry 4.0 to develop a financing strategy at the outset of projects, as this will result in the development of solutions that are more financially sustainable.
Focus Area 2

Create a responsive policy environment for Industry 4.0

The implementation of Industry 4.0 allows companies to gain data and insight. The digitalisation of operations offers the ability to capture more detailed information that enhances decision-making in the areas of business planning, manufacturing planning, customer relationships and asset utilisation. However, data management poses various challenges that can be burdensome. Data privacy and cybersecurity issues, as well as operational disruptions caused by data breaches, are persistent concerns. Current standards pertaining to these aspects are also unclear, and potential risks could deter companies from engaging with these tools. Nevertheless, data management will be especially critical as more companies integrate their production processes to incorporate customer inputs and cater better to customer preferences.

One solution to this is to develop clear legal standards for adoption of Industry 4.0 technologies. Specifically, addressing challenges faced by SMEs is an important aspect as they are less equipped with resources to manage complicated legal and regulatory standards. It is important to simplify and provide basic training on legal standards so that SMEs are not deterred from investing. For example, ‘Factory of the Future’ or related industry associations could consider providing “toolkits” for SMEs to perform simple self-assessments on their legal liabilities and risks. Also, checklists can be provided to ensure that they are guided through the necessary processes.

As the use of Industry 4.0 is accelerated, integration of external partners, such as suppliers and customers, will become increasingly common. Clarifying legal standards on data protection, security and liability in this situation will provide companies with confidence when approaching new partnerships.

While leveraging Industry 4.0 to create a competitive edge is crucial for France, collaborating with other EU countries to strengthen the region’s position as a premier Industry 4.0 hub can attract investments from around the world. Creating a shared understanding of Industry 4.0 standards across Europe can reduce legal and operational complexities and reduce investment barriers. It will also enable French SMEs with expertise in Industry 4.0 to scale and regionalise.

Currently, the Industry 4.0 plans of each of Germany, France and Italy have already undertaken cooperation efforts in three key areas, namely:

1. Standardisation and reference architecture
2. SME engagement and testbeds
3. Policy support

Expanding upon existing efforts by increasing the scope and number of areas of cooperation and expanding the number of countries involved in the Industry 4.0 cooperation would be a good next step. For example, involving the European Commission will be important as it is a key stakeholder in this ongoing conversation, having already established several pan-European initiatives, such as technology testbeds.

France bears a lot of promise in pushing its manufacturing sector to the next level, and can leverage greater strength by positioning itself as part of a regional Industry 4.0 hub, provided that it sharpens its focus on the manufacturing sector by driving technological readiness through to implementation, and builds upon existing efforts to create a more supportive policy environment.
Case Study:
Leading industry 4.0 countries have taken steps to bring technology to an operational level within companies

Plattform Industrie 4.0’s focus is on the digitisation of industrial production, in particular through cyber physical systems. The German approach to Industry 4.0 has centred on creating working relationships between the main stakeholders, industrial companies and the government, to establish a common understanding of Industry 4.0 and providing joint recommendations on how to create a reliable and consistent framework.

The realisation of the vision is supported by three main initiatives:

1. Use cases that help companies understand possible benefits of Industry 4.0 and implementation efforts required
2. Create testbeds that allow companies to test ideas and make developments ready-for-use
3. Establish information centres that provide advisory services on coping with the newly emerged business contexts

The Industrial Internet Consortium (IIC) is an industry-led initiative, focused on driving the use of Industrial Internet of Things (IIoT). The founding members and initial driving force for the initiative came from American technology and manufacturing companies - GE, IBM, AT&T, Cisco and Intel. However, the vision of the IIC is as a global organisation with membership from foreign and domestic institutions including small and large companies, industry associations, universities and even government organisations.

The IIC Testbed working group plays a crucial role in the process of synthesising ideas into implementation-ready propositions. Proposals for testbeds are generally created by member companies, academia and government agencies may support industry players with funding support. The IIC will provide guidance on implementation of the testbed. All testbed proposals are required to demonstrate that they involve multiple technologies and can scale outside a single company. The testbed model also creates opportunities for spin-off applications based on the knowledge gathered through the testbed.

