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United States of America
Department of Commerce

Advanced Manufacturing Market Resource Guide



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Contents

Austria	3
Belgium	4
Bulgaria	5
Croatia	6
Czech Republic	7
Denmark	8
Finland	9
France	10
Greece	11
Germany	12
Hungary	13
Italy	14
The Netherlands	15
Poland	16
Portugal	17
Romania	18
Serbia	19
Slovakia	20
Spain	21
Sweden	22
UK	23

Austria

Capital: Vienna

Population: 8.6 million (2015)

GDP: \$374.2 billion (2015)

GDP per capita: \$43,711 (2015)

Currency: Euro

Language: German



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Overview of Austria's Advanced Manufacturing Initiatives

Austria has one of the European Union's most prosperous economies and is home to a manufacturing sector that accounts for 18% of GDP (2014). Austria exports over 60% of its manufactured goods, making it one of the most export-oriented countries in Europe. Currently, one in four Austrian manufacturers already reports a high level of digitalization throughout internal and external value chains; by 2020, 85% plan to be highly digitalized.

Overview

According to a recent study, Austrian companies are expected to invest almost 4% of annual turnover or over \$4 billion in advanced manufacturing solutions between now and 2020. Best prospects include identification systems such as RFID, equipment for data collection and processing, and ITC programs and infrastructure that will enable self-managed production in near real time based on inputs from production, supply, and customers. Companies predict that within five years, over 85% of Austrian manufacturing companies will have implemented high levels of digitalization both for internal processes and b2b value chains, up from 20% (internal) and 30% (b2b) in 2015.

Opportunities

Automotive Industry

Currently only 17% of Austria's automotive manufacturers report a high level of digitalization, but 80% plan to be highly digitalized by 2020. With a production value of \$18.4 billion (2014), and an export rate of over 90%, Austria's automotive industry is both large and very international. Annual nominal investment in advanced manufacturing solutions is \$400 million.

Process Industries

Processing industries include chemical, pharmaceutical, plastic/rubber, and metals production and processing. Currently, only 10% describe their manufacturing as highly digitalized; by 2020, 85% expect to have highly digitalized processes in place. This group also projects the highest nominal annual investment, with over \$2 billion/year or 3.7% of turnover.

Mechanical Engineering and Construction

With annual production values at around \$20 billion, the mechanical engineering and construction sector is also among the least digitalized. Only 22% categorize themselves as highly digitalized, yet 86% expect to adopt a high rate of advanced manufacturing by 2020. This sector reports projected spending of 4.3% of annual turnover (around \$900 million/year) in advanced manufacturing investment.

Belgium

Capital: Brussels

Population: 11.409 million

GDP: \$494.620 (2015)

GDP per capita: \$43,600 (2015)

Currency: Euro

Languages: French – Dutch – German



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Overview of Belgium's Advanced Manufacturing Initiatives

Belgium was the second country after the United Kingdom to experience the Industrial Revolution. In the last decade, Belgium has experienced a revival in manufacturing prowess and competitiveness through the implementation of innovative technologies. The increased employment of cutting-edge products and forward-thinking processes in factories across Belgium has highlighted advanced manufacturing as a means of ensuring manufacturing will not leave Belgium.

Overview

In 2008, the Flemish government called upon Belgium's many strategic research centers, lobbies, think tanks, and trade association to help write a new industrial policy for Flanders. The Flemish government freed up €250 million from its budget for advanced manufacturing projects. Currently, the manufacturing sector accounts for one-sixth of the Belgian GDP. While manufacturing is still growing in Wallonia, the manufacturing industry in Flanders currently accounts for 15.9% of employment, 80% of total exports, and 8% of worldwide turnover in additive manufacturing.ⁱ Top manufacturing industries in Belgium are the chemical, plastics and life sciences industries and the ICT (Information Communications Technology) sector.

Key Actors

Government

At both the federal and regional level, the Belgian government maintains advanced manufacturing as a priority for safeguarding the future health of the country's economy. Through PPPs (public-private partnerships), both policy-making and research oriented organizations have been lending their services to help reinvent fledgling Belgian manufacturers falling behind in the age of Industry 4.0, turning their plants into smart factories and making their production more sustainable and intelligent.ⁱⁱ

Made Different

Made Different is a program with a focus on helping manufacturing businesses embrace technology innovation, sustainability, and remain at the forefront for adopting industry trends and forward-looking business practicesⁱⁱⁱ. Since the inception of the project, Made Different has helped to convert 11 manufacturing companies into Factories of the Future. Currently 250 companies across Belgium are enrolled in the program. In the future, Made Different plans to begin collaboration with their counterpart organizations in the Netherlands, France, and Germany. By 2018, Made Different plans to have helped develop 50 more Factories of the Future and inducted more than 500 Belgian factories into the program.

Bulgaria

Capital: Sofia

Population: 7,045 million

GDP: \$143.1 billion (2016)

GDP per capita: \$20,116 (2016)

Currency: Bulgarian Lev (BGN)

Language: Bulgarian



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Overview of Bulgaria's Advanced Manufacturing Initiatives

In the past decade, Bulgaria strived to become the manufacturing hub in the Balkans. The country achieved significant progress in the sectors for manufacturing of metal products and machinery, automotive parts, electronics, pharmaceuticals, apparel, wine and tobacco products. Manufacturing accounts for 27.87 percent of Bulgarian GDP.^{iv} In December 2016, the industrial production index recorded an increase of 6.9 percent compared to the same month of 2015. This trend continues in 2017 as part of the overall economic progress of Bulgaria.

Overview

Advanced manufacturing is one of the most dynamically developing sectors in Bulgaria. More than 75% of the production of the electronics manufactured in the country is exported.^v Key markets for the Bulgarian electronics manufacturing are the EU countries, USA, Russia and CIS. Wires and cables comprise 25% of the total subsector exports, followed by industrial batteries with 11% and electrical apparatuses with 8% of the export. Automotive advanced manufacturing and digital manufacturing are other subsectors that have large shares in the advanced manufacturing of Bulgaria.

Subsectors and Opportunities

Automotive Parts: Nearly 100 enterprises in the auto parts sector employ over 33,000 people, producing components for over 20 brands, such as Peugeot, BMW, and Mercedes. The components are high technology products that generated \$1.6 billion in sales in 2015.^{vi}

Electronics Manufacturing: The subsector is mainly comprised of small and medium companies, working for export of high-tech products.

Digital Manufacturing: Process industries software and drivers offer a wide and unique portfolio of software tools, industrial automation and propulsion technologies that meet the specific customer requirements in the field of discreet industrial production. The subsector also develops software for machines, implementing the high-tech innovations into manufacturing and industry.