High Value Manufacturing Catapult (HVMC) is a UK government-led initiative that aims to support high value manufacturing businesses with innovation projects that require new manufacturing solutions. The purpose of this initiative is to spread economic success across sectors in order to generate broad-based growth. HVMC bridges the gap between innovation in academia and the application of innovation within companies. HVMC works with high value manufacturing businesses that have potential ideas about innovative practices but do not have the capabilities needed to implement. HVMC is able to fill the gap for companies by providing support on missing capabilities, facilities to test and scale high-value manufacturing processes and identify potential suppliers. HVMC supports companies with capabilities such as automation and digital manufacturing. However, the focus is not purely on Industry 4.0 technologies, as the initiative also supports innovation in ‘traditional’ engineering. The HVMC has been one of the UK’s most successful business support programmes generating US$17 of net benefits for each US$1 of public funding.

Source: Plattform Industrie 4.0, Industrial Internet Consortium, Catapult HVM, Digital Transformation Monitor
B. Prepare SMEs and start-ups for growth in the global arena

Small and medium enterprises (SMEs), having less than 250 employees, have a dominant presence in the French manufacturing sector, accounting for 99% of the nearly 200,000 manufacturing companies in France. Within this, a majority (87%) are micro-enterprises with less than 10 employees. According to a 2016 report by Directorate General for Enterprise (DGE), SMEs accounted for about one-fifth (18%) of the manufacturing sector’s turnover and a quarter (25%) of manufacturing value-added.

The level of innovation remains high among SMEs with more than half (52%) of French SMEs having innovated - slightly above the EU-28 average of 48%. Specifically, a third of SMEs engaged in technological innovation, with those in the manufacturing sector more likely to innovate than SMEs in the services sector. However, SMEs have been increasingly facing - and are particularly vulnerable to - challenges such as increasing competition due to globalisation, especially in traditional manufacturing sectors, as well as rising input costs. They have also been more restrained in global investments in recent years due to weak economic conditions.
Focus Area 1

Create innovation clusters for small, medium and micro enterprises

An existing culture of innovation sets a good basis for SMEs to exercise their inherent agility in driving innovation. SMEs are able to experiment with ideas such as testing niche products at a smaller scale with lower capital investments. They also possess greater flexibility to pivot business strategies which also enhances their ability to produce ‘disruptive innovation’ as they are able to work outside of dominant knowledge paradigms. Furthermore, a current shift towards an ‘open innovation’ paradigm, that utilises ideas not only those generated internally but also those generated from external cooperation efforts and sources, will likely reduce the need for innovation-related capital investments, making business innovation even more accessible to SMEs.

The impact of the challenge, however, is in the lack of presence of intermediate-sized companies (defined as companies with >250 workers and >€50m turnover) that are the engine of growth in the French manufacturing sector²⁸. Intermediate-sized enterprises are of a more suitable scale for innovation as they tend to ensure coordination and upgrading, participate in the supply chain of SMEs as well as possess sufficient scale for exporting and developing their own market niche through innovation.

Another challenge is that French manufacturing SMEs have not established unique value propositions unlike the SMEs in Germany. Without these, French SMEs are not able to differentiate products relative to low-cost competition to establish ‘non-price competitiveness’ even though they have access to some of top R&D, talent and digital innovation efforts. Non-price competitiveness refers to the ability of a business to sell regardless of price and the rhythm of foreign demand. Non-price competitiveness is characterised by product quality (innovation content, positioning, design, and reliability) and producer quality (brand, reputation, after-sales service). The lack of non-price competitiveness in French SMEs also limits opportunities for exports (an important source of revenue for manufacturing companies) and internationalisation. Additionally, a study by French public investment bank Bpifrance found that the diffusion of innovation and operationalisation of findings from innovation was an area of concern for French SMEs thereby preventing French SMEs from fully realising the potential of their innovations.

A way to overcome the above-mentioned challenges faced by SMEs is by encouraging them to leverage the presence of regional clusters organised around specific manufacturing sectors. For example, SMEs in the aerospace supply chain can look to set up such a cluster in Toulouse. This builds on the idea of “Competitiveness Clusters” that already exist in France. These competitiveness clusters need to extend their ability to include small companies and microenterprises and also to increase their focus on technology. This will enable manufacturing SMEs to benefit from the presence of other players along the industry value-chain within the same cluster, as well as technology resources and other facilities such as industry-specific R&D centres, training and educational institutions. Being in a regional cluster also lends credibility and visibility to SMEs and increases access to venture capital funding and angel investors.

In addition, French SMEs experience more difficulties in internationalising and exporting than other European SMEs. Some of the major problems in exporting that affect French SMEs disproportionately are:

1. Having specialised staff for export activities (23% of French SMEs consider this a ‘major problem’)
2. Identifying business partners abroad (34%)
3. Dealing with administrative procedures (39%)
4. Finding information (25%)²⁹

Regional hubs would be a good way to channel specialised support on the above areas to SMEs. Organisations such as Bpifrance (Public Investment Bank) already have schemes to support these efforts but directing these efforts towards a regional hub rather than individual companies would allow these measures to have a greater impact.

²⁸ French public investment bank Bpifrance
²⁹ Regional hubs would be a good way to channel specialised support on the above areas to SMEs. Organisations such as Bpifrance (Public Investment Bank) already have schemes to support these efforts but directing these efforts towards a regional hub rather than individual companies would allow these measures to have a greater impact.
There is also a need to encourage cross-industry collaboration between manufacturing SMEs and digital technology companies. Increasing collaboration can help to drive innovation and support the digitisation of manufacturing SMEs. An initiative that could help drive this could be to invite a number of digital technology companies to take up residence within industry clusters and to look into rotating them such that manufacturing SMEs have a chance to be exposed to a variety of cutting-edge digital solutions.

Increasing opportunities for cross-sector collaboration can also help the diffusion of innovation that has been a challenge for French SMEs. The diffusion of innovation theory suggests that the four factors that influence the spread of a new idea are: the quality of innovation, communication channels, time, and a social system. Regional manufacturing hubs designed as shared business parks with technology resources and centres of excellence can be a good way to create a social system to increase opportunities for networking, enhance collaboration and communication to enable the spread of technology.

Another way is to work closely with local universities to attract skilled talent. As SMEs may have challenges versus larger firms in attracting highly skilled talent, they can be more proactive in reaching out to students by way of providing internships and vocational training. Also, they can partake in shaping the curriculum of local universities addressing specific skillsets required out of the future talent pool.
Case Example: Sophia Antipolis Business Hub

Sophia Antipolis is a technology park located in the Provence-Alpes-Côte d’Azur region. The business hub upholds the concept of cross-fertilisation of ideas between researchers and companies. These companies are primarily SMEs, working alongside large multinationals. The business hub is the location of 2,230 companies, employs 36,300 people, and works alongside 4,500 researchers and 5,500 students.

It houses an ecosystem of higher education establishments, standardization institutes, competitiveness clusters and research institutes needed to drive innovation. One of its competitiveness clusters that focuses on the development of secure communication solutions based in Sophia Antipolis Hub has been recognised as world-class by the French Direction Générale des Enterprises (DGE). There is also the Pégase Competitiveness Cluster, which brings together players dedicated to the development of next-generation aircrafts.

The IT sector has the largest presence in the hub, accounting for 300 companies or 20% of all companies and 15,000 jobs or 42% of jobs. There are 45 companies and 2,600 jobs in the Health Sciences sector, and 23 companies and 350 jobs in Environment and Energy Preservation.

There is a high level of collaboration between companies within the hub. Initiatives such i3S, a collaboration between three local institutions: University Nice Sophia Antipolis (UNS); Polytech Nice Sophia; Faculty of Sciences and IUT, researches the practical and theoretical challenges of computer science and engineering, automation and signal processing. They also focus on robotic research such as humanoid robots and augmented reality applications.

SMEs in the business hub are able to leverage on incubators, venture capitalists and crowd investing platforms region to fund their research. Incubators in the Sophia Antipolis business hub include ‘Incubateur PACA Est’ and ‘Telecom ParisTech’ (France’s first IT incubator). Additionally, the Sophia Antipolis Foundation mobilises funding and partnerships. The Sophia Business Angels, a collective which provides investment and funding to promising start-ups in the technology sector, is also an important source of funding. The government also directs funding and support to businesses in the region through the Regional Innovation and Internationalisation Agency.

The regional government has played an important role in attracting businesses to the region by providing business support services and investing in infrastructure. In turn, the Sophia Antipolis Business Hub has created significant economic and social benefits for the region.
Promote entrepreneurship to drive digitalisation in manufacturing

Digitalisation can help drive more efficient operations, ease innovation, centralise the storage of specialist knowledge, introduce rigorous quality management controls, and many other benefits. One way to drive digitalisation in manufacturing is to promote entrepreneurship to encourage new manufacturing companies that are building a technology-focused business model as well as digital technology companies that provide specialised solutions for manufacturing.

As entrepreneurship grows in France, particularly in the technology sector, encouraged by government reforms and business optimism, similar efforts can be directed toward driving entrepreneurship in manufacturing. In 2016, France saw the second highest venture capital investment in Europe of US$3.2 billion (€2.7 billion). In the first three months of 2017, there was a 14.4% increase in new businesses in the manufacturing industry compared to same period in 2016\(^1\). The highly educated French workforce also provides a good base as having the right talent in place to take innovative ideas forward is important to creating successful French start-ups, and to enhance the likelihood for them to scale into mid-sized enterprises that will better contribute to economic growth.