Additive Manufacturing: The 3D printing and techniques is a developing subsector that has demonstrated its potential, as Bulgarian firms step on the EU market of 3D printing as a manufacturing tool. Although the service is still perceived as exotic and innovative, more and more companies get established or rely on the new technologies.

Smart Manufacturing: Bulgaria is still in the planning and testing stage of the sustainable and efficient development of manufacturing. Pioneer companies subsidized by the EU entered the subsector of solar and wind energy. Development of smart cities is also a key initiative in the subsector. The Bulgarian intracom develops innovative solutions for smart cities smart lighting through smart services, intelligent traffic monitoring, smart waste management, and smart parking.

Croatia

Capital: Zagreb

Population: 4.3 million

GDP: \$50.43 billion (2016)

GDP per capita: \$22,400 (2016)

Currency: Croatian Kuna

Language: Croatian



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Overview of Croatia's Advanced Manufacturing Initiatives

Croatia is among the top countries in the European Union by industrial growth. Industrial production accounted for 21.2% of the GDP in 2014, and the production grew by 5% in 2016, recording the third year of consecutive growth. Production grew 1.5% in March 2017 compared to the previous month. The electricity, gas, steam and air conditioning supply with 7% and the processing industry with 5.4% are driving the growth. The fastest growing sectors within the processing industry are also the largest: food and beverage (24% of the processing industry), manufacturing of pharmaceutical and chemical products (11%), manufacturing of electrical machinery and equipment (9%), and manufacturing of rubber, plastic, leather and paper products (9%). The exceptions are metal industry (20%) and manufacturing of coke and refined petroleum products (17%) that are among the largest sectors, but with low growth rates.

Overview

The average industrial maturity level in Croatia in 2015 was estimated to 2.15 out of 4, which represents 2nd industrial generation or middle of 20th century.^{vii} Pharmaceuticals and IT manufacturing, as well as electronic and optical products are the most technology advanced sectors, with over 50% of revenues being generated by exports. In 2015, Croatian companies had 263 robots or 13 robots per 10,000 employees. 18% of all companies in Croatia used industrial robots for heavy industry, while 17% used robots for handling processes. Robots usage in Croatia is still low, but it is expected to grow by 5% until 2018, matching average World's growth rate.^{viii}

Advanced Manufacturing Initiatives

The government intends to transform the economy and improve competitiveness through national and EU projects: Strategy of Smart Specialization (S3)^{ix} – Outlines Croatian economy indicators, available EU funds and priority areas for improvement during the period 2016-2020. Priority sectors within the strategy include: health and quality of life, bio-economy, security, energy and sustainable environment, transport and mobility, and agro-food.

Centre for Industrial Development (CIRAZ)^x – a department within the Croatian Chamber of Economy established to implement two EU funded strategic projects: support of the competitiveness cluster initiative and support of the establishment of innovation network for industry and thematic innovation platforms. CIRAZ activities follow priority areas identified in the S3 strategy. The U.S.-Croatian Innovation Council was established within CIRAZ to find ways to promote U.S.-Croatia innovation exchanges, and U.S. advanced manufacturing companies and associations are welcome to join.

National platform for industry digitalization – Action plan for industry transformation run by the Ministry of Economy and the Faculty of Mechanical Engineering and Naval Infrastructure Zagreb, related to EU Digital Agenda 2020. The platform is a basis for utilization of 300 million Euros worth EU fund for creation of smart and digitalized companies and public institutions (50% funded by the company, 25% local government, 25% EU funds).

Czech Republic

Capital: Prague

Population: 10.6 million

GDP: \$192.9 billion (2016)

GDP per capita: \$34,711 (2016)

Currency: Czech crown (CZK)

Language: Czech



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Overview of Czech Advanced Manufacturing Initiatives

The Czech Republic has the highest industrial share of value added as a percent of GDP (37.7%) in Europe. Four major Czech manufacturing sectors – automotive; electronics; machinery and electrical equipment - contribute 45% to the national GDP and 75% to Czech exports. Since only about 2-3% of Czech companies in these sectors utilize digital technologies on a larger scale, Industry 4.0 brings many opportunities and challenges. The major challenge is likely to be the Chinese initiative *Made in China 2025*.

Overview

In 2016, the Czech Government approved the “National Initiative Industry 4.0” strategy that was prepared by the Ministry of Industry and Trade. The purpose of the national initiative was to ensure Czech competitiveness with the development of Industry 4.0. The Action Plan for the implementation of Industry 4.0 is under discussion. The plan will support investment, standardization, applied research, HR development, education, cybersecurity, the regulatory framework and the deployment of Industry 4.0 technologies in energy, transport and smart cities. As a part of this Initiative, the [Czech Institute of Informatics, Robotics and Cybernetics](#) (CIIRC) was established at the Czech Technical University in Prague. CIIRC also serves as a unique Industry 4.0 testbed.

Opportunities

Automotive: The Czech automotive market is the sixth largest in the EU. The country is the sixteenth largest motor vehicle producer and the twelfth largest motor producer in the world. In 2016, automotive production accounted roughly for \$44 billion, which represented about 9% of Czech GDP, 25% of total industrial production and 25% of total Czech exports (by local production).

Electronics: Czech manufacturers of electronic components, computers and peripheral equipment produced about \$12.5 billion in goods and generated value added worth \$1.4 billion in 2015.

Machinery: This sector accounted for almost 8% of revenues for own products and services in the manufacturing industry. Revenues were about \$12 billion and value added \$2.3 billion in 2015.

Electrical Equipment: Revenues from manufactured electric motors; generators; transformers; and electricity distribution and control apparatus amounted to \$11.8 billion and generated value added of \$1.1 billion in 2015.

Denmark

Capital: Copenhagen

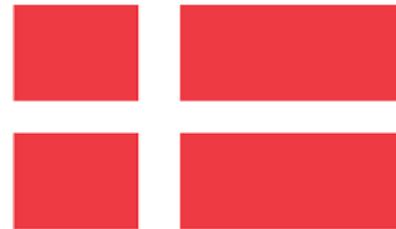
Population: 5.7 million

GDP: \$ 306 billion (2016)

GDP per capita: \$ 53,417 (2016)

Currency: Danish Krone

Language: Danish



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Overview of Denmark's Advanced Manufacturing Initiatives

Manufacturing is one of Denmark's key industries, accounting for approximately 20% of the country's GDP. The most important sub-sectors include process manufacturing within life science and pharmaceuticals, chemicals, renewable energy technologies and industrial equipment, but also consumer product sectors, such as beverages and toys. Denmark exports over 60% of the manufactured goods, but relies on import when it comes to industrial raw materials. The public and private sector investments in industrial R&D and innovation amounted to \$8 billion in 2016 and accounted for 3% of the country's GDP.