However, the existing business environment in France is not conducive to entrepreneurship. This is due mainly to strict labour laws, high taxation, high minimum wage requirements and others. France ranks 25\(^{th}\) in the World Bank’s ‘Starting a Business’ measure and 31\(^{st}\) on the ‘Ease of Doing Business’. To address this, there have been reforms initiated such as with the implementation of the tax reduction scheme based on R&D investments, called ‘Credit d’Impot Recherche’.

Another key challenge for manufacturing sector start-ups will be the significant competition for talent in advanced technology fields such as artificial intelligence. Additionally, high upfront capital investments are required in the manufacturing sector to purchase machinery and equipment, which makes it less attractive as an option for entrepreneurship as compared to the services sector.

One way to address the above challenges is to create initiatives targeted at the two company segments:

1. Manufacturing start-ups that pursue digitisation
2. Technology companies that provide digital tools and solutions for manufacturing applications

There are already some existing government programmes that support start-ups and innovation programmes such as ‘La French Tech’, a project that supports start-ups from securing funding through to offering mentorship and access to tech talent. A number of agencies also support start-ups such as national agency Business Start-Up Agency (APCE), chambers of commerce, and a start-up advisory scheme, NACRE. However, these programmes are targeted at companies focused on innovating consumer applications rather than companies that provide innovative solutions for the manufacturing sector.

Existing government organisations and associations that support innovation and entrepreneurship can focus on reaching out to the manufacturing sector, especially to new start-ups and potential entrepreneurs, as a way to work towards the creation of a manufacturing start-up hub. The creation of a start-up hub would facilitate networking and knowledge sharing, encourage collaboration and the flow of talent and technology between SMEs.
Specific initiatives could also focus on providing mentorship to start-ups by established manufacturing companies. This can help start-ups better understand the current needs of manufacturing players, identify market gaps and opportunities, and help them understand how to integrate into the existing supply chain. This is also a good way for established manufacturing companies to be exposed to innovative start-ups and market opportunities.

Finally, to address concerns pertaining to business environment challenges, government agencies can continue to look into pursuing labour market and tax reforms. These reforms have a role in promoting entrepreneurship apart from being a way to attract new investments into France. Also, measures can be taken to reduce the number of administrative procedures such as by creating a one-stop online platform for new company registrations.

Overall, SMEs in France have a good platform to raise their global competitiveness and can leverage on the existing strong R&D and innovation culture, as well as the presence of quality talent. Having SMEs join industry-specific innovation clusters can drive industry collaboration and further sharpen their value-proposition. Building on the existing strong culture of entrepreneurship to focus on manufacturing sector as well as encouraging the collaboration with technology companies offering digital solutions can also help the manufacturing sector with its ‘digital-first’ makeover.
The ‘ICT Innovation for Manufacturing SMEs’ (I4MS) initiative was launched by the European Commission in 2016, under the “Digital Industrial Leadership” - an EU-wide strategy for digitising the European manufacturing industry. The I4MS initiative aims to enable and foster the collaboration of manufacturing mid-caps, SMEs and start-ups across their value chains with the support of European innovation centres, such as European Digital Innovation Hubs (DIH), universities, application-oriented research organisations in cross-border experiments.

The I4MS Initiative supports mid-caps and SMEs in the manufacturing sector along three dimensions, including 1) providing access to competencies that can help in assessing, planning and mastering digital transformation, 2) providing access to innovation networks of a broad spectrum of competencies and best practice examples, and 3) providing financial support to mid-caps and SMEs on the demand and supply side to master digital transformation.

The I4MS initiative aims to nurture the manufacturing ecosystem and provide benefits to all stakeholders. For example, DIH provides companies with universal access to digital competencies and all other necessary resources that support the development of regional ecosystems to turn excellent technical solutions into innovative products and services. The initiative also supports SMEs financially to adopt advanced technologies so that SMEs can develop innovative and competitive products and services. The initiative provides a platform for companies to experiment, test and mature existing technologies while broadening its applications.