Overview

Like its European neighbors, the design-savvy and innovation oriented Danish manufacturing industry is faced with the challenges of the new industrial revolution, the rise of disruptive technologies, and the digitalization of manufacturing processes. In June 2016, the Danish Government asked a panel of public and private sector participants to prepare a digital growth plan, to create the right conditions for exploiting the potential and benefits of industrial digitalization. The Digital Growth Panel, led by the CEO of Danfoss, presented its report "Denmark as a Digital Frontrunner" to the government in May 2017. The report provides recommendations on all the aspects of societal digitalization, and looks specifically into five value-adding sectors, including manufacturing. Some of the recommendations include appointing a senior minister to lead the digitalization process, introducing new education technology, supporting SME digitalization through both capital and contacts, promoting innovative business models and the growth of new technologies, and engaging in international cooperation on both new technologies and digital economy. When it comes to manufacturing, the report looks specifically at digital R&D, production technology and supply chain management within industrial equipment, life science and consumer goods manufacturing.

Another public-private partnership promoting new technologies within advanced materials, machining and metalworking is the Danish Advanced Manufacturing Research Center (DAMRC). The Center was established in 2009, and it aims to boost the competitiveness of Danish manufacturing companies by providing industry training, testing new technologies and materials, and providing R&D project support.

Opportunities

Potential sub-sectors for cooperation with U.S. companies within the Danish advanced manufacturing sector include IoT solutions, AI and Augmented and Virtual Reality, intelligent robotics, quantum computing, additive manufacturing and big data analytics.

Finland

Capital: Helsinki

Population: 5.5 million

GDP: \$ 237 billion (2016)

GDP per capita: \$ 43,090 (2016)

Currency: Euro

Language: Finnish



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Overview of Finland's Advanced Manufacturing Initiatives

Finland has traditionally been a strong and competitive manufacturing nation, rich in raw materials, resources, innovations and competence. After a slight industrial downturn in the early 21st century, mainly due to world economics, the manufacturing sector has recovered and currently accounts for 16% of the country's GDP and almost 60% of total exports. The most important sub-sectors include forestry, chemicals, metal (including shipbuilding and vehicles), engineering, telecommunication and electronic industries. The R&D investments for manufacturing industries amounted to \$7 billion in 2016 and the sector employs around 600,000 people.

Overview

To further boost the growth and recovery of the industrial manufacturing sector and to keep up with globalization, increasing competition and rapid technological development and disruption, the Government of Finland launched series of industry renewal programs in 2014. The goal was to transform and strengthen traditional manufacturing industries through both investments and political decisions, and to move towards digitalization and reshoring, encouraging the establishment of new and advanced industrial enterprises.

Finland is promoting advanced and smart manufacturing and digital economy through several centrally funded public-private sector programs and initiatives. Some of the most successful ones include the Finnish Innovation Funding Agency's Industrial Internet and 5th Gear next generation wireless programs, Smart Machines & Manufacturing Competence Center SMACC for SMEs run by academia and Finland's Technical Research Center, VTT, and the DIMECC Platform, accelerating the commercialization of new products and materials, including the 'Advanced Manufacturing in USA'-growth/export promotion program. According to a 2016 VTT/Tekes study on Industrial Internet (TINTTI,) many Finnish manufacturers, large and small, have already adapted various aspects of advanced manufacturing and digitalization, and all Finnish companies are eager to learn about the new business models and value chains that digitalization enables. Other studies include a comparative study (including US) on manufacturing renewal and digitalization, conducted by the University of Vaasa (iREN.)

Opportunities

Potential sub-sectors for cooperation with U.S. companies within the Finnish advanced and smart manufacturing sector include IoT solutions for the whole manufacturing value chain: data analytics tools that streamline production, M2M solutions/advanced robotics that enable remote management, lean and flexible manufacturing solutions for resource efficiency, additive manufacturing models and materials, and cross-sector management solutions for digital economy.

France

Capital: Paris

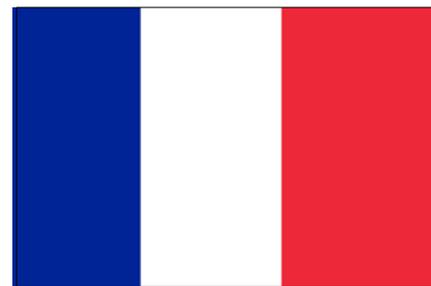
Population: 66.6 million

GDP: \$2.8 trillion

GDP per capita: \$36,248 (2015)

Currency: Euro

Language: French



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Overview of France's Advanced Manufacturing Initiatives

Advanced Manufacturing in France is a growing industry within an already established industrial capital. Notably, Paris has been ranked second in cities developing smart manufacturing. This ranking indicates that Paris is a global city that is embracing the digital transition of its economy through attracting investment, companies and capital and forming formidable centers to accompany the revolution of smart manufacturing. Some 62% of French enterprises have created a CDO (chief digital officer) position.^{xi}

Overview

France officially launched the "Industry of the Future" program in April 2014. The initiatives and plans undertaken by the French government put an emphasis on the reinforcement of European and international cooperation. Although strategic partnerships with European countries, especially Germany, are a priority for France, cooperation with the U.S. at the governmental, institutional and corporate level is welcome and ongoing. The third US-France economic commercial dialogue took place in October 2016. Both countries, as important players in advanced manufacturing, have launched initiatives to build on the convergence between industry and digital technologies to bring together government, academic and private players, including major companies, SMEs and startups.

Sectors of Interest and Targeted Expertise Sectors

As part of the "Industry of the Future" plan, the French Government has identified nine priority areas of interest, where efforts and budgets will be concentrated. These are New Resources, Smart Cities, Eco-Mobility, Tomorrow's Transport, Medicine of the Future, The Data Economy, Smart Devices, Digital Confidence, and Smart Food Choices. France hopes to become a European and/or global leader in the following cutting-edge technologies in next three to five years: Additive Manufacturing, The Virtual Plant and the Internet of Things, and Augmented Reality.

Role of the French Government

France has already set aside 2.5 billion EUR in tax incentives for companies that invest in their own production base for modernization. For additional financial support, the French government, through the BPI France Investment Programs agency, has made available 2.1 billion EUR in loans for SMEs looking to modernize as well. This amount supplements the already existing 1.2 billion EUR the government had made available in loans to companies who are already investing money into Industry 4.0, especially robotics, energy efficiency and digital programs. As of last year, 250 companies representing more than 330 projects have received €1.5bn in funding from the State, for a total investment of €3.7bn.

Greece

Capital: Athens

Population: 11 million (2014)

GDP: €176.9 billion (2016)

GDP per capita: \$26,800 (2016)

Currency: Euro

Language: Greek



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Overview of Greece's Advanced Manufacturing Initiatives

Greece's manufacturing sector has been suffering from a multi-year financial crisis which caused many factories to move to neighboring countries or cease operations. The Greek Manufacturing Purchasing Manager's Index (PMI) – which measures output, employment and expectations in the sector – increased to 50.5 in June 2017, the first reported increase after a 9-month decline and a 37-month high.^{xii} Also positive is the continued decline in unemployment and a reduction in inflation. Despite the market climate, manufacturing production rose by 4.2% in May 2017. On average, Manufacturing Production in Greece for the last 20 years is estimated to be -0.33%, with an all-time high of 18.70% in March 1998 and a record low of -17.50% in January 2009.^{xiii}

Overview

Despite the broad spectrum of its definition, Advanced Manufacturing initiatives in Greece are limited although steadily growing. Promoting R&D in measurement technologies and robotics, raising awareness of the benefits of automation and improving support for start-ups are just some areas of recommendations for developing Advanced Manufacturing. A brief look in high-technology exports as a percentage of manufactured exports shows a positive trend. Latest statistics show that the percentage of manufactured products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery in Greece rose to 11% of exports compared with 16% across the European Union.^{xiv}

Advanced Manufacturing Initiatives

In response to the uncertainty caused by the economic recession, the National Research and Innovation Strategy has undertaken the project of increasing competitiveness and growth by innovation. In its 2014-2020 programming period, the General Secretariat for Research and Technology bases its strategy on Smart Specialization, which possesses a competitive advantage.^{xv} Priority areas of this strategy include agro-food, biosciences and health/pharmaceuticals, information and communications technology (ICT), energy, environment and sustainable development/climate changes, transport and logistics, materials/construction, culture/creative industry and tourism. Emphasis is placed in promoting synergies with the Horizon 2020 Program to cultivate an international innovative culture. Cultivation of these synergies is proven by the successful pursuit of EU funding. Namely, Greece ranks 11th among the 28 member states that received funding for the Horizon 2020 Program.^{xvi} A total of 328.4 million euro was approved for projects in fields such as medicine, information and communications technology, security, environment and energy.

Germany

Capital: Berlin

Population: 82.2 million (2015)

GDP: € 3.03 billion (2015)

GDP per capita: € 37,127 (2015)

Currency: Euro

Language: German



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Overview of Germany's Advanced Manufacturing Initiatives

Germany's manufacturing industry, with more than 200,000 businesses ranging from sole proprietorships to large corporations, has more than 7.2 million employees. When only considering companies with 20 or more employees, Germany counts 44,300 industrial enterprises with a combined workforce of nearly 6.1 million. The manufacturing industry in Germany generates half of its revenues through exports, with an upward trend.

Overview

Industrie 4.0 focuses on automation and process integration, while the U.S. analogue, the Industrial Internet Consortium (IIC), uses pilot-testing environments with newly emerging, often disruptive digital business models that result in new business environments that need new standards and regulations. The industrial segment employing the largest number of people in Germany is mechanical engineering, with over 1 million employed in 5,260 firms.

Government Involvement

The concept of Industry 4.0/Internet of Things (IoT) was originally formulated in policy circles and leading associations. The Federal Ministry for Economic Affairs and Energy (BMWi), the Federal Ministry of Education and Research (BMBF), the VDMA - Mechanical Engineering Industry Association, the ZVEI - German Electrical and Electronic Manufacturers' Association, and the BITKOM - Federal Association for Information Technology, Telecommunication and New Media, pursued the goal of promoting the international competitiveness of the domestic manufacturing industry through the use of modern information and communication technologies and emerged for the first time as a project for the future in 2011.

Industrie 4.0 is a central focus of the Federal Government's Digital Agenda. In the two funding programs "Autonomics for Industrie 4.0" and "Smart Service World", the Economic Affairs Ministry is already providing close to €100m to foster research and innovation in the field of "Industrie 4.0".

Cooperation

Many associations, like the VDMA, work together with and/or are members in U.S. associations and vice versa. About 19% of German manufacturers are implementing the Internet of Things (IoT), but will need at least 5 years to complete the implementation process. Nearly 35% of German manufacturers are considering implementing IoT. There are numerous regional "clusters" in Germany that support regional advanced manufacturing companies. One of these clusters is OWL in North-Rhine Westphalia with 174 companies and a budget of around € 100 million. They work closely together with other international organizations.

Hungary

Capital: Budapest

Population: 9,818,000 (2016)

GDP: \$124.2 billion (2016)

GDP per capita: \$12,733 (2016)

Currency: Forint (HUF)

Language: Hungarian



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Overview of Hungary's Advanced Manufacturing Initiatives

Formerly characterized by large, heavy industrial plants dependent on cheap energy imports and sheltered from competition, Hungarian industry today has been transformed into a largely modern and efficient one, thanks in large part to the early entry of foreign investors. The Hungarian industrial sector, accounting for 24% of the country's GDP, has seen massive output growth in recent years with a growth rate exceeding the EU average.

Currently, the electronics, automotive, and food industries are the main contributors to Hungary's GDP. The electronics industry is one of the largest sectors, accounting for 22% of total Hungarian production. The country is the largest electronics producer in the Central and Eastern Europe region, providing 26% of regional production.

Overview

The importance of Industry 4.0 trends and the necessity of a national-level Industry 4.0 strategy were recognized relatively late in Hungary. In early 2016, the Ministry for National Economy launched a series of preparatory meetings for setting up an Industry 4.0 working group. Prior to this, there were a number of related policy interventions, support instruments, and strategic programs in place, some of which were partly related to Industry 4.0. Examples include the Digital Nation Development Program, the National ICT Strategy 2014–2020, the national R&D and innovation strategy (Investment in the Future 2013–2020), and a number of industry-specific programs.

Key Advanced Manufacturing Measures

Advanced technologies in the vehicle and other machine industries is a priority area that covers several segments of the machine industry. The main objective (but not exclusively) is to expand from the vehicle industry and develop different branches of machine production (including, but not limited to, agricultural, food processing, precision and household machinery). One of the most recent examples of projects is a contract signed between the Ministry for National Economy and Hungarian companies Autóipari Próbapálya Zala Kft and Fomterv Mérnöki Tervező Zrt, and the British-based unit of Japanese company Horiba Mira to establish a track in Zalaegerszeg, in Western Hungary. The facility aims to be world-class and put Hungary at the forefront of the development of self-driving vehicles.

Overall, there is strong potential for cooperation in the sub-area of factory and process automation (e.g., smart machines and equipment, actuators and smart sensors) because of the actual potential and the added value for mechanical and systems engineering, manufacturing industry and process manufacturing, automation technology, the ICT and electronics industry.

The main challenge remains, however, with commercializing innovation and the internationalization of innovative enterprises that develop energy efficiency or advanced manufacturing-related technologies.