Increasing collaboration across Europe has proven to be important in strengthening the European manufacturing industry. About 29 EU member states and associated countries were involved in Phase 1 and Phase 2 of the I4MS. Also, more than 70% of experiments conducted until 2016 have a relevant European dimension and are executed in collaboration with partners from different EU member states combining existing regional strengths and know-how. In Phase 1 alone, 195 experiments have been initiated and are either completed and have achieved the intended technological and economic impact or in a final state of implementation. Meanwhile, for Phase 2, 25 experiments have been launched at the outset and 60 additional experiments that focus on establishing new user-supplier collaborations have been put up for selection.

### Case Study: Enhancing the digital transformation of the European manufacturing sector through I4MS

The Key Phases of ‘I4MS’

**Phase 1: Start-up the I4MS Ecosystem**

- 2013-2017

**Phase 2: Organically grow the I4MS system**

- 2015-2019

**Phase 3: Nurture ecosystem to focus on EU added-value**

- 2018-2021

### Key Technologies

1. HPC cloud-based simulation services
2. Advanced laser-based equipment assessment
3. Industrial robotics systems
4. Intelligent fixtures

### Key Actions

1. Technological focus - CPS and IoT targeting SMEs
2. ‘New Coordination and Support Actions’ for multiplying effects of the Innovation Actions
3. Mentoring programmes for DIHs

### Key Technologies

1. Integration of CPS and IoT for smart production
2. Robotics systems
3. HPC cloud-based modelling and simulation
4. Digital design for additive manufacturing

**Source: European Commission**
Conclusion

The French economy is highly-developed and is one of the economic lynchpins of the Eurozone. France has seen a steady increase in growth since 2012, largely driven by domestic private consumption as well as demand from the Eurozone countries. Proposed economic reforms by the Macron government are a source of optimism as they are likely to lead to increased foreign and domestic investment in the country. However, high input costs remain a concern, especially for exports.

France’s manufacturing sector remains strong in terms of its fundamentals but has faced volatility as a result of increased global competition. The sector faced an overall decline in CAGR of -1.1% from 2010-16, though the outlook is more positive with an expected 2.1% CAGR between 2016 to 2022. The manufacturing sector still remains a significant contributor to the country’s GVA and employment, though these have also been impacted by the sector’s decline. Nonetheless, the potential of the French manufacturing sector is substantial as it has the ability to transform the country into a ‘digital-first’ economy, where manufacturing is a meaningful contributor to broad-based economic growth. This will require a recognition of the new success factors for manufacturing in the age of digitalisation and the motivation to create the supporting conditions and ecosystems for manufacturing firms.

One of the important steps for the manufacturing sector will be to accelerate the use of Industry 4.0 tools by French manufacturing companies. It will be critical to provide the impetus for companies to transform their technological readiness into operational advantages. Companies must focus their investment priorities on technological upgrades in order to seize the substantial benefits of being an early mover. At the same time, it will be necessary for governments and industry associations to step in to build the supporting infrastructure in terms of engaging stakeholders, enabling collaboration and developing the appropriate legal frameworks. There is also a need for renewed focus on SMEs and start-ups as well as a recognition of their crucial role in the sector. The development of regional hubs can potentially support SMEs with the opportunities for creation and diffusion of innovation, internationalisation, talent, and financing that are necessary for scaling. Enabling the growth of digital-first manufacturing companies will also bring vitality to the French manufacturing sector.

In the new era of manufacturing, France has significant sources of comparative advantage, in terms of its highly qualified workforce, a strong foundation of research universities, capital access, stable government, a responsive legal system, dynamic digital technology hubs, and significant innovative capacity. Translating these advantages into economic success will require a renewed focus on the manufacturing sector by all stakeholders involved.

“France’s SMEs and large industrial companies – in aerospace, agrifood, chemicals, and others – need to be innovative and grab the opportunity offered by Industry 4.0 and the broad interest in venture investments, as well as President Macron’s reforms. France’s economic revival depends on innovation, entrepreneurship, and the development of versatile and tech-savvy skills, with a significant reemergence of the manufacturing sector.”

Anil Khurana  
GMIS Organising Committee  
PwC Partner, US & ME, and Advisor

“As this report highlights, enabling a transition in the French manufacturing sector will, to a large extent, depend on companies which already have the necessary ingredients for transformation through technology being supported in channeling their capacity into tangible market advantages. It is here that a multi-stakeholder effort, allied with renewed support for SMEs and startups, will be pivotal to how the next stage of France’s economic journey unfolds. If these efforts are deployed, and the necessary support is provided, France will re-energise its manufacturing sector, aligning it with established industrial principles and strong fundamentals underpinned with innovative thinking to generate economic success and sustainability.”

Badr Al-Olama  
Head of GMIS Organising Committee
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