Italy

Capital: Rome

Population: 60,802,085

GDP: \$1,814,762 million (2015)

GDP per capita: \$29,847 (2015)

Currency: Euro

Language: Italian



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Overview of Italy's Advanced Manufacturing Initiatives

Manufacturing accounts for 23.6 percent of Italy's GDP. In 2015, during a phase of economic recovery following the 2008 recession, Italy continued to maintain the fifth highest manufacturing trade surplus in the world, amounting to approximately \$63.2 billion. As for 2016, Italian manufacturing experienced an unstable trend; for instance, while in April revenues across all industrial sectors grew by 2.6% overall on a year-to-year basis, the following month they declined by -2.7% on the same basis, due to the international political instability and the unsteadiness of the Italian banking system.

Overview

The English term "Industry 4.0" refers specifically to the digitization of manufacturing process and can be thought of as a synonym of "Industrial Internet of Things", itself a subset of advanced manufacturing. "Industria 4.0" focuses on Internet of Things; additive manufacturing; cloud computing; robots and advanced machine tools; digital industry; 3D printing, cyber security and so on. A recent survey found that over 64% of Italian metalworking and machinery companies are now actively applying at least one of the advanced manufacturing technologies mentioned above.

Key Actors

National Government

The Italian national government (GOI) is currently the most active advanced manufacturing stakeholder in the country. The GOI's "Piano Nazionale Industria 4.0" was presented in September 2016 in Milan by Prime Minister Matteo Renzi and Minister of Economic Development Carlo Calenda, in accordance with the Ministers of Finance Education. The plan consists of €13 billion in tax breaks for investments to be performed during the year 2017, and €10 billion in additional resources that span the 2017–2020 timeframe. It aims at "triggering" private investments worth €23.9 billion in the above-mentioned timeframe.

Among the main features of the plan are tax breaks such as "super-" or "hyper-" amortization for the purchase of capital goods, with higher incentives for the acquisition of machinery containing sensors or data transmission software. The plan also includes subsidized loans for machinery purchases and increases in tax incentives from €5 to €20 million per company for businesses investing in research and development. It also contains resources to enable all companies and startups to have access to Internet and broadband technology (6.7 billion already allocated). The plan is expected to increase investments in machinery and equipment by 3.2% in 2017 and 3.4% in 2018.

Lombardy

The Italian region of Lombardy (where Milan is located) is also actively involved in supporting advanced manufacturing. It is planning initiatives to sustain business and industry that are complementary, and not competitive, to the central GOI's.

The Netherlands

Capital: Amsterdam

Population: 16.94 million

GDP: \$752.5 billion (2015)

GDP per capita: \$44,433.41 (2015)

Currency: Euro

Language: Dutch



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Overview of The Netherlands' Advanced Manufacturing Initiatives

The High-Tech Systems and Materials (HTSM) industry in the Netherlands, better known as Advanced Manufacturing, is a key industry for the Dutch. In 2011, it was identified as one of the most stimulating sectors for the economy and, of the top sectors, it generates the most money. The Semiconductor Equipment division of the HTSM sector is especially significant because of the worldwide influence Dutch companies have on the market.

Overview

In recent years, HTSM has been the largest top sector in the Netherlands and generated more than €46.3 million value added tax (VAT), accounting for 30% of the total VAT generated by the top sectors in 2015. In 2014, the industry was also largest in employment and export goods with 452,000 FTE, 32.7% of all jobs in the top sectors and 28.3% of the total top sector export value. HTSM was slightly smaller in number of companies, with 24.2% of all companies in the top sectors, but is by far the largest spender on Research and Development, with 57.3% of the total spending of the top sectors and 51.9% of all spending of industries in the Netherlands.

Semiconductor Equipment

The Semiconductor Equipment sector is an important market in the Netherlands. According to the Netherlands Enterprise Agency, almost all chips around the world have a Dutch part inside them or are manufactured with Dutch tools. Worldwide, the Netherlands have a market share of 20%. The expectation is that the market will grow by 14% per year, for the coming 10 years. But with the growth, the chips will become more complex as well. This complexity is explained through the market challenges the industry is expected to face: Continuous miniaturization, Higher productivity, Improving accuracy of equipment, Product metrology, and 450 mm production equipment. Besides these challenges, another feature is trending that will complicate the manufacturing of chips, and that is rise in different physical features, such as optical communication.

Role of the Dutch Government

Once HTSM was identified as top sector, the government established Holland High Tech which controls and assists the industry. It operates as an independent company, but is part of the Dutch government. Any company in the HTSM industry can come to Holland High Tech for research and the organization tries to connect and involve companies within the sector and implement more public-private partnerships. The ultimate goal is to strengthen the whole sector in the Netherlands. For each of the subsectors, they made roadmaps about what kind of products are involved, how the industry is developing, where the priorities lie, how funding can be received and what institutions are involved. Holland High Tech has identified key technologies for doing business as microelectronics, embedded systems, smart materials advanced manufacturing, photonics, and nanotechnology.

Poland

Capital: Warsaw

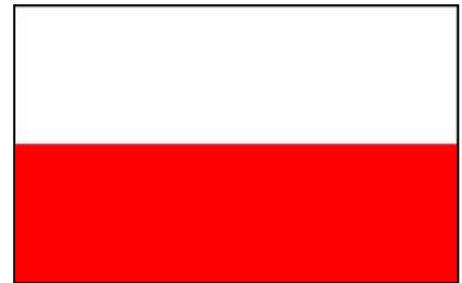
Population: 38 million (2016)

GDP: \$477 billion (2016)

GDP per capita: \$27,810 (2016)

Currency: Polish zloty PLN

Language: Polish



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Overview of Poland's Advanced Manufacturing Initiatives

The manufacturing industry accounts for a major part of the Polish economy, but it is still in the beginning stages of transforming to the industry 4.0 era. The Polish government is in the process of finalizing its industrial development plans, which include regional specializations and the promotion of innovative technologies through robust tax and grant incentives for research and development. A newly created Polish *Industry 4.0 Platform Foundation* will coordinate public and private sector efforts toward the industry transformation through information, competency and technology support, facilitating access to technologies and know-how. The government also plans to establish a National Technology Institute (NIT) to focus on the development in strategic areas such as biotechnologies, modern materials and energy. Both the Platform and NIT will become operational in 2018. The government views digital infrastructure as a pillar of industry 4.0 development, vital to the development of all elements, such as cloud services, big data, and the Internet of Things (IoT).

Overview

In 2015, Polish manufacturing accounted for 23.2% of GDP, compared to the 15.3% EU average. While the Polish GDP grew 2.7% in 2016 and 3.8% in 2015, the gross value added by manufacturing reached 3.5% and 6.5% respectively. Nevertheless, only 6.0% of manufacturers have already begun the transformation process. Some 65% of the industry is still at the 3.0 automation stage, with only 15% being fully automated and 75% in-process. Almost 14% of manufacturing is still done manually and with only 22 robots for 10,000 industry employees, Poland is far below the EU average.

Sectors of interest

Recent analyses of the competitive global industry markets indicate Poland's strong position and good prospects for future investments in industrial automation and manufacturing technology.

The most promising industry sectors are automotive and aviation manufacturing, both dominated by large international manufacturers with a large number of local suppliers, which must meet their technical and technology requirements. Automotive manufacturing alone accounts for 8% of the GDP, generates 13% of Polish exports and employs 10% of the manufacturing industry. Other prospects are in the pharmaceutical, medical, household appliances and defense industries. It is estimated that as many as 66.3% of industrial companies planned technology investments in 2017, compared to 45.6% such expenditures in 2016.

Portugal

Capital: Lisbon

Population: 10.32 million

GDP: \$204.6 billion USD (2016)

GDP per capita: \$19,813.31 (2016)

Currency: Euro

Language: Portuguese



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Overview of Portugal's Advanced Manufacturing Initiatives

Beginning the new century there was an clear increase in the production of electronics and wood materials, which in 2016, together with textiles, shoe production, leather products, and furniture, represent 43 percent of Portuguese exports. The structural reforms implemented since 2011 have created an economic and regulatory climate that is favorable to foreign investment, which remains a priority, focusing on niche sectors of the economy such as tourism, renewable energy, high quality industrial components, technology services, and value-added agricultural products.

Overview

The main objectives of developing Advanced Manufacturing in Portugal involve mobile devices, cloud computing, platforms of IoT, geographic location's technology, advanced interfaces of human interaction, authentication and detection of fraud, 3D printing, intelligent sensors, big data analysis and advanced algorithms, interaction in several platforms and analyze of customers' profiles and augmented reality and wearables. The challenges of implementing the advanced manufacturing measures until i4.0 were mainly related to the lack of digital culture and training, lack of cultural transformations of the companies, few economic benefits in digital investment, protection of data and not enough qualifies employees.

Key Advanced Manufacturing Measures

The i4.0 is a set of 60 measures that will result in 4.5 million euros injected into the Portuguese economy in a period of 4 years. Including all sectors such as agroindustry (production, transformation, transportation and storage), retail (distribution, electronic commerce, textile, shoes, etc.), tourism and automobile (molds, plastics, machinery, robotic, electronic, etc.). The program was organized in six strategic pillars, considering 4 priority industry sectors, more than 120 entities, 80 companies, 400 personnel involved and 200 work sessions.

At the end, the pillars focus on:

- Human capital qualifications - require changes in the skills framework of human resources and adaptation to a new set of education and qualification system.
- Technological cooperation – create strong cooperation between companies, universities, technological centers, business associations, public bodies.
- Startup i4.0 – creation of benefit conditions to promote innovation and new business models.
- Financing and investment incentive - Structural funds (funding i4.0; line of credit; reinforcement of the technological centers role).
- Internationalization – inbound (attract new people, funding and capital) and outbound (promotion and funding).
- Standards and regulation – Develop legal framework through personal data protection, intellectual and industrial property rights, and standards and specifications.

Romania

Capital: Bucharest
Population: 19.6 million
GDP: \$187 billion (2016)
GDP per capita: \$9,528 (2016)
Currency: RON
Language: Romanian



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Overview of Romania's Advanced Manufacturing Initiatives

The industrial manufacturing sector in Romania represents one of the main sectors of opportunity in the region due to the low cost of labor, the availability of resources and facilities, as well as the proximity to end-user or buyer. The Romanian Manufacturing sector has continued to grow in 2015, with main productive industries including metal working, automotive, oil equipment, naval and shipbuilding, agricultural equipment and machinery and others. Companies in the manufacturing sector received 3.5 percent more orders in April of 2017 over the same month in the previous year, according to the National Institute of Statistics. The growth was mainly due to the higher demand recorded by companies in the chemical industry, pharma sector, and metallurgical industry. In 2016, the employment rate in the manufacturing sector stood at 20.4%.

Overview

According to a report by Accenture, industrial companies need to maximize the return on their investment in industrial software and automation because they are heavily investing in those areas to improve the efficiency and flexibility of their processes and solutions. The company developed a software and engineering services to help countries like Romania to embrace the Industry 4.0. In their view, industrial software is embedded in machines, tools and connected devices and can improve process efficiency and flexibility by transforming core processes in areas such as manufacturing to make operations faster, smarter and more adaptable.

Best Prospects

Focus Economics Consensus Forecast panelists expect industrial production to expand by 3.4% in 2017, which is unchanged from last month's estimate. The panel predicts that industrial output will increase 3.8% in 2018. Macroeconomic stability and relatively predictable fiscal (combined with low tax levels^{xvii}) that the country has been experiencing during the last 15 years are among the strengths for the development of the Romanian industry. Primarily, using Information Technology (IT) in agriculture, agro-food sector and manufacture could present great potential in increasing its productivity.

In Magurele, Romania, the ELI Nuclear Physics (ELI-NP) facility will focus on laser-based nuclear physics. It is a laser facility that aims to host some of the most intense lasers worldwide, develop new interdisciplinary research opportunities with light from these lasers and secondary radiation derived from them, and make them available to an international scientific user community. The facility will be based on four sites. Three of them are presently being implemented in the Czech Republic, Hungary and Romania, with an investment volume exceeding €850 million, mostly stemming from the European Regional Development Fund (ERDF).

Serbia

Capital: Belgrade

Population: 7 million (2015)

GDP: \$37.8 billion (2016)

GDP per capita: \$14,200 (2016)

Currency: Dinar

Language: Serbian



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Overview of Serbia's Advanced Manufacturing Initiatives

Industrial production in Serbia grew 4.7% in 2016. Among the top performers within manufacturing in 2016 were tobacco products (over 20% growth), chemicals (15%) and rubber and plastics production (10%). By far the largest single field within manufacturing, the food industry, grew by 6% and accelerated at the end of the year, and entered 2017 with food industry growth rates of over 10%. Industrial production was up 6.2 percent year-on-year in May 2017, following a 2.6 percent fall in April. This is the biggest increase since April 2016, driven by mining and quarrying (10%) and manufacturing (9.2%). Also, electricity, gas, steam and air conditioning supply decreased less than in the previous year (-6.3%, compared to -11.4% a year earlier). On a monthly basis, industrial output jumped 4.1%.

Overview

Developments in advanced manufacturing are burdened with many limitations, such as a small domestic market, low capital accumulation and scarce resources for development, combined with years of devastation of domestic industry and transitional recession in the 1990s and 2000s. Today, industrial production is on the same level as it was in the 1960s, and at 50% of 1989 levels. At the same time, the size of the workforce engaged in industrial production has declined more than 50% compared to the 1980s. Almost 80% of the manufacturing sector consists of production with low or mid-level technology. For all these reasons, it is essential for Serbian industry to pick up the pace and join modern manufacturing trends found in more developed economies. The main promoters of this concept in Serbia are the Faculty of Mechanical Engineering in Belgrade, Academy of Engineering Sciences of Serbia, and the Serbian Chamber of Commerce. These institutions are currently working to establish a National Forum for Industrial Development Policy, which will work closely with the Serbian Government on creating a strategy for future industrial development.

Advanced Manufacturing Initiatives

For Serbia, the advanced manufacturing concept is still in the domain of theory and academic research. As a first step to promote Advanced Manufacturing concepts, the above-mentioned institutions are working to create a network of companies, scientific organizations, and universities engaged in the promotion of EU Manufature programs in Serbia. The next step is to include government institutions and engage them in EU and regional development initiatives. The Manufature Serbia concept is aimed at strengthening production, especially in metallurgy, which should result in an overall strengthening of the economy. This concept will focus on five initiatives:

1. Promotion of Industrial Production
2. Education
3. Research and Development
4. Management and Organization
5. Support and Subsidies for Innovative Production

The program also includes the development of a detailed action plan.

Slovakia

Capital: Bratislava
Population: 4.5 million
GDP: \$89.61 billion
GDP per capita: \$19,200
Currency: Euro
Language: Slovak



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Overview of Slovakia's Advanced Manufacturing Initiatives

Slovakia adopted the euro as its currency in 2009, resulting in the facilitation of trade through lower transaction costs, higher pricing transparency, and greater monetary stability. According to Moody's, S&P, and TE rating agencies, Slovakia has a positive financial outlook. Real GDP growth reached 3.3% in 2016, one of the fastest growth rates among all EU countries.

Overview

Slovakia officially launched and implemented *The Strategy for Research and Innovation for the Intelligent Specialization (RIS3)* and the *Concept of Intelligent Industry* in 2016. In addition, Slovakia developed the *Manufacture SK* strategy as part of the European Factories of the Future Research Association (EFFRA). Advanced Manufacturing in Slovakia is a growing industry, especially in the automotive sector.

Key Sector of Interest

Slovakia is the world leader per capita in automotive production. Three car manufacturers VW, KIA Motors and PSA, directly employ 129,000 people and produce more than 1 million cars yearly. Jaguar Land Rover will begin production in early 2019. Automotive production represents about 44% of Slovakia's industrial production. The Slovak automotive industry produces about 6,000 electric and hybrid cars annually, including the Volkswagen e-up!, Touareg Hybrid, and the Audi Q7 e-tron, the first plug in diesel hybrid in the world. Slovakia recently announced Aeromobil 4.0. – the first commercially sold Slovak flying car. When used as a car, the vehicle has a range of 310 miles and as a plane, has a take-off speed of 90 mph and a range of 430 miles.

Role of the Slovak Government

The government provides tax incentives for companies that invest into Industry 4.0, especially automotive, robotics, energy efficiency and digital programs. It also provides EU funds for applied R&D with a focus on automotive production as it is critical for continued sectorial growth, with target opportunities including smart production (intelligent manufacturing with digitalization, sensors, internet of things and robotization), innovative materials (composite, organic, memory), components, complex solutions, adjacent processing, 3D printed equipment and recycling of waste. Slovakia has incorporated important EU support tools for research and innovation funded by the European Strategic Investment Fund (EFSI) and Horizon 2020. Slovak industry participates in Future Factories initiatives, where priority initiatives focus on high added value processing technologies that create clean, high-performance, ecological and social long-term solutions. Small and medium-sized enterprises have access for financing through the COSME Program.

Spain

Capital: Madrid

Population: 46,528,966 (2017)

GDP: \$1.232 trillion (2016)

GDP per capita: \$26,528.5 (2016)

Currency: Euro

Language: Spanish



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Overview of Spain's Advanced Manufacturing Initiatives

Although Spain did not have very much success with the First Industrial Revolution in the 19th century, during this 15-year period, Spain underwent the greatest cycle of industrialization and prosperity of its time. Now, compared to its global competitors, Spain ranks 15th in manufacturing outputs (2014)^{xxviii} and has the 12th largest economy by nominal GDP in the world, almost ranking in the top 10.^{xxix} The industrial sector is so important to the Spanish economy that its gross value accounts for 15% of the country's GDP. During the 1960s, the steel industry expanded greatly making Spain the fifth largest steel producer in Europe, and 13th in the world, leading the country's industry sector. Although Spain's steel industry has declined, the manufacture of automobiles; mining, energy, water, and waste; food, beverages, and tobacco; as well as metallurgy and the production of metal products dominates the country's manufacturing industry.^{xx} Spanish manufacturing sectors such as textile, food-processing, machinery, and iron and steel are largely concentrated in select regions of the country. Major areas of Spanish industry take place in the autonomous communities of Madrid, the Basque Country, Catalonia, Castile and León, Valencia, and Asturias.^{xxi}

Overview

Recent Data (2007) shows that industry in Spain makes up 72% of Spanish exports, 12.5% of the work force, and 12.1% of GDP (16.1% when including the energy industry).^{xxii} Because industry is so vital to the Spanish economy, the inauguration of Industry 4.0, or "Industria 4.0" in Spanish, attempts to increase the efficiency and direction of the market I+D+I, boost industrialization, and establish the digital strategy of the industry. Shorter time to market, enhanced flexibility, and increased efficiency are the three pillars necessary to increase competitiveness.^{xxiii}

Advanced Manufacturing Initiative

In 2016, Spain's Ministry of Industry, Energy, and Tourism announced that Spain would be launching the initiative: Connected Industry 4.0, a project to boost the digital transformation of the Spanish industry. The performance guidelines for the initiative are as follows:

1. Ensure the knowledge and skills development of Industry 4.0 (I4.0).
 - By building awareness of communication and promoting academic and work training
2. Promote multidisciplinary collaboration.
 - By creating collaborative environments and platforms
3. Boost the development of facilitation among businesses.
 - To encourage the development of digital facilitation and support business technologies
4. Promote the adequate actions for the start-up of Industry 4.0.
 - By supporting the adoption of I4.0 and adopting regulatory framework and standardization for I4.0 projects.^{xxiv}

According to Siemens, Spanish businesses that adopt Industry 4.0 measures will be able to improve productivity by more than 8%, save 12% on energy costs, and reduce more than 5% of the maintenance required from projects.^{xxv}

Sweden

Capital: Stockholm

Population: 9.9 million

GDP: \$495 billion (2016)

GDP per capita: \$ 50,319 (2016)

Currency: SEK Swedish Krona

Language: Swedish



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Overview of Sweden's Advanced Manufacturing Initiatives

Sweden has a strong and successful manufacturing/industrial engineering sector that accounts for 20% of the country's GDP at \$102 billion. It also accounts for 77% of exports and creates over 1 million jobs. Both public and private sectors have always been eager to invest in both R&D and innovation, and this will continue to be one of the key enablers for successful sector transformation. Currently the industries' annual R&D investments amount to \$12 billion. Sweden has a broad industrial manufacturing structure and it plays an important role in the country's economy, accounting for 20% of the GDP. Many of the most important sub-sectors are within the traditional base industries, such as steel, chemical and forestry industries that are all still key export sectors, as well.

Overview

Sweden has more global manufacturing companies per capita than any other country in the world. The largest manufacturing sub-sectors include motor vehicles, metal products, machinery & equipment, automation and food processing equipment. Sweden is currently in the process of reshaping the conditions for industrial production to stay globally competitive. While digitalization is one of the key strategies, as in Germany's Industrie 4.0, Sweden has chosen to take a wider perspective on re-industrialization, sector transformation and technological competitiveness.

Government Involvement

The Swedish government's strategy for new industrialization was launched in 2016. The key focus areas of the strategy are exploiting the potential of digitalization, moving towards sustainable and resource-efficient production, ensuring industrial talent creation and creating an attractive environment for innovation. The implementation of the strategy will be accomplished with new legislation, education and research, investments in businesses and by opening the public sector and procurement for test beds and open data.

Opportunities

Additive Manufacturing: advanced 3D printers and CAD and CAM programs; advanced printing materials, including biomaterials; large scale production capabilities.

Agile Manufacturing: Factory-of-Future models; augmented and virtual reality applications for lean production; CRP solutions for lean manufacturing; Quick Response Manufacturing (QRM) solutions.

Digital Manufacturing: IoT solutions; Big Data analytics models; PLM solutions; AI and advanced robotics; Six Sigma solutions.

United Kingdom

<i>Capital:</i>	London
<i>Population:</i>	64 million
<i>GDP:</i>	\$2.9 trillion
<i>GDP per capita:</i>	\$40,096 (2016)
<i>Currency:</i>	GBP
<i>Language:</i>	English



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Overview of UK's Advanced Manufacturing Initiatives

The UK's manufacturing industry, which contributes \$8.7 trillion to the global economy, makes up 10 percent of the country's economy. The sector is committed to growth as it focuses on shifting from low to higher productivity goods, and improvements in technology and automation. UK manufacturing represents 68 percent of business research and development (R&D) and provides 14 percent of all business investment. The manufacturing workforce employs 2.7 million people in the UK, of which approximately 11 percent are EU migrants. EU workers from outside of the UK statistically have been willing to work longer hours than the workforce average. As manufactured products total 45 percent of exports, large carmakers, as well as aerospace and pharmaceutical companies, have pleaded their case for the UK to remain in the customs union until there is an agreement on a new trade deal with the EU.

Overview

Digital manufacturing is being utilized to maximize efficiency and operational decision-making. This digitalization is leading to increases in productivity, quality, and flexibility, while providing a common digital thread through each phase of product development and decreasing the time to market. Additive manufacturing is having a tremendous impact on the manufacturing industry and looks to continue to be a game changer in the future. An estimated 69 percent of manufacturers in the UK have used elements of additive or 3D printing.

Opportunities

After gaining traction in 2016, servitization is increasingly growing as a popular new method to pleasing and maintaining customers. Businesses now need to have technology and systems in place to guide their transition to delivering the service to the customer. Some 44 percent of manufacturers regard themselves as beginners in their approach to and awareness of servitization, and only 17 percent consider themselves advanced. In addition, 48 percent of companies stated that they were likely to increase their investments in servitization in the next year, which provides an opportunity for those who are more advanced and possess the rare skills necessary to be successful at delivering the service.

Smart manufacturing includes use of machines that are technologically capable of communicating with each other and monitoring physical processes to make decisions. This technology is especially useful in the fintech sector, and financial hubs such as London are putting more resources into developing this skill. One of the UK's greatest challenges in smart manufacturing, which presents a real opportunity for outsiders, is the shortage of skilled workers in the field. An estimated 20 percent of manufacturers using smart technology identify the recruitment and lack of skilled staff as the primary barrier to growth.

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- ⁱ <https://www.flandersinvestmentandtrade.com/invest/en/activities/advanced-manufacturing>
- ⁱⁱ <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/news/changes-science-and-innovation-policy-belgian-region-flanders>
- ⁱⁱⁱ <http://www.madedifferent.be/en>
- ^{iv} <http://data.worldbank.org/indicator/NV.IND.TOTL.ZS?locations=B>
- ^v http://www.investbg.government.bg/files/useruploads/files/statchni_stranici/broshuri_sectors/electronics_eng.pdf
- ^{vi} <https://www.ft.com/content/4da3ca06-9a07-11e6-8f9b-70e3cabccfae>
- ^{vii} Analysis of the current state of Croatian manufacturing industry with regard to industry 4.0. Authors: Ivica Veza, Marko Mladineo, Ivan Peko - University of Split, FESB
- ^{viii} EMS HR (2016), <http://www.efzg.unizg.hr/default.aspx?id=21801>
- ^{ix} Available only in Croatian language at <https://rio.jrc.ec.europa.eu/en/library/smart-specialisation-strategy-republic-croatia-period-2016-2020-and-action-plan>
- ^x www.ciraz.hr/en/
- ^{xi} <http://www.pwc.fr/fr/espace-presse.html>
- ^{xii} <https://tradingeconomics.com/greece/manufacturing-pmi>
- ^{xiii} <https://www.ft.com/content/45e3db2e-c6d6-38a8-838f-c9850f194f5a?mhq5j=e3>
- ^{xiv} http://data.un.org/Data.aspx?q=greece+manufactured+exports&d=WDI&f=Indicator_Code%3aTX.VAL.TECH.MF.ZS%3bCountry_Code%3aGRC
- ^{xv} <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/organisation/general-secretariat-research-and-technology-gsrt>
- ^{xvi} <http://www.ekt.gr/en>
- ^{xvii} While in the 1990s corporate and taxes were relatively high, many countries in the region introduced flat taxation, including Romania with 16% flat tax rate (introduced in 2005).
- ^{xviii} researchbriefings.files.parliament.uk/documents/SN05809/SN05809.pdf
- ^{xix} <http://statisticstimes.com/economy/countries-by-projected-gdp.php>
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- ^{xxii} ABC Intrevisión BC (28 marzo 2007)
- ^{xxiii} http://w5.siemens.com/spain/web/es/el-futuro-de-la-industria/pages/el_futuro_de_la_industria.aspx
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- ^{xxv} <http://www.expansion.com/economia-digital/companias/2016/12/02/583dc18a46163fbc3b8b45c3.html